370

THE 4TH AFRICAN ORGANIC CONFERENCE SENEGAL

NOVEMBER 5-8, 2018

Ecological and Organic Agriculture Strategies for Viable Continental and National Development in the Context of the African Union's Agenda 2063

Scientific Track Proceedings of the 4th African Organic Conference

November 5-8, 2018 in Saly Portudal, Senegal

EDITORS

GEROLD RAHMANN
VICTOR IDOWU OLOWE
TIMOTHY IPOOLA OLABIYI
KHALID AZIM
OLUGBENGA ADEOLUWA

ISOFAR
International Society of Organic Agriculture Research

AfrONet
African Organic Network

“Ecological and Organic Agriculture Strategies for Viable Continental and national Development in the Context of the African Union's Agenda 2063”

FOREWORD

Organic agriculture is fast emerging as a common household slogan amongst most African families because of rising awareness on the need to consume wholesome food that can nourish the body, improve livelihoods and family incomes through the exploits of the stakeholders of the ongoing continental project on Ecological Organic Agriculture Initiative (EOAI). The 4th edition of the African Organic Conference is holding in Palm Beach hotel, Saly Portudal, Senegal on November 5 – 8, 2018 with the theme '**Ecological and Organic Agriculture Strategies for Viable Continental and national Development in the Context of the African Union's Agenda 2063'.**

Agriculture remains the major job provider (>70% of jobs) and significant contributor to the Gross Domestic Product (30%) in the Continent. The importance of organic agriculture is being underscored in the Continent because the small holder farmers that constitute the major food producers (90% of food in the continent) are keying into the principles and practices of organic agriculture.

Consequently, there has been a sizeable increase (33.5%; 0.4 million hectares) in the total land area under organic agriculture in Africa between 2014 and 2015. Unfortunately, the 1.7 million hectares of land under organic agriculture in Africa still constitutes just 3 percent of the world's organic agricultural land. There is therefore, the need to scale up all the modest achievements hitherto recorded under the EOAI with a view to boosting agriculture output of the continent. This can only be achieved through sharing the potentials of EOAI in transforming the fortunes of the teeming African population, remaining focused on the set goal of mainstreaming EOA into national and continental agricultural production systems in Africa by 2025 and demonstrating the relevance of EOAI in actualizing the objectives of the African union's Agenda 2063.

The role of agricultural research in achieving the above captioned goals is very crucial. As such, efforts should be stepped up to support research projects that address the major challenges African farmers are facing as advocated by United Nations Conference on Trade and Development (UNCTAD) in 2016 through a publication titled “**Financing Organic Agriculture in Africa**”. To this effect, the 4AOC Scientific Track of the 4AOC is being organized as a forum whereby scientists can exchange ideas, share knowledge, experiences, breakthroughs and skills with a view to creating new frontiers of knowledge that will benefit the entire populace of Africa. Consequently, total of fifty three (53) papers were accepted for presentation in the conference. The papers were submitted by scientists from twelve (12) countries namely Cameroun, Benin Republic, Nigeria, Uganda, Kenya, Ghana, Rwanda, Morocco, Zambia, Czech Republic, France and Finland. The papers are from different disciplines such as agronomy, livestock production, aquaculture, socio-economics, rural sociology, plant health, etno-vetmedicine etc.

The 4AOC Scientific track has been put together as Book of Proceedings for Scientists worldwide to make reference to in their future research endeavors. This exercise has been facilitated by International Centre for Research in Organic Food Systems (ICROFS) through the organic e-print platform for the submission of papers, International Society of Organic Agriculture Research (ISOFAR), and African Organic Network (AfrONet) for funding the production of the Proceedings. Hopefully, a download of the Proceedings shall be made available for ISOFAR members under the webpage of ISOFAR (www.isofar.org) after the conference.

The contributions of all the Stakeholders that have assisted in the organization of the 4AOC and Scientists that volunteered to assist in manuscript review are highly appreciated. The authors take full responsibility of the content of their papers as the editors only edited the manuscripts submitted.

GEROLD RAHMANN (Germany)
VICTOR IDOWU OLOWE (Nigeria)
TIMOTHY IPOOLA OLABIYI (Nigeria)
KHALID AZIM (Morocco)
OLUGBENGA ADEOLUWA (Nigeria)

November, 2018

CONTENTS

Blank

Sustainable Agro-forestry Practices for Climate Change Adaptation and Promotion of Organic Agriculture among Farmers in Imo State, Nigeria

[1]Anyoha, N.O., [2]Chikaire, J.U. and [3]Atoma, C. N.

[1&2]Federal University of Technology, Owerri.
[3]Delta State Polytechnic, Ozoro.

Corresponding author:
ndypaschal2004@yahoo.com

Keywords:
Agro-forestry, Climate change, organic agriculture, Adaptation

Abstract

The study ascertained sustainable agro- forestry practices and the benefits as a mitigation strategy for climate change and for promotion of organic agriculture among farmers in Imo State, Nigeria. Data were collected through the use of questionnaire instrument administered to 180 respondents and analyzed using descriptive statistics - percentages, frequency, mean scores. The results revealed that the prevalent agro-forestry practices using multiple responses included rotational farming (86.1%), improved fallow (98.1%), intercropping (98.8%), live fence making (100%) and soil and water conservation (91.6%) among others. The respondents agreed that the benefits of agro-forestry included reduced soil erosion (Mean=3.30), reduced heat stress (Mean=3.01), protection of crops from wind damage (Mean=3.32), improved soil fertility using organic manure (Mean=2.98), reduction of wind speed (Mean=3.10), among others practices. Extension agents should visit farmers for information dissemination and land should be allocated to enterprising agro-foresters. The government should enact laws protecting agro-foresters, forest reserves, encourage and invest in organic and agro-forestry agriculture related researches to determine the best combination of forest and crop production practices best for the environment in order to reduce the effect of climate change.

Introduction

A large percentage of the population in developing countries depends on agriculture for their livelihood. The practice of the agriculture ranges from the primitive subsistence farming to large scale commercial ventures. At either end of the farming practices' spectrum is the continual exposure of the environment to adverse conditions due to degradation of the forest and the exposure of the soil to agents of erosion. Furthermore, the application of farm inputs such as fertilizer creates carbon pollutants in the atmosphere. The trapping of these carbon pollutants such as CO_2 and methane from farming and other human activities causes the atmospheric temperature to rise to an extent of altering the world climate (Intergovernmental Panel on Climate Change - IPCC 2007a). The need for food security, raw materials and to enhance socio-economic development has influenced the activities implicated in climate change (Ogbeide and Ele 2016; Abeygunawardena *et al*. 2003). Therefore, the interacting effects of climate change and agriculture on the farmers and the environment are already being felt in many countries most times negatively.

Subsistence and industrial agriculture have implication for climate change as both involve land clearing and exposure that lead to warmer surface. As it is important that food, shelter and the environment be maintained in a sustainable manner, agriculture must be practiced in a way that delivers maximum benefit to the general society. Different models of farming have been suggested to ensure mutual relationship between plant and other living organisms in different ecosystem including organic (Rodale Institute 2014; FAO, 2016;) and agroforestry (Neufeldt 2013; Mbow *et al,* . 2014).

Agro-forestry is one of the prominent land use systems across many agro-ecological zones in Africa that cater for food production and mitigates the impact of climate change. Sustainable agro-forestry practices are the practices that conserve an ecological balance by avoiding depletion of natural resources The prevalent sustainable agro-forestry practices include rotational farming, improved fallow, intercropping, forest fencing and soil and water conservation among others. It is a practical innovative production approach to improve the economic and ecological sustainability of agricultural systems and at the same time provide a flow of valued ecosystem services (FAO 2011). Agro-forestry provides assets and income from carbon, wood energy, improved soil fertility using organic matters and enhances local climate conditions; it provides ecosystem services and reduces human impacts on natural forests Nguyen *et al*. 2013; Mbow *et al,* 2014).

To alleviate the threats from climate change and overall ecosystem degradation, as reported by FAO (2016) various land use practices have been recommended. FAO (2016) also reported that organic agriculture provides management practices that can help farmers adapt to climate change through strengthening agro-ecosystems, diversifying crop and livestock production, and building farmers' knowledge base to best prevent and confront changes in climate. Similarly Rodale Institute (2014) noted that there should be a shift in the management of the existing cropland to reflect a regenerative model. Regenerative organic agriculture comprises of organic practices including the use of cover crops, residue mulching, composting and crop rotation (Rodale Institute, 2014). Conservation tillage, while not yet widely used in organic systems, is a regenerative organic practice integral to soil-carbon sequestration. Rodale Institute (2014) reported further that with regenerative organic agriculture, more than 40% of annual emissions could potentially be captured and if at the same time, all global pasture was managed to a regenerative model, an additional 71% of greenhouse gases could be sequestered.

Imo state is in South-east Nigeria and lies within latitudes $4^0$45N and $7^0$15N and longitudes $6^0 50^0$N and $7^0 25^0$E with an area of around 5,100sq/km (IMSG,2010). Imo state lies in the rain forest region of Nigeria and is vulnerable to climate change impact. IPCC (2007b) noted that climate change related issues make agricultural activities in Imo state highly susceptible to climate-related extreme events such as floods, severe wind storms, soil erosion, and excessive rise in temperature. These extreme events have effects on agricultural production IPCC, 2007b). According to Lal (2004) and Van Oost, Govers, Quine and Heckrath (2004), continued growth at a declining rate is expected in land productivity due to decreasing returns from increased use of technology and greater use of marginal land with lower productivity. Agro-forestry systems are a key type of agriculture that allow for a high level of progressive adaptation from simply increasing structural and temporal diversity of the production system to selling ecosystem services for increased economic diversification (Lin, 2015). Therefore when well managed, agro-forestry can play a crucial role in improving resilience to the uncertain climate through microclimate buffering and regulation of natural resources like water flow. Management options in agro-forestry such as tree pruning are important measures to reduce below-ground competition, particularly for water such that trees tap into deep groundwater rather than top soil moisture that annual crops rely upon.

It is in line with this that the study was designed to ascertain the benefits of sustainable agro-forestry practices as a mitigation strategy for climate change and for promotion of organic agriculture among farmers in Imo State, Nigeria.

Methodology

The study was conducted in Imo State. Purpose sampling techniques was used for the study to select agro-foresters only. A list of 1800 agro-foresters from the three forest reserve areas in Imo state was compiled from the forest Department of the Ministry of Agriculture and Research headquarters Owerri. From the list, 10% of the foresters was obtained to give a sample size of 180 respondents. Questionnaire was used to gather the data from the respondents. The data were analyzed using percentages, frequency and mean. Mean score (M) of the responses to the variables designed as a 4-point Likert type scale items was used to find out the agreement response of the foresters based on the listed items under the benefits of agro-forestry. The scale ranged from Strongly agree (SA), Agree (A), D (Disagree) to Strongly Disagree (SD) with assigned scores of 4, 3, 2 and 1 respectively, where '4' represented 'strongly agree' and '1' indicated 'strongly disagree'. The mean score of each scale item greater than or equal to 2.50 was used to determine the influence of each variable and any mean response below 2.50 was considered of no effect.

Results

Sustainable Agro-forestry practices

Table 1 shows that farmers adopted sustainable agro-forestry practices in the study area. The more frequently adopted practice using multiple response was making of live fences(100%). This was followed by intercropping trees in farms (98.8%), improved fallow (98.3%), tree planting along boundaries of the farm (96.1%), and home garden establishment (92.7%). Making of live fences being the most frequently adopted agro-forestry practices is an indigenous practice. Oral discussion reveals that in live fences making, there is easy access of the planting materials, less labour requirement and low cost of adoption. Again, practice of tree planting along boundaries of the farm is a common practice for boundary demarcation, claim of ownership, notification of use and for family security, making these practices to be sustainable.

Table 1. **Sustainable Agro-forestry Practices in Study Area. (n =180)**

Adopted Practices	*Frequency	Percentage (%)
Improved fallow	177	98.3
Rotational farming	155	86.1
Alley cropping	133	73.8
Hedgerow making	125	69.4
Direct tree planting	101	56.1
Home garden	167	92.7
Mixed farming/cropping	149	82.7
Forest farming	154	85.5
Maintenance of trees on farm land	128	71.1
Intercropping tree	178	98.8
Soil and water conservation	165	91.6
Wind breakers planting	140	77.7
Tree planting along boundaries of the farm	173	96.1
Taungya	104	57.7
Orchards	109	60.5
Plantain and crop combination	117	65.0
Live fence making	180	100

This study revealed that agro-forestry systems comprised a list of innovative land management practices that allowed for crop diversification, long rotation systems for soil conservation, home-gardens, boundary plantings, perennial crops, hedgerow intercropping, live fences, improved fallows or mixed strata agro-forestry.

Benefits of sustainable agro-forestry

Agro-forestry plays prominent role in climate change adaptation both at the environment and farm/agricultural level. Making the environment suitable for organic farming through the use of organic manure from decomposed leaves and other plant residues.

Table 2. **Benefits of Sustainable Agro-forestry (n= 180)**

Statement	SA (%)	A (%)	D (%)	SD (%)	Mean	S.D
Slows down water runoff	53 (29.4)	19 (10.6)	33 (18.3)	75 (41.7)	2.58	1.28
Reduces soil erosion	90 (50)	72 (42)	0 (0)	18 (10)	3.30	0.90
Reduction of flood menace	54 (30)	54 (30)	36 (20)	36 (20)	2.70	1.10
Reduces water pollution	32 (178)	35 (19.4)	55 (30.6)	58 (32.2)	2.62	1.08
Reduces heat stress on crops/animals	54 (30)	90 (50)	18 (10)	18 (10)	3.01	0.89
Protects crop from wind damage	90 (50)	72 (40)	0 (0)	18 (10)	3.32	0.90
Reduces cold stress by providing shelter	54 (30)	54 (30)	18 (10)	54 (30)	2.65	1.14
Reduces wind speed	90 (50)	36 (20)	36 (20)	18 (10)	3.10	1.05
Reduces total crop failure	4 (2.2)	140 (77.8)	36 (20)	0 (0)	2.82	0.45
Promotes crop diversity on farmland	6 (3.3)	120 (66.7)	18 (10)	36 (20)	2.53	0.84
Provision of natural habitat for beneficial soil fauna	34 (18.9)	108 (60)	20 (11.1)	18 (10)	2.88	0.83
Builds plant resistance/resilience to disease	36 (20)	72 (40)	35 (19.4)	37 (20.6)	2.59	1.02
Improves soil fertility	54 (30)	90 (50)	16 (8.9)	20 (11.1)	2.98	0.91
Provision of energy needs of rural farmers	55 (30.6)	58 (32.2)	32 (17.8)	35 (19.4)	2.73	1.09
Improves the exchange of gases in the forest	36 (20)	90 (50)	24 (13.3)	30 (16.7)	2.73	0.96
Promotes water use efficiency	18 (10)	36 (20)	108 (60)	18 (10)	2.30	0.78
Improves income of farmers	104 ( )	34 (18.9)	29 (16.1)	7 (3.9)	3.30	0.91
Rich sources of food for rural populace	90 (50)	73 (40.6)	17 (9.4)	0 (0)	3.40	0.65
Increase water infiltration	15 (8.3)	46 (25.6)	49 (27.2)	70 (38.9)	2.03	0.99
Promotes soil porosity	39( )	51 (28.3)	43 (23.9)	47 (26.1)	2.65	1.10
Aids soil air aeration/water retention capacity	53( )	19 (10.6)	33 (18.3)	75 (41.7)	2.87	1.27
Improves pollination of wild flora	3 (1.7)	106 (58.9)	40 (22.2)	31 (17.2)	2.55	0.79
Rich source of medicinal plants	86 (478)	9 (5)	77 (42.8)	8 (4.4)	2.96	1.04
Source of forage for animal h/di	115 ( )	27 (15)	30 (16.7)	8 (4.4)	3.38	0.9

Field survey data, 2016

Result in Table 2 shows the numerous roles of agroforestry as perceived from the respondent's mean (M) response to the statements. Agro-forestry reduces soil erosion with a mean response of 3.30, reduces heat stress on crop/animal (M=3.30), improves income of farmers (M=3.30), and a source of food for the rural populace (M=3.4). Other roles included slowing down of water run-off (M=2.58), reduction of flood menace (M=2.70), reduces water pollution (M=2.62), reduces cold stress by providing shelter (M=2.65), reduction of total crop failure (M=2.82), promotes crop diversity on farmland (M=2.53), provision of natural habitat for beneficial soil fauna (M=2.88), building plant resistant/resilience to diseases (M=2.59), and improves soil fertility (M=2.98). The Table revealed also that agro forestry practices provides the energy needs of rural farmers (M=2.73), improves the exchange of gases in the forest (M=2.73), increase water infiltration (M=2.73), promotes soil porosity (M=2.65), improves the pollination of field flora (M=2.55) and aids soil aeration/water retention capacity (M=2.87), rich source of medicinal plants (M=2.96), and source of forage for animal growth/production (M=3.38). From the result, agro-forestry practices are of great importance in the improvement of soil fertility in various ways directly, when leguminous crops that fix nitrogen to the soil are planted with other crops without application of any synthetic substances to the soil and indirectly, as in the provision of natural habitat for soil fauna. The soil fauna aid in the decomposition of plant residues thereby enhancing the production of organic manure. The use of the organic manure to enrich the soil and the use of forage from agro-forest to feed the animals help to improve crop and animal productivity respectively in organic agriculture.

The response from the survey supports Sen (1991); Neupane and Thapa (2001) and FAO (2011) that agro-forestry systems are not only a source of timber and fuelwood but also support crop production throughout the world. Furthermore, the result indicated that the use of trees and shrubs in agricultural systems helps to tackle the triple challenge of improving food security, increasing the adaptability of agricultural systems and mitigating climate change. While trees in the farming system can help increase farm income, they enable diversification of production and spread the risk of crop or market failure.

Conclusion

Based on the findings of the study, the agro-forestry practices in the study area were fully adopted by the farmers. Live fences making was the mostly adopted practice by the farmers as a result of its sustainability in terms of easy access to planting materials, less labour requirement and security reasons. The study also reveals the benefits of agro-forestry as it serves as rich sources of food, improves farm income, improve soil health through which suitable environment is provided for organic plant growth among others. It is recommended that agro-forestry based on its economic and ecological advantages be given more attention in terms of regular practice and policy making for its establishment in every agricultural unit, schools and institutes. More researches should be done to determine the best combination of forest and food crops to yield maximum benefits for organic agriculture, the environment and agriculture in general.

References

Abeygunawardena, P., Vyas, Y., Knill, P., Foy, T., Harrold, M., Steele, P., Tanner, T., Hirsch, D., Oosterman, M., Rooimans, J., Debois, M., Lamin, M., Liptow, H., Mausolf, E., Verheyen, R., Agrawala, S., Caspary, G., Paris, R., Kashyap, A., Sharma, R., Mathur, A., Sharma, M. & Sperling, F. (2003). Poverty and climate change—reducing the vulnerability of the poor through adaptation. World Bank Press.

FAO, (2016). Organic Agriculture and Climate Change. Retrieved from http://www.fao.org/organicag/oa-specialfeatures/oa-climatechange/en/

IMSG, (2010). Education in Imo State. Imo State, Nigeria: Ministry of information, Owerri, Imo State Government.

IPCC (2007a). Climate Change 2007: Impacts, Adaptation and Vulnerability. Summary for Policymakers, IPCC AR4 WGII, Cambridge University Press, Cambridge, UK.

IPCC (2007b). Climate Change: Fourth Assessment Report. Retrieved from IPCC, www.ipcc.ch/

Lal, R., (2004). Soil carbon sequestration impacts on global climate change and food security. *Science*, *304*, 1623-1627.

Lin, B.B. (2015). Agroforestry adaptation and mitigation options for smallholder farmers vulnerable to climate change. Retrieved from http://aciar.gov.au/files/node/13992/agroforestry_ adaptation_and_mitigation_options_for_10868.pdf , 2015.

Mbow, C., Smith, P., Skole, S., Duguma, L. & Bustamante, M. (2014). Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. *Current Opinion in Environmental Sustainability, 6*, 8-14.

Neufeldt, H. (2013). Agroforestry and Climate Change Adaptation and Mitigation. Retrieved from http://www.fao.org/climatechange/36174-0552b1d21a0dd865ae3a3eda6acc8a3a0.pdf

Nguyen, Q., Hoang, M.H., O¨born I. & Noordwijk, M. V. (2013). Multipurpose agroforestry as a climate change resiliency option for farmers: an example of local adaptation in Vietnam. Climatic Change 2013, 117:241-257. Ogbeide, O.A. & Ele, I. (2016). Consumer Attitude, Socio-demographics and Adoption of Climate Change Measures. *Mayfair Journal of Agriculture Development in Emerging Economies 1*(2), 12-31.

Rodale Institute (2014). Reversing Climate Change Achievable by Farming Organically. Retrieved from http://rodaleinstitute.org/reversing-climate-change-achievable-by-farming-organically/

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes, B. & Sirotenko, O. (2007). Agriculture. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Evaluation of Aqueous Extract of *Vernonia amygdalina* Leaves as Organic Fertilizer to Leafy Vegetables

Fabunmi, Thomas Oladeji

Department of Plant Physiology and Crop Production, Federal University of Agriculture, Abeokuta

Corresponding Author:
tomdeji@yahoo.com

Keywords:
Corchorus olitorious, Amaranthus hybridus, Celosia argentea, leaf extract, *Vernonia amygdalina*

Abstract

Efficient means of replenishing soil nutrients without using chemical fertilizers must be continually proffered in organic crop production systems. The potential of aqueous leaf extract of Vernonia amygdalina (VA) as organic fertilizer was evaluated using three leafy vegetables: Corchorus olitorious, Amaranthus hybridus and Celosia argentea. Three trials were carried out simultaneously, each consisted of six treatments arranged in completely randomized design and replicated three times. The treatments in each trial were three rates of VA: 150 ml, 250 ml and 500 ml per pot; 1.55 g and 0.78 g NPK 15:15 :15 per pot (75 kg/ha or 37.8 kg/ha of N, P and K) and no fertilizer. Plant height, dry weight and fresh weight (economic yield) across the vegetables were significantly affected by the treatments. The general response was 500ml VA produced plants that were at par with those that received 37.8 Kg/ha of N, P and K, but significantly taller, with higher dry and fresh weight relative to other VA treatments. The laboratory analysis of the VA leaf extract used for the trial showed that the concentration of K was 877.21 mg/l; while N and P, Ca and Mg were 122.42, 70.09, 24.22 and 11.89 mg/l respectively. The VA contained the fertilizer nutrient in the ratio approximately 2:1:7. It was concluded that aqueous extract of V. amygdalina can be used as a nutrient source in organic production system.

Introduction

Land degradation and reduction in soil fertility have been identified as the greatest challenge for sustainable crop production in the tropics and nutrients are lost through crop removal (Agegnehu and Amede, 2017). Use of chemical fertilizers is associated with the challenges of scarcity, high prices and pollution of ground water (Savci, 2012).The use of more eco-friendly practices like crop rotation, animal manure, green manure, alley cropping have re-emerged in recent years (Kumari,*et al*., 2014).

Vernonia amygdalina popularly referred to as bitter leaf is a shrub that is popular in Nigeria. This plant is underutilized but has several nutritional, medicinal and antioxidant values (Kadiri and Olawoye, 2016, Hamman *et al;* 2016, Offor, 2014). The leaves are macerated and washed repeatedly with water to extract, remove or reduce the bitter taste to the acceptable minimum before using the leaves as vegetable in making of soup. Both the leaves and the extract remain green after series of washing. Greenness in plant is associated with the pigment chlorophyll. Chlorophyll is rich in nitrogen and magnesium which are both essential mineral nutrients required for plant growth, development and yield.

Celosia argentea, Amaranthushybridus and *Cochorusolitorious* are common leafy vegetables consumed in Nigeria. They are rich in proteins, vitamins and minerals essential for human healthy living (Alegbejo,2013; Ebert *et al.,* 2011, Choudhary *et al.,* 2014, Adeyeye *et al.,* 2013, Olawuyi *et al.,* 2014) .

Sustainable production of these vegetables is hinged on, among other factors, adequate nutrient supply. This study was therefore conceptualized to evaluate the fertilizer potential of aqueous extract of

Vernonia amygdalina (VA) using *Celosia argentea, Amaranthushybridus* and *Cochorusolitorious*.

The objectives are to ascertain the nutrient content of the aqueous extract of Vernonia amygdalina and to evaluate the growth performance of the leafy vegetables using three rates of the extract compare with two rates of chemical fertilizer and no fertilizer.

Materials and Methods

Experimental site treatments and design

The trial was a pot experiment carried out at College of Plant Science and Crop Production of the Federal University of Agriculture Abeokuta, Ogun State Nigeria between the month of October and November, 2017.Three leafy vegetables: *Amaranthushybridus, Cochorusolitorius* and *Celosia argentea* were evaluated simultaneously for their growth response to three rates of VAaqueous extract (500, 250 and 150 ml per pot) and three controls: two rates of NPK 15:15:15(0.78g and 1.55g per pot) and no fertilizer application. Thus given a total of six treatments arranged in completely randomized design and replicated three times per vegetable.

Preparation of aqueous extract of *Vernonia amygdalina*

2.225 Kg of fresh leaves of *Vernonia amygdalina* harvested from a farm was pounded in a mortar manually, the macerated leaves was rinsed repeatedly with a total of 9000 ml of tap water and sieved to obtain the extract (1 g of leaves to 4 ml of water). The extract was stored in plastic bottles for 7 days under room temperature before application. The moisture content of the leaves was 14.7%. Sample of the aqueous extract was then taken to the laboratory for chemical analysis.

Planting of vegetables and application of treatments

Seven (7) kg of homogenized sandy loam soil each was put in 54 plastic pots and watered to field capacity. The three leafy vegetables were planted in18 pots each. The seed rate for each was 0.5g/pot, 0.3g/pot and 0.2 g/pot for cochorus, celosia and amaranthus respectively. The seeds of the vegetables were sown on the 13th of October, 2017. The liquid extract was applied at the rate of 50, 150 or 250 ml per pot one week after planting of seeds, that was on the 20th of October, 2017; while chemical fertilizer was applied 2 weeks after planting at the rate of 0.78g and 1.55g per pot representing 37.8 Kg/ha and 75 Kg/ha respectively of N, P_2O_5 and K_2O/ha using NPK 15:15:15, the quantity applied per pot was arrived at by using the weight of soil per hectare furrow slice ($2.26 X10^6$).

Data collection and statistical analysis

Data were collected on the plant height, fresh and dry weight of the vegetables. Plant height was taken using a meter rule, while fresh and dry weight per plant were measured by weighing using a sensitive scale before and after oven drying to stable weight, the value for each parameter was average measured from two plants per pot. The data collected were analyzed using analysis of variance; significant means were separated using least significant difference (LSD). Genstat statistical package was used for the analysis.

Results

Chemical analysis of the soil and Vernonia amygdalina extract used for the trial

The results of the pre planting physico-chemical analysis of the soil used for the study showed that the soil is sandy (91.4%, 3.8% and 4.8% for sand silt and clay respectively). Percentage nitrogen was 0.07, available P was 6.78 mg/g, pH 6.7, Na,K,Ca,Mg were 0.26, 0.43, 2.04 and 0.54 (all in cmolkg^{-1}) respectively.

The results of the laboratory analysis of the VA leaf extract use for the trial on the other hand showed that the concentration of potassium was the highest in the extract: 877.21 mg/l; while nitrogen and phosphorus, calcium and magnesium were 122.42, 70.09, 24.22 and 11.89 mg/l respectively.

Growth of vegetable amaranth, *Celosia argentea*and *Cochorusolitorius*as influenced by rates of aqueous extract of leaves of *Vernonia amygdalina* and NPK fertilizer at 3,4, 5 and 6 weeks after planting (WAP) are presented in Tables 1,2 and 3 respectively.

Table 1. **Growth of vegetable amaranth as influenced by rates of aqueous extract of leaves of *Vernonia amygdalina* and NPK fertilizer at 3,4, 5 and 6 weeks after planting (WAP)**

	Plant height (cm)			Fresh weight (g/plant)				Dry weight (g/plant)			
Treatment	4	5	6	3	4	5	6	3	4	5	6
500ml VA	9.0	14.6	21.7	0.34	1.00	1.44	2.62	0.05	0.13	0.18	0.52
250ml VA	10.0	9.3	12.0	0.27	0.79	1.01	1.46	0.06	0.08	0.27	0.40
150ml VA	5.7	9.3	10.3	0.27	0.66	0.77	0.79	0.06	0.09	0.16	0.43
No Fert.	5.7	6.7	7.67	0.26	0.41	0.62	0.48	0.07	0.06	0.15	0.25
0.78g NPK15:15:15	14.7	18.7	20.0	0.51	1.35	2.32	2.62	0.07	0.23	0.52	0.58
1.55g NPK15:15:15	11.0	24.3	27.7	0.57	2.16	3.34	4.11	0.10	0.27	1.35	1.16
LSD (p=0.05)	4.36	4.42	2.22	0.18	0.28	0.48	0.86	0.03	0.05	0.24	0.19

500ml VA= 500ml of Vernonia amygdalina leaf extract per pot, No fert.= No fertilizer

Table 2. **Growth of *Celosia argentea* as influenced by rates of aqueous extract of leaves of *Vernonia amygdalina* and NPK fertilizer at 3,4, 5 and 6 weeks after planting (WAP)**

	Plant height (cm)			Fresh weight (g/plant)				Dry weight (g/plant)			
Treatment	4	5	6	3	4	5	6	3	4	5	6
500ml VA	12.3	20.0	22.0	0.42	0.67	3.91	4.22	0.06	0.16	0.26	0.69
250ml VA	13.0	13.7	20.3	0.38	0.63	1.47	1.71	0.07	0.10	0.22	0.36
150ml VA	10.3	12.3	16.7	0.37	0.59	1.45	1.92	0.07	0.14	0.23	0.33
No Fert.	9.0	11.3	14.0	0.33	0.44	0.80	1.49	0.06	0.11	0.15	0.23
0.78g NPK15:15:15	15.0	19.3	26.7	0.72	1.77	3.21	3.09	0.09	0.29	0.46	0.36
1.55g NPK15:15:15	16.0	24.7	37.3	0.78	1.91	5.67	5.52	0.43	0.28	0.71	0.54
LSD (p=0.05)	3.82	4.46	2.65	0.13	0.80	1.18	0.98	Ns	0.08	0.09	0.17

500ml VA = 500ml of Vernonia amygdalina leaf extract per pot, No fert.= No fertilizer

Table 3. **Growth of *Cochorusolitorius* as influenced by rates of aqueous extract of leaves of *Vernonia amygdalina* and NPK fertilizer at 3,4, 5 and 6 weeks after planting (WAP)**

	Plant height (cm)			Fresh weight (g/plant)				Dry weight (g/plant)			
Treatment	4	5	6	3	4	5	6	3	4	5	6
500ml VA	19.7	26.3	31.67	0.67	1.05	2.05	2.20	0.09	0.08	0.33	0.41
250ml VA	19.0	23.7	28.3	0.49	0.67	0.99	2.02	0.08	0.05*	0.30	0.33
150ml VA	16.0	22.3	27.7	0.41	0.41	0.90	1.19	0.04	0.05	0.27	0.25
No Fert.	15.7	20.3	26.0	0.34	0.34	0.87	0.74	0.01	0.01	0.20	0.21
0.78g NPK15:15:15	28.3	36.7	41.3	0.76	0.76	2.27	2.42	0.09	0.12	0.54	0.48
1.55g NPK15:15:15	32.0	43.0	48.7	0.93	0.93	3.32	4.11	0.10	0.19	0.66	0.81
LSD (p=0.05)	8.31	4.51	2.97	0.12	0.12	0.42	0.78	0.02	0.05	0.11	0.12

500ml VA = 500ml of Vernonia amygdalina leaf extract per pot, No fert.= No fertilizer

Across the three types of vegetables, application of 500ml/pot of VA extract produced plants that were as tall as those that received 0.78g/pot (37.8 Kg N,P and K /ha) ()$p>0.05$), while the least plant height was recorded from the plants without fertilizer application ($p<0.05$). The observation made on plant height was similar for both fresh and dry weight across the three vegetables. The exceptions however were that at 6 WAP celosia plant that received 500ml of VA had dry weight that was at par ($p>0.05$) with that which received 1.55g/pot of NPK 15:15:15. While for cohorus and amaranthus dry weight of plants that received 500ml of VA were at par ($p>0.05$) with those that received 0.78g/pot of NPK 15:15:15. However, the third control (check) that received 1.55g of N: P:K per pot (equivalent to75 kg/ha of each nutrient element) produced plants that were superior ($p<0.05$) in the growth parameters.

Discussion

Chemical analysis of the VA extract shows that the extract contains the fertilizer nutrients N, P, K in the approximate ratio of 2:1:7 apart from other nutrients, this is very important since the efficacy of any material that will be used as fertilizer is its ability to contain and supply the required nutrients for plant growth. The moisture content of the Vernonia amygdalina leaves used for this study is slightly higher than the 10.02 and 10.55% reported from earlier studies as reported by Kadiri and Olawoye (2016); this difference can be as a result of stage of plant at harvesting; and environmental factors (Kadiri and Olawoye, 2016).

Similar response of the plant height, fresh and dry weight of these leafy vegetables to application of VA extract suggests that application of 500 ml of the extract will supply nutrients to the vegetables that will produce plant performance equivalent to that which can be obtained by applying 37.5 kg/ha each of N, P_2O_5 and K_2O. The analysis of the VA extract had shown that it contained the fertilizer nutrient in the ratio of 2:1:7; this response implies that the nutrients were not only present in the extract, they were as well available and not injurious to the vegetables. The positive response of the vegetables to the applied extract could be due to additional nutrient elements present in the extract apart from N,P and K. The substantial presence of calcium and magnesium in the extract is also very important as it has been reported that yields of 25 t/ha of vegetable amaranth will extract 125 Kg N, 25 Kg P, 250 Kg K, 75 Kg Ca and 40 Kg Mg from the soil (Ebert et al. 2011). Offor (2014) had reported that that the leaves of *Vernonia amygdalina* contains varying concentrations of chemical, elemental and macronutrient components that can serve as a good source of useful elements. Kadiri and Olawoye (2016) also reported that the nutritional analysis of Vernonia amygdalina revealed that it is rich in the nutrient P, Fe, Zn, Mn, and calcium. This result is however at variance with the findings of Chukwuka et al. (2014) who reported that the extract of VA inhibited the plumule development of maize compared to the control and that the growth, development and yield of maize were not significantly affected by the plant extracts. The result of this study could be due to the fact that the extract was applied to growing seedlings and not to sown or germinating seeds.

Conclusion

The response of the growth parameters of the three leafy vegetables in this study revealed that aqueous extract of *V. amygdalina* can be used intentionally as a nutrient source in organic cropping systems. This was proven by similar response of growth parameters of the three vegetables.

Further studies will however be needed to ascertain the economic feasibility of the usage in large scale in terms of the number of the plants that will supply certain quantity of nutrients per a given area and better processing methods of the leaves to get the extract.

References

Adeyeye, A.S., Ogunwale, O.A. and Mofikoya, F.A. 2013. Growth, dry matter accumulation and shoot yield of Celosia argentea as affected by poultry manure and urea. International Journal of Agricultural policy and research 1(8): 210-215.

Agegnehu, G. and Amede, T. 2017. Integrated soil fertility and plant nutrient management in tropical agro-ecosystems: A review. Pedosphere Elsevier 27(4): 662-680.

Alegbejo, J.O. 2013. Nutritional value and utilization of Amaranthus (*Amaranthus* species): A review. Bayero Journal of pure and applied science 6(1);136-143.

Choudhary, S., Sharma, H.K., Karmakar, P.G., Kumar, A.A., Saha, A.R., Hazra, P. and Mahapatra, B.S. 2013.Nutritional profile of cultivated wild jute (*Corchorus* species). Australian Journal of crop science 7(13): 1973-1982.

Chukwuka, K.S., Obiakara, M.C. and Ogunsumi, I.A. 2014. Effects of plant extracts and inorganic fertilizer on the germination, growth and development of maize (Zea mays L.). Journal of agricultural sciences 59(3): 243-254.

Ebert, A.W., Wu,T. and Wang, S. 2011. Vegetable amaranth (*Amaranthus* L.). AVRDC Publications Number 11-754. 9 pages. Cooperators guide_amaranth-s-web.pdf. Accessed 17th April, 2018.

Kadiri, O andOlawoye, B. 2016. Vernonia amygdalina: An underutilized vegetable with nutraceutical potentials. A review. Turkish Journal of Agriculture Food Science and Technology. 4(9): 763-768.

Kumari, K.A., Kumar, K.N.J. and Rao, N.C. 2014. Adverse effects of chemical fertilizers and pesticides on human health and benvironment. Journal of chemical and pharmaceutical sciences, special issue 3:150-151.

Offor, C.E. 2014. Comparative chemical analyses of Vernoniaamygdalina and Azadirachtaindica leaves. Journal of Pharmacy and Biological Sciences 9(5): 73-77.

Olawuyi, P.O., Falusi, A.O., Oluwajobi, A.O., Azeez, R.A., Titus, S.D., Akomolafe., J.F and Mayaki, H. 2014. Chromosomes study in jute plant (Corchorusolitorius). European Journal of Biotechnology and Bioscience 2(1):01-03.

Savci, S. 2017. An agricultural pollutant: chemical fertilizer. International journal of environmental science and development 3(1): 77-80.

Improving Food Sovereignty in Africa – An Activity Theory Approach

Jaakko Nuutila[1], Victor Olowe[2] and Ewa Rembialkowska[3]

[1]Natural Resources Institute, Finland
[2]Federal University of Agriculture, Abeokuta, Nigeria,
[3]Warsaw University of Life Sciences, Poland

Corresponding author:
jaakko.nuutila@luke.fi

Keywords:
Food sovereignty, organic food, food system, rural area, urbanization, Activity Theory

Abstract

This article presents a new approach to the problem of food sovereignty in Africa using an Activity Theory approach. Undernourishment in Africa is big reaching 232.5 million citizens in 2015. Sufficient food sovereignty can't be reached because of the weak food-producing abilities in Africa. Smallholder sector can't compete with highly subsidized Northern African farmers. Present intensive agriculture is causing environmental pollution and occupational hazards for the workers. Small holder family farmers could double their harvest in a decade if converting to more agro-ecological production like in organic agriculture. The change of legislation is necessary to increase the private land owning of smallholders that would enhance also the livelihood of organic production, because organic produts are mainly from the small farms. More sustainable trade policy should be introduced to diminish the excessive export of food. Education of the African citizens is necessary to increase the understanding of more sustainable choises in production methods and consumption habits by choosing organic that has proven less negative externalities that conventional food and its production. Reducing food waste links to availability of food and food sovereignty. Boosting the fairness and sustainability in the food chains including holistic organic system which is actively contributing to all the 17 the UN sustainable development goals (SDGs).

Introduction

Globally about 795 million people were undernourished in 2015 and 232.5 million (20%) live in Africa, where food is insufficient and the soils are generally poor. Sub-Saharan Africa (SSA) remains the most food insecure region of the continent with about 75 percent of the land degraded . This study presents a new approach, with Activity theoretical model, for understanding some of the major phenomena that decrease the food sovereignty in Africa. African continent has 1.7 million hectares of organic agricultural land and 30 percent of the world's organic producers (Willer and Lernoud 2017) providing a huge potential to provide organic food with its positive impact to the nature (Reganold & Wachter 2016). Consequently, the Addis Ababa Conference on "Changing Food Systems in Africa: Agroecology and Food Sovereignty and their role in Nutrition and Health" in 2016, called for a complete transformation of food systems across the continent of Africa. Transforming to organic food system is supported by FAO, UN and European Community. Organic Food System Programme (OFSP) is poised to combine sustainable food production (organic agriculture) and sustainable food consumption (sustainable and healthy consumption pattern). The research question now is: How can the level of livelihood in rural areas of Africa be improved to achieve food sovereignty?

Food sovereignty can be described as the right of peoples and sovereign states to democratically determine their own agricultural and food policies , and it comprises of 1) priority to local food production by local people, 2) access of smallholders and landless people to land, water, seeds and livestock, 3) right of consumers to decide what to consume, 4) fair price for the whole value chain, and 5) populations' participation in agricultural decision-making. Current food production and distribution systems fail to feed the world . Rural–urban migration is basically based on inequality in wealth . In sub-Saharan Africa, about 32.8 and 65 percent of the population dwell in the urban and slums, respectively . On average, about 60 percent of Africans live in places where water supply and sanitation are inadequate. Smallholder farm families in the rural areas continue to play a very pivotal role in African food system despite the difficult conditions under which they operate. Important is therefore to increase the livelihood in rural areas to reduce the rate of urbanization.

The United Nations has set several goals and actions to correct the situation . The organic food system is actively contributing to all the 17 UN sustainable development goals (SDGs) with special emphasis on: Number 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture, and number 12: Ensure sustainable consumption and production pattern. (UN 2015b) The food system can be defined as conceptualized relationships between the different forces operating on the commodity flows from primary production to consumers . It can be described as local and global food systems and the local one as an alternative system for industrialized and globalized one . The local food system has a strong connection with the vitality of the rural development .

Activity theory for analysing the current activity of the African food system

Activity theory (AT) was used as a model where to place the current activity of the generalized African food system and to present actions leading to an outcome of increased food sovereignty. Activity theory provides a framework model for where to place the elements of the food system activities: *subject, tools, object, rules, community* and *division of labour,* and where the object leads to an *outcome* .

Discussing the current activity of African food system

The current activity is presented using the Activity theory framework (Figure 1.)

Outcome "sufficient food sovereignty" cannot be reached, partly because of the weakened food-producing capabilities in Africa. Smallholder sector cannot compete with highly subsidized Northern farmers and African cities have become dependent on imported food . Food aid is to help in catastrophes, but it can have long run disincentive effects on domestic food production. Removing it, has caused modest increase in prices, but also stimulated own food production in ten years period.

Subjects are the actors of the food chain: agriculture, industry, retail, catering and consumers . Aproximately 33 million small farms with an average size below 2 hectares, produce about 90 percent of all agricultural production in Africa . FAO supports the increase of the share of smallholders and family farmers in rural food systems.

Object of the current food chain activity is financial profit and private good . The present African Food System is not well structured and it is rather difficult to trace origins of food products in case of any eventualities .

Tools used in intensified farming and use of pesticides are causing land degradation, desertification, pollution and decreased water resources . Organic agriculture brings benefits, like more nutritious diet and health, job creation and reduced occupational hazards caused by pesticides . The special reporter Olivier se Schutter claimed that small holder family farmers could double their harvest in a decade if converting to more agro-ecological production like in organic agriculture .

Community's worsened living conditions in rural areas lead to migration to cities causing urban growth,, food insecurity, crime and preponderance of slums. The livelihood of villages lies on smallfarmers that produce food also for other communities. It could be enhanced by promoting traditional and easily adaptable methods and crops, also typical to organic farming. Good example is Fair Trade that with the end-users support can affect positively to African communities.

Rules regulate the food system. Legislative processes are lobbied by large scale actors in the food chain for their own private good . On the contrary to the people in the rural areas, who have no access to influence to the legislation, such as the land reform that could enable the living conditions for food-producing peasants and family farms .

Division of power in the food chain is often benefiting the retail and large scale food industry and that increases the price margins in the food chain . Many countries such as China have started to obtain land in Africa for agricultural purposes to secure their own food supplies .

Suggestion of changes to improve the food sovereignty in Africa

To enable the development in the African food chain towards "sufficient food sovereignty", the change begins on securing the livelihood in rural areas to decrease the immigration to urban areas: 1) government banns selling or renting of land and natural resources to foreign countries and companies, 2) better access is created for rural people to influence legislation to enable the traditional nomad culture and private land owning of smallholders, 3) alternative marketing channels are supported to increase the fairness in the food chain, 4) pre-retail food waste is cut down with better methods, transportation and storage, 5) knowledge transfer and collaboration within the food chain and with researchers and

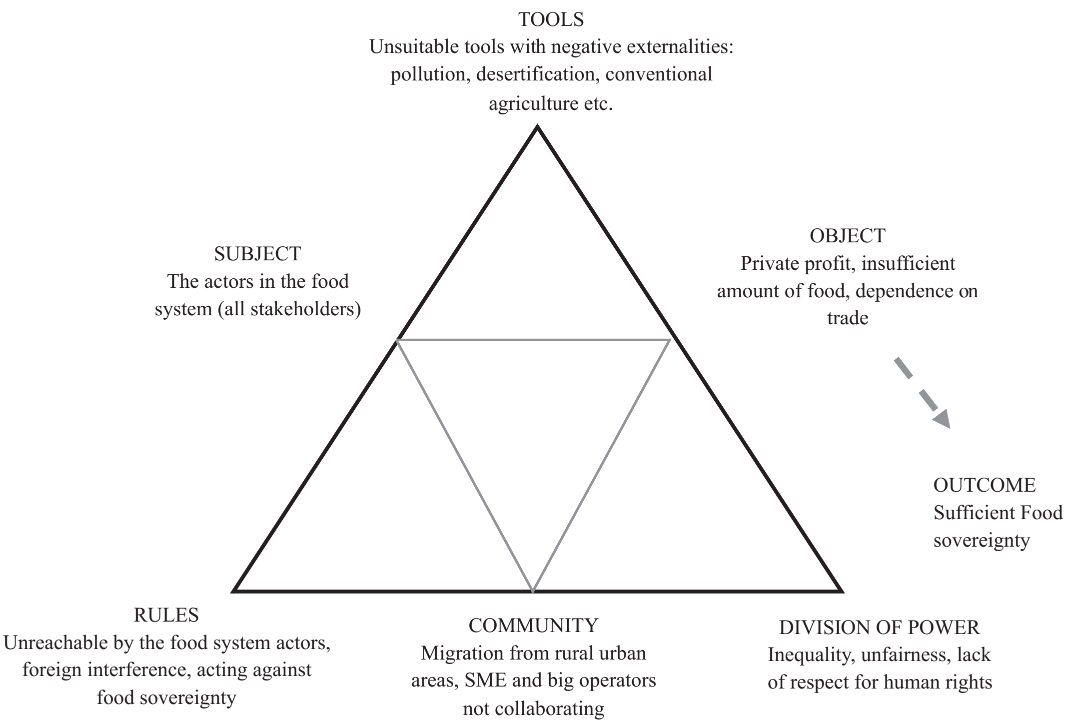


Figure 1. **The current activity of African food system in Activity theory framework**

authorities is improved, 6) organic principles and sustainable practices for crop production and animal husbandry are introduced, 7) overscale export of food and agriculture input related unrenewable natural resources is restricted and a more sustainable trade policy is introduced.

Conclusions

A diagnosis of the existing food system in Africa reveals serious irregularities causing financial finally inequality, malnutrition, hunger and lack of food sovereignty. There is a major need for the governmental interventions hampering selling or renting of land and natural resources to foreign countries and companies; the change of legislation should enable to increase the private land owning of smallholders. The trade could be considered as a major driver to incite farmers to take up innovations for sustainable agriculture development. Education of the African citizens is necessary to decrease the food wastes and to increase the fairness and sustainability in the food chains including holistic organic system which is actively contributing to all the 17 SDGs. This study shows several interactions between Western world and Africa. They have a significant affect on African food sovereignty and therefore it is most important to analyse the activity and interactions of these two connected food systems.

Acknowledgments: We thank our employers for financing this research.

References

AfDB. (2012). *Urbanization of Africa.* African Development Bank

AFSA. (2016). Moving forward strategically towards sustainable, just and nutritious food systems in africa. http://afsafrica.org/wp-content/uploads/2017/03/Moving-forward-strategically-from-Addis-Ababa-Nov-2016-conference-1.pdf

Anon. (2014). The importance and relevance of small-scale farms in the world. *The state of food insecurity in the world.* (http://www.agriculturesnetwork.org/rsources/learning/mod1-online/learning-block-1/1.5/1.5.4), Rome: FAO

Atkins, P., & Bowler, I. (2001). *Food in society*. New York: Oxford University Press Inc. Bakhurst, D. (2009) Reflections on activity theory. *Educational Review, 61*(2), 197.

Bryceson, D. F. (2009). Sub-saharan africa's vanishing peasantries and a specter of a global food crisis. *Monthly Review, 61*(3), 69-84.

Domina, D. A., & Taylor, C. R. (2010). The debilitating effects of concentration markets affecting agriculture. *Drake Journal of Agricultural Law, 15*(1), 61-108.

Engeström, Y. (1987). *Learning by expanding*. Helsinki: Orienta-Konsultit Oy.

Ericksen, P. J. (2007). Conceptualizing food systems for global environmental change research. *Global Environmental Change, 9*, 1.

European Community (2015). Every fift hectare to organic production. http://www.europarl.europa.eu/sides/getDoc.do?pubRef=%2f%2fEP%2f%2fNONSGML%2bCOMPARL%2bPE-549.119%2b01%2bDOC%2bPDF%2bV0%2f%2fEN

Fair Trade (2018) Fair trade home page - presentation. https://www.fairtrade.net/

FAO (2012a).What is organic agriculture? http://www.fao.org/organicag/oa-faq/oa-faq1/en/

FAO (2012b). *Sustainable diets and biodiversity: Directions and solutions for policy, research and* *action.* Rome: FAO

FAO (2014). *Building a common vision for sustainable food and agriculture.* Rome: FAO.

FAO (2015). *The state of food insecurity in the world - meeting the 2015 international hunger targets: Taking stock of uneven progress.* Rome: FAO

FAO (2016a). Factsheet - smallholders and family farmers. http://www.fao.org/fileadmin/ templates /nr /sustainability_pathways/docs/Factsheet_SMALLHOLDERS.pdf

FAO (2016b). Smallholders and family farmers. Retrieved from http://www.fao.org/fileadmin/ templates /nr/sustainability_pathways/docs/Factsheet_SMALLHOLDERS.pdf

Felber, C. (2015). *Change everything - creating an economy for the economy of common good*. London: Zed books

Gelan, A. U. (2007). Does food aid have disincentive effects on local production? A general equilibrium perspective on food aid in ethiopia. *Food Policy, 30*, 436-458. doi:10.1016/ j.foodpol. 2006. 09.001.

Hinrichs, C., C. (2003). The practice and politics of food system localization. *Journal of Rural Studies,* 19.

IAASTD (2008). *Agriculture at the crossroads.* Washington: IAASTD.

Irz, X., Niemi, J., & Xing, L. (2011). Determinants of food price inflation in Finland. EAAE 2011 Congress "Change and Uncertainty", Zurich.

Madu, I. A. (2006). Spatial inequality in nigeria: The imperative of geographic perspectives in the development process. *Journal of Social and Economic Development, 8*, 105-120

Nuutila, J., & Kurppa, S. (2016). Reaching goals for organic food in Finland: Which changes should occur in the food chain? *Organic Agriculture, 7*, 303-314. doi:10.1007/s13165-016-0158-2.

Nwuneli, N. (2018). Fake processed food is becoming an epidemic in Africal urban life. http://flipboard. com/@flipboard/-fake-processed-food-is-becoming-an-epid/f428cc 558a3% 2Fqz.com

Reganold JP & Wachter JM (2016). Organic agriculture in the twenty-first century. Nature Plants, 2, Doi: 10.1038/NPLANTS.2015.221.

Renting, H., Marsden, T., K., & Banks, J. (2003). Understanding alternative food networks: Exploring the role of short food supply chains in rural development. *Environment and Planning, 35*, 393.

Rosset, P. (2009). Fixing our global food system: Food sovereignty and redistributive land reform. *Monthly Review, 61*(3), 189. doi:206.

UN (2010). Report submitted by the special rapporteur on the right to food, Olivier de Schutter. http://www.srfood.org/index.php/en/component/content/article/1-latest-news/1174-report-agroecology-and-the-right-to-food;

UN (2015a). Goal 12: Sustainable consumption and production patterns. http://www.un. org/ sustainable development/sustainable-consumption-production/

UN (2015b). Sustainable development goals. http://www.un.org/sustainabledevelopment /sustainable-development-goals/#prettyPhoto

va Dijk, M. P. (2016). Is china grapping land in Africa? A literature overview study. *Landac Conference,* Utrecht, June 30, 2016.

Willer, H. & Lernoud, J. (2017). The world of organic Agriculture. Statistics and emerging trends, FiBL and IFOAM – Organics International, Frick and Bonn

Windfuhr, M., & Jonsen, J. (2005). *Food sovereignty - towards democracy in localized food systems.* Warwickshire: ITDG.

Land Degradation as an Issue in Agro Ecosystems: A Review of Underlying Causes

Adidja, M.W., Ssekyewa, C., and Mwanga-Zake, J.W.F.

Faculty of Agriculture, Uganda Martyrs University, Nkonzi, Kampala, Uganda.

Corresponding author: adidjamatabaro@gmail.com, wadidja@yahoo.com

Keywords: Land degradation, agro ecosystem, human wellbeing, rural areas, underlying causes

Abstract

Land degradation is a big issue in agro ecosystems in developing, transition economy and developed countries. This problem negatively affects agriculture productivity and production in rural areas of all countries where most people depend on agricultural activities for their survival. Therefore it impacts food security, poverty, livelihood and wellbeing of rural populations. Factors such as poverty, population growth or pressure, climate change, human activities (intensification of agriculture, industrialization and urbanization), poor awareness and lack of institutions and poor governance (poor policies and management) are causing and increasing land degradation and its negatives consequences on agro ecosystems functions and services. Some of these causes are also initiated and increased by land degradation (vicious circle). This emphasizes the needs to identifying and understanding the root cause of land degradation, consequences and response in order to develop better mechanisms of eradicating or mitigating the unwanted effects.

Introduction

An agro-ecosystem is an integrated region for agricultural production where food production systems are considered as a whole, including their complex inputs and outputs and the interconnections between their components. Basically, an agro-ecosystem is an agricultural and natural resource system manipulated by human beings for their food needs and other valuable products (Krishna, 2014; WRI, 2011). Being an agricultural production system, land is its very important components and plays the key role of supporting and feeding crops for their growth and production. Land is also central in the relationship that links energy, food, water, and environmental health in an interdependent circle. However, this component has been degraded in most parts of the world especially in rural areas where the majority of the population uses agriculture as the main activity to generate income and survive. This degradation has also happened in dry lands due to human activities and climate change and desertification. Continued land degradation during the coming years could reduce global food production, increase food insecurity, hunger and poverty over the world (AU, 2014; FAO, 2015).

Land degradation results from every decline in biodiversity and ecosystem functions, which adversely impacts the provision of ecosystem services and hinders poverty extermination and sustainable development. Land degradation means the decline in the productive capacity of the land (UN/FAO definition) or "the aggregate diminution of the productive potential of the land, including its major uses, its farming systems and its value as an economic resource." This degradation is called desertification in arid, semi - arid and dry sub - humid areas where productivity is constrained by water availability. Land degradation has also been defined as the reduction of the current or future capacity of land to produce (Oluwole and Sikhalazo, 2008).

Land degradation affectsabout70% of the world's rangelands, 40% of rain fed Agricultural lands and 30% of irrigated lands. Salinity affects30% of irrigated lands while above 1/4 of the world's land is affected by desertification. The latter affects half of the world's poor people who live in dry land regions with fragile soils and unreliable rain). In addition, land degradation reduces the productivity and production (yield) in those areas. Hence, this problem has been broadly recognized as a major threat to food production and poverty eradication around the world. This situation emphasizes the need to preserve, restore land potentialities and/or control land degradation at national, regional and international level for sustainable improvement of human economy and wellbeing in the world (FAO, 20011, BAI *et al,* 2008, UN General Assembly, 2012). Land degradation has been globally caused deeply by different factors among which: poverty, population growth or pressure, climate change, human activities (e.g. urbanization, industrialization, agriculture and deforestation), weak institutional/poor awareness/poor governance and natural processes (Wakindiki and Ben-Hur, 2002). These factors are summarized in the figure 1(Adidja, 2017) below:

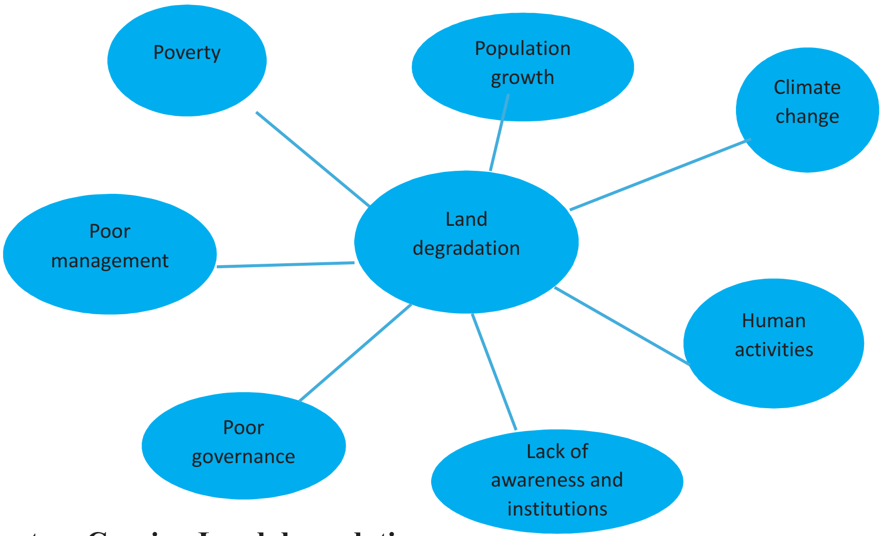


Figure 1: **Factors Causing Land degradation**

This article will present and discuss the underlying causes of land degradation as an issue in agro ecosystem, which can be useful in elucidating the consequences and response mechanisms for proper or long-term solutions to reduce or mitigate land degradation, increase productivity/production, reduce poverty, and improve income and human wellbeing in the rural areas of the world.

1. **Poverty and land degradation**

There are important links between natural resource management and poverty. Many poor people rely on natural resources for their livelihood and survival and are very vulnerable to deterioration of these resources (Heady 2000). The poor are both victims and agents of resources degradation. The poor destroy their resources by putting pressure on it to meet the needed and wellbeing standards compared to the rich (equity) and to satisfy their multiple needs (Anijah-Obi 200; Nwagbara, 2012; NEMA, 2002;

Shiferaw and Holden, 1999b; Nkonya *et al.,* 2004). These linkages are very strong in the rural areas in assumed poor countries where agriculture is the main livelihood activity (Turner *et al.,* 1994). This situation implies that poverty leads to land degradation and land degradation contributes to poverty (Barbier, 2000; Lambin *et al*., 2001; Eswaran *et al*., 2001). Thus, poverty can be seen as a consequence of degrading land and, at the same time, as a cause of land degradation. Despite the level of land degradation and government effort to promote use of land technologies, the adoption remains very low-below 30 percent (Nkonya *et al.,* 2004). This situation is due to poverty, which constrains households in rural areas to invest in mitigating land degradation. Social capital affects adoption and diffusion (exchange between those who have adopted and those willing to do so) of land management technologies (Isham, 2000; Reid and Salmen, 2000; Nyangena, 2005; Rogers, 1995). Therefore, land degradation is the major constraint to enhanced agricultural productivity and household welfare whose main source of living is crop agriculture (UPPAP, 2002, Deininger and Okidi, 2001). This poverty problem can be addressed by the identification of its determinants and their inclusion it into the design of government policies and programs as priorities (GOU, 1997). Elsewhere, poverty and adoption of various land management technologies are mutually interrelated: poverty determines the level of adoption of technologies while the level of adoption has implications on land productivity and on poverty. Also poverty and social capital are interconnected. This situation leads to an endogeneity problem, which needs to be considered when drawing conclusions about solutions (Birungi, 2007).

2. Population growth and land degradation

Population growth influences land use, land status and land potentials to sustain the livelihoods and wellbeing of present and future generations. **Land use** change includes deforestation and fragmentation of forests, intensification of agriculture and its expansion into marginal areas and fragile ecosystems, as well as urban expansion and infrastructure development. Land degradation affects land resources in tropical, subtropical and dry land regions of the world. It impacts much on the population whose livelihoods depend on agriculture and land exploitation. Rapid population growth impacts natural resources and leads to land scarcity and degradation: demographic pressure implies more intensive use of natural resources, which implies resources deterioration. The growing population put immense pressure on intensification at cost of forests and grazing lands to meet the increased food demand, and hence, leads to deterioration of land resources. In India for example, increasing demographic pressure and the subsequent competition for rare resources stimulates rearrangement of physical (fragmentation or dispersion), and social attributes (land tenure; use/ownership rights) of landholding. This situation creates changes, which deteriorate land productivity and increase food shortage in rural areas by affecting land management practices, land use, conservation technologies, fertilizers, and other inputs. Densely populated countries around the world, experience a growing cultivation of marginal lands and consequently their degradation (Gregersen, *et al.* 1992). The migration on marginal lands has a significant change in the structure of landholding and impacts negatively natural resources. Thus, when farmers/herders try to increase their production in fragile areas, the dynamics of the relationships between human and natural resources change radically. This shift also affects farmer's investments and land use strategies and then leads to increased land degradation: farmers are pushed to occupy mid and upper slopes lands where erosion problems are common with low yields and less interest to invest in conservation because of their characteristics. This leads to spring of low production and low investment (Pingali and Binswanger, 1984). Also the expansion of cultivation on marginal lands has increased their degradation due to the higher seasonal or annual cropping disturbance compared to their traditional uses (e.g long fallow). This situation has limited cropping options and choices too. Land use and crop selection is a dynamic process affected by external structures and local conditions. When technologies change or degradation occurs, farmers adapt by adopting suitable practices to new conditions or by moving to fragile areas. However, research results suggested that households with insufficient land have to plant ever-increasing amounts of their lands holdings with sweet potatoes and other tubers (Clay and Magnani 1987; Loveridge, *et al.* 1988). These tubers have a higher caloric value than other crops and grow relatively well in poorer conditions such as steeper slopes and protects the land from degradation more than annual crops (Gleaveand White 1969). The population growth problem can be addressed either by controlling population's fertility (family planning) or by developing and disseminating technologies to control land degradation while increasing production (Clay *et al., 1994).*

3. **Climate change and poor management**

Climate change refers to changes in rainfall patterns, increased frequency and intensity of drought and floods, rising temperatures, and profound ecological changes. The effects of climate change are intensifying the effects of demographic pressure and unsustainable land management practices on land degradation over the world. Therefore, the capacity for the populations to generate livelihoods has become restricted. Land degradation or desertification in the arid, semi-arid and dry sub-humid areas results from climatic variations due mostly to human activities. This degradation induces the reduction or loss of areas of the biological/ economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a combination of processes from such as erosion; deterioration of the physical, chemical, and biological or economic properties of the land; and loss of natural vegetation (WMO, 2005). The climatic changes lead also to water shortages, salinity and compaction which affect negatively the production and productivity of lands (see figure 2).

Figure 2: **Water shortage and desertification (ODADA, 2004)**

This climate change problem increases low productivity leading to increased food insecurity and poverty (because of low income).Increased poverty impacts negatively the access to adaptation and mitigation measures and the exposure to extreme events in those countries(as shown in figure 3) (UA, 2014).

Figure 3: **Uprooted tree by wind in dry lands (ODADA, 2004)**

The reactions between climate change and land degradation are very complex and can be self-reinforcing when land degradation contributes to climate warming (loss of carbon stores from soils and vegetation)(Cordova, 2000; Mohawesh, 2015).Also, the degradation by reductions in vegetation cover creates local microclimate (decrease of air humidity, increase of soil temperature and amount of solar radiation). Thus, land degradation combined with climate change can disturb the ecological and land use systems which can lead to food insecurity and water shortage with negative impacts on livelihoods and households adaptive capacity).Recent research suggests that increased global warming could lead to extreme events occurring more frequently and with greater severity in a globally synchronized way. This could significantly reduce our resilience to drought and disruptions to food systems at a global scale. Sustainable land management practices are therefore needed to reduce land degradation due to climate changes with its impacts on natural resources such as land(WMO, 2005). Adaptation practices such as coping, adjustment and transformation can be established. These adaptation options include Climate Smart Agriculture which suggests solutions combining food security, climate adaptation/mitigation while supporting sustainable landscapes and food systems (UNCCD, 2015).

4. Industrialization, Intensified Agriculture and urbanization

The rapid industrial development of recent years has led to a number of shared environmental problems in the world such as severe land degradation (UNEP, 2002). Industrialization is one of the major causes of increased land degradation and depletion while urbanization, deforestation, erosion of the topsoil and desertification are its consequences. The revolution of industry and the large-scale application of science and technology in industries increased industry production which made natural resources consumed in big quantities. Much impact of industrialization is seen in developed countries than in developing ones. Agriculture also increases degradation of the land in the way that crop production requires the removal or modification of the natural vegetation of the land. Thus, arable farming alters the land by adding and removing plant nutrients, reducing acidity with lime, draining excess soil moisture with underground pipes, removing stones, and changing its structure(Grigg, 1987). Both agriculture (over cultivation, deforestation and overgrazing) and development (industrialization and urbanization) cause land degradation and then reduce also productivity and production of this resource while impacting negatively the livelihood and wellbeing of people in the world. Therefore, good policies must be designed with proper planning and good technologies for sustainable management of lands (Ahuti, 2015). These needs will not be met sustainably unless we preserve and restore the productivity of our land. Business as usual will lead to more deforestation. If hunger and food insecurity are to be overcome, an estimated 60% increase in agricultural productivity, including a 100% in developing countries, will be necessary by 20507. However, the world's ecosystems, biodiversity and associated goods and services are also under increasing pressure from the loss of crop diversity, the overexploitation of fish stocks, deforestation, degradation and losses of arable land, growing competition for increasingly scarce water and the adverse impact of climate change. Although land degradation is a generalized risk, some 40% of the world's degraded lands are found in areas with the highest incidence of poverty, which remains overwhelmingly rural. As rural to urban migration is increasing, the urbanization is also taking continuously place. This continuation of urbanization increases land and resource consumption which deteriorates these resources(land) and people's economy. Therefore, planners, governments, planning agencies and others should acknowledge these problems immediately and put environmental perspective into land use planning and decision making process effectively and promptly.

5. Lack of awareness and Weak institutions

Most time, lack of awareness, capacity building programs and networking for farmers/resource users, technicians and policy makers on integrated land use systems and technologies lead to poor adoption, use and adaptation of sustainable management technologies and restoration/conservation practices of lands in rural areas. This weakness makes the degradation of lands and poverty to continue increasing in those areas. This situation is reinforced by the lack and weakness of specific institutions to conduct different training program to build public capacities and awareness on sustainable use and management of land and to conduct monitoring and evaluation programs on adoption, use and adaptation of best practices and technologies over the globe. In DRcongo for example, low adoption of conservation practices were observed and identified due to poor awareness and lack of extension services(Adidja, 2012). Government should reinforce people capacities and awareness by organizing different training programs with these priorities and increasing networking within and across farmers.

6. **Poor policies or poor governance**

Some policies discourage sustainable use and management of land resources while others prioritize other sectors than conservation and agriculture sectors. Insecure land tenure and property rights for example, can also lead to the discouragement to investment in land management practices among the rural poor, and then to deeper poverty (Gabremedhin & Swinton, 2003; Kabubo-Mariara, 2007). Also, institutional arrangements that govern access to and use of resources may also undermine resource management leading to heightening of poverty (Leach *et al.,* 1997rev). Different government must review their policies goals and priorities to increase adoption of conservation and restoration practices. The policies and governance approaches must move away from macro scale level to a greater appreciation of people in places because the land problems are highly differentiated and experienced differently by diverse groups(Means, 1991; chambers, 1997).In addition, these policies must increase the perceived importance of local institutions and poor people in their content which implies the use of community-based natural resources approaches.

Conclusion and recommendation

Land degradation remains a big challenge in agro ecological systems. It mainly results from poverty, unplanned population growth, climate change, human activities, poor management, poor governance/policies, and the lack of awareness and institutions. These factors threaten the proper functionality of these systems and their capacity to provide better services to human being (welfare) and to the environment in general (self-resilience). Thus, land degradation problem reduces the productivity/production/yield of the land, and therefore, people's income especially in rural areas where the majority of habitants rely on agriculture as main activity and source of income over the world. This situation increases, therefore, food insecurity, poverty and hunger while affecting negatively the health and wellbeing of a large number of people in those areas. Therefore, there is a need to control population growth via sensitization campaigns and reinforce adoption/adaptation of best technologies and practices to restore, conserve and manage the lands sustainably in order to improve its productivity and production while reducing poverty, food insecurity and hunger, and therefore, improving people's welfare and conserving/protecting land resource in the world. Also, strong governance approaches and policies must be designed and implemented. These policies must be context specific and must involve the participation of local community in the land management process equitably in order to reduce poverty and promote best management practices and technologies in the affected areas.

References

Ádám, K., 2009. The global problem of land degradation and desertification. *Hungarian Geographical Bulletin 2009. Vol. 58. No 1. pp. 19–31.*Degradation and Sustainable Development: A Discourse, Global Journals Inc. (USA) Online ISSN: 2249-460x & Print ISSN: 0975-587X.

Ahuti, S., 2015. Industrial Growth and Environmental degradation. Environmental Science, E-ISSN: 2454-9916, vol-9.

Bai, ZG, Dent, DL, Olsson L, Schaepman ME., 2008. Global assessment of land degradation and improvement. Identification by remote sensing. Report 2008/01, ISRIC – World Soil Information: Wageningen.

Batistella, M., Valladares, G.S., 2009. Farming expansion and land degradation in Western Bahia Brazil.BiotaNeotrop. 9 (3).

Chambers, R. (1997) Whose reality counts?, London: Intermediate Technology Publications.

Daniel C., Guiz, M., Wallace, S., 1994. Population and Land Degradation, Departments of Agricultural Economics and Sociology, Geography, and Resource Development Michigan State University.

Dasgupta, P. 2000. Population and resources: An exploration of the reproductive and environmental externalities. Population and Development Review 26 (4): 643–689. Development Economics. 5, 3, 241-258.

Duraiappah, A., 1996. Poverty and Environmental Degradation: a Literature Review and Analysis, CREED Working Paper Series.

FAO, 2011. The state of the world's land and water resources for food and agriculture (SOLAW) - Managing systems at risk. Food and Agriculture Organization of the United Nations, Rome and Earthscan, London.

FAO, 2015. Agroecology to reverse Soil Degradation and Achieve Food Security.

Gebremariam, A., 2010. Farmer's Awareness about Land Degradation and their Attitude towards Land Management Practices. Addis Ababa University College of Education Department of Geography and Environmental Education.

Grigg, D., 1987. The Industrial Revolution and Land Transformation. Land Transformation in Agriculture Edited by M. G. Wolman and F. G. A. Fournier, SCOPE. Published by John Wiley & Sons Ltd. 91 1 | Issue : 5 | Dec 2015E-ISSN : 24

Heady, C. (2000). Natural resource sustainability and poverty reduction. Environment and

Mearns, R. (1991) “Environmental implications of structural adjustment: reflections on scientific method”, IDS Discussion Paper DP284.

Mohawesh, Y, Taimeh, A., Ziadat, F., 2015. Effects of land use changes and soil conservation intervention on soil properties as indicators for land degradation under adoi:10.5194/se-6-857-2015 Mediterranean climate. Solid Earth, 6, 857–868.

Ozturk, M., Ruhi, A., Celik, M. ,S., 2011. Urbanisation, Land Use, Land Degradation and Environment. Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre), :Daya Publishing House.

Rattan L., 2015. Restoring Soil Quality to Mitigate Soil Degradation. The Ohio State University, Columbus, OH 43210, USA; E-Mail: lal.1@osu.edu;Tel.: +1-614-292-9069, Academic Editor: Marc A. Rosen, ISSN 2071-1050.

UN General Assembly, 2012. High-level meeting on addressing desertification, land degradation and drought in the context of sustainable development and poverty eradication. A/65/861.

UNCCD, 2015. Climate change and land degradation: Bridging knowledge and stakeholders, Outcomes from the UNCCD 3rd Scientific Conference. 9-12 March 2015, Cancun, Mexico.

WMO, 2005. Climate and Land Degradation. WMO-No. 989© 2005, World Meteorological Organization. ISBN 92-63-10989-3.

Efficacy Evaluation of Selected Biorational Combinations in the Management of Tomato Blight

*Kamoga Gerald[1],
Mwine Julius[2] and
Ssekyewa Charles[2]

[1-2] Faculty of Agriculture,
Uganda Martyrs University,
Nkozi, P. O. Box 5498,
Kampala, Uganda.

Corresponding author:
*Kamoga Gerald, as above

Keywords:
Biorational, Dose,
Ecosystem, Efficacy,
Lethal.

Abstract

This experiment was conducted in Katabi Sub-county in Wakiso District from March 2012 to June 2013.The study evaluated efficacy of selected biorational combinations in the management of tomato blight. These biorationals were picked from the local plant materials used as natural pesticides and fungicides. They included (Carica papaya, Phytolacca dodecandra, Jatropha curcas, Capsella Bursa-pastoris and. Tephrosia vogelli.). The major objective was to evaluate efficacy of Carica papaya, Phytolacca dodecandra, Jatropha curcas, Capsella Bursa-pastoris and. Tephrosia vogelli. against tomato blight. This research used a complete Randomized block design in which three treatments (Jatropha curcas and Capsella Bursa-pastoris, Carica papaya and Phytolacca dodecandra and water as a control) were applied at varying biorational concentrations (25%, 50%, and 75%). Data were collected from all treatments and their efficacy evaluated. There were four replicates from each treatment in the experiment. Results revealed that treatments of Carica papaya with Phytolacca dodecandra were more effective in managing tomato blight below economic injury thresholds. This research recommended that Caricapapaya with Phytolacca dodecandra at a concentration of 50% be used by farmers in the management of tomato blight.

Introduction

A number of biorationals are known and used by many organic farmers. According to Ssekyewa, (2001), *Tephrosia vogelli* is a known pesticide among others. Although it is known that combinations of such plant extracts may be effective, it is not clear how best they can be combined to reduce pests and disease levels below economic injury thresholds (Mwine *et al.* 2010). The quantities in which they can be used to manage diseases are also not known, (Henry *et al* 1996). Dosage of the biorationals to water, the rate of application, the interval of application and/or withdraw period are all not clearly established. As result their performance may not be satisfactory. This has brought about lack of confidence among farmers and other practitioners in some of the botanicals as they may sometime appear very ineffective.

Ankli *et al.* (1999) reported that knowledge of such herbs is usually in the hands of a small group of people who guard it jealously for their advantage. This is escalated with death of the elderly people who were custodians of this knowledge; yet there is no sufficient documentation for the same,(Mwine et al 2010). In Cameroon for example, the mean yield loss attributable to late blight damage was as high as 100%, D.A. Fontem (2003).

Where organic agriculture is practiced, efficacy, quantities of biorationals, dosage, frequency of application and rates are all knowledge gaps in Uganda, (Mwine *et al.* 2010). The major objective of this study therefore, was to evaluate efficacy of *Carica papaya*, *Phytolacca dodecandra*, *Jatropha curcas*, *Capsella Bursa-pastoris* and *Tephrosia vogelli* against tomato blight.

The specific objectives were to determine the biorational combinations that can reduce tomato blight to levels below economic injury thresholds, establish the optimum concentration of biorationals used in controlling tomato blight and identify the ecological conditions that influence the effectiveness of biorationals when managing tomato blight.

Materials and methods

The study area

The farm where research was conducted is located at 25km on Kampala-Entebbe road, Nalugala Village, Katabi Sub-county Wakiso District. The soils in this Agro-ecosystem are sandy loams with average fertility, well drained at a gentle slope**.**

This farm is located within Lake Victoria basin where climatic conditions such as rainfall, temperature and humidity are ideal for tomato growing; but make tomato blight proliferate at a high rate,(SSEKYEWA, C. 2001), and(HENRY ELWELL et al (1996).

Data collection

Every two other days the fields were inspected. With direct observation, plant parts affected by tomato blight were counted and recorded with respect to the restrictions of plots in a Randomized Complete Block Design(RCBD). Farmers at the farm were engaged in an interview to collect data on which ecological conditions influence the effectiveness of biorationals when managing tomato blight?
Restrictions of plots were as follows:

Tephrosia vogelli at a 50% concentration was applied all through the plots for purposes of killing insect pests. Such pests include aphids which are vectors for *Phytopthora infestans* and *Alternaria solani* among other diseases. This was prepared by dissolving 50gm of *Tephrosia vogelli* powder and dissolving it in 100mls of water.

Tomatoes in plots marked P1 were sprayed with liquids obtained from dry leaves of *Caricapapaya* and *Phytollacca dodecandra* at a concentration of 25%

Tomatoes in plots marked P2 were sprayed with liquids obtained from dry leaves of *Caricapapaya* and *Phytollacca dodecandra* at a concentration of 50%

Tomatoes in plots marked P3 were sprayed with liquids obtained from dry leaves of *Caricapapaya* and *Phytollacca dodecandra* at a concentration of 75%

Tomatoes in plots marked J1 were sprayed with liquids obtained from dry leaves of *Jatrophacarcus* and *Capsella Bursa-pastoris* at a concentration of 25%

Tomatoes in plots marked J2 were sprayed with liquids obtained from dry leaves of *Jatrophacarcus* and *Capsella Bursa-pastoris* at a concentration of 50%

Tomatoes in plots marked J3 were sprayed with liquids obtained from dry leaves of *Jatrophacarcus* and *Capsella Bursa-pastoris* at a concentration of 75%

Tomatoes in plots marked C1, C2 and C3 were not subjected to any biorational material but were sprayed with water to provide the same degree of wetness as was the case in the test plots. These plots therefore served as a control plots.

This research engaged workers of this farm in an interview to get a wider understanding of the ecology of the tomatoes, blight and all other interacting components; within this agroecosystem.

Data analysis

Genstat software) was used to analyze the differences between group means and their associated procedures (such as "variation"among and between biorational combinations and concentrations). In this case, the observed variance in a particular variable was partitioned into components attributable to different sources of variation such as biorational concentration. This tool provided a test of whether or not the means of several groups were equal, and therefore generalized a *t*-test to more than two groups. For this reason, ANOVA was useful in comparing (testing) means (groups or variables) for statistical significance.

Results

Incidence of *Phytopthora infestans* on leaves

Comparing infection rates of leaves by tomato blight, as shown in figures 1 and 3; infection rate was highest in treatment J(where *Jatropha curcas* with *Capsella Bursa-pastoris* was used at a concentration of 25%). Lowest infection rates were recorded in treatment P (where *Carica papaya* with *Phytolacca dodecandra* was used at a concentration of75%).

Figure 1. **Leaf damaged by tomato blight**

Figure 2. **Symptoms of tomato blight on tomato fruits and leaves**

Fruits

Fruits affected by tomato blight in figure 2.Lowest infection rates were recorded in treatment P (where *Carica papaya* with *Phytolacca dodecandra*) was used. At all biorational concentrations a maximum of one leaf was infected. A highest rate of infection was recorded in treatment J (where *Jatropha curcas* with *Capsella Bursa-pastoris* was used) at 25% concentration.

Leaves

Figure 3 shows efficacy of biorationals used at varying concentrations. This is why a constant value from treatment C (where water was used) against results from treatment P (where *Carica papaya* with *Phytolacca dodecandra* was used) and treatment J (where *Jatropha curcas* with *Capsella Bursa-pastoris*was used). *Carica papaya* with *Phytolacca dodecandra* (in treatment P) at 75% concentration reduced tomato blight on tomato leaves to the lowest level compared to *Jatropha curcas* with *Capsella Bursa-pastoris* (in treatment J) at the same concentration.

Branches

Lowest efficacies were recorded in treatment J (where *Jatropha curcas* with *Capsella Bursa-pastoris* was used at concentration of 25%. The rest of the concentrations and biorational combination (*Caricapapaya* with *Phytolacca dodecandra*) showed high efficacies on tomato blight on tomato leaves, Figure 3.

Fruits

There were variations in performance of biorationals as seen in figure 4. These are results of biorationals used in all plots at varying concentrations, keeping that of the control treatment constant (sprayed with water). High efficacies of biorational combination were recorded by *Carica papaya* with *Phytolacca dodecandra* at a concentration of 75% (in treatment P). Lowest efficacies were recorded in treatment J at 25% concentration of *Jatropha curcas* with *Capsella Bursa-pastoris*.

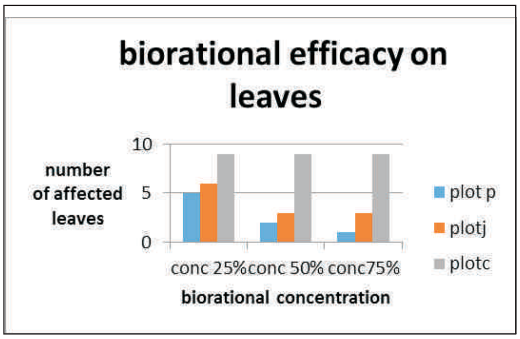


Figure 3.**Efficacy of *Carica papaya* with *Phytolacca dodecandra* and *Jatropha curcas* with *Capsella Bursa-pastoris* against *Phytopthora infestans* on leaveswith *Capsella Bursa-pastoris* against *Phytopthora infestans* on leaves**

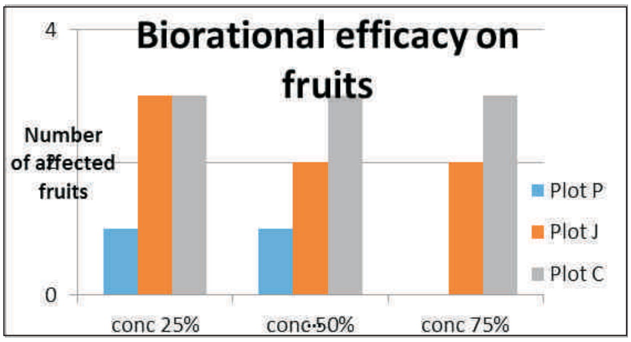


Figure 4. **Efficacies of *Carica papaya* with *Phytolacca dodecandra* and *Jatropha curcas* with *Capsella Bursa-pastoris* against *Phytopthora infestans* on tomato fruits**

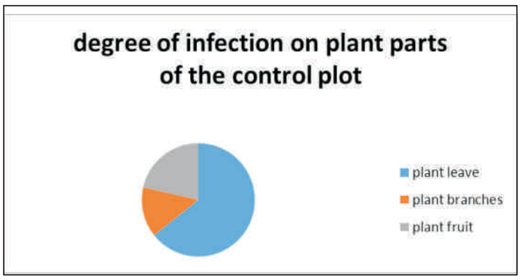


Figure 5. **Infections on plant parts by tomato blight**

Figure 6. **Health tomatoes** (*Photo by Ssagala David)*

Discussion

Biorationals are not independent from the rest of the Agro-ecological components, neither are they useful without human beings, Kakudidi EK (2004). When used effectively, farmers make economic gains which impact the rest of the ecosystem components directly or indirectly. Ecological factors such nutrient availability, soil water, predation and policy among others were reported as key factors that enhance efficacy of biorationals.

Biorationals protected tomatoes against tomato blight on different parts of the tomato plant differently. *Phytopthora infestans* responded differently to each biorational. *Phtolacca dodecandra* with *Caricapapaya* reduced this disease to minimum levels compared with *Jatrophacurcas* with *Capsella Bursa-pastoris*. This is attributed to the known fungicidal properties of the former, (Elwell *et al* 1995).

It was found out that biorationals protected tomato plant parts at varying degrees. In this case braches were protected most, followed by fruits and lastly leaves. This is because leaves open up in the space and have maximum contact with wind than branches. Wind and sunshine are responsible agents for blowing off and evaporating biorationals from leaves before they suppress the spores. This leads to low protection of leaves by biorationals compared to protection exhibited at branches and fruits. The hands and tools of the farmer increase the rateat which tomato blight spreads; making protection of tomato plants by biorationals inefficient.

During field sampling and observations with the use of a still camera healthy tomato plants were recorded in treatment P where *Carica papaya* with *Phytlacca dodecandra* was sprayed at concentrations of 50% and 75%. This observation was consistent all through the growth period of the tomato crop (4 months). This showed that when farmers use *Carica papaya* with *Phytlacca dodecandra*, they can manage tomato blight and produce healthy tomatoes such as the one shown in figure 6. According to Henry *et al*, (1996), these two plants used to make the biorational used *(Carica papaya* with *Phytlacca dodecandra)* have anti-fungalproperties. Thus farmers can make use of them so that they manage tomato blight. A concentration of 50% is recommended basing on results of figures 4 and 5.In all these figures, *Carica papaya* with *Phytolacca dodecandra* managed to keep tomato blight to the lowest levels of up to zero as seen in figures 3 and 4.

Results also revealed that there were several ecological components that had a direct relationship with tomato production. This was evidenced by the presence of several pests such as aphids and American ball worm which was responsible for damaging the crop. Other than damaging tomatoes, biodiversity in the field and around the field caused rotting of plant residues in order to generate crop nutrients. The plant diversity around the experimental site created a conducive environment for several beneficial organisms. Such organisms included playing mantis, lady bird beetles, and wasps which enabled to manage several pest populations (Ssekyewa, 2001). The environment with diverse plant species enhanced biorational efficacy when it provided homage to organisms such as playing mantis that fed onaphids. This nutritional relationship between aphids and beneficial organisms kept pestpopulation low. This was an opportune moment for biorationals to keep tomato blight incidence low, (Rosskopf *et al* 2007). It is imperative to enhance biodiversity if farmers are to benefit from natural interactions such as predation. There were pathogens other than *Phytopthora infestans* which caused wilting of some tomato plants. "In natural settings, many organisms exist despite human interventions" Katende *et al*, (1995). This showed that a mult-dimensional approach must be sought to enhance the efficacy of such selected biorationals.

Conclusion

Biorational combination in treatment P(*Carica papaya* with *Phytolaxcca dodecandra*) at concentrations of 50%and 75% managed to reduce tomato blight to levels below economic injury thresholds. The ecological conditions that influenced the effectiveness of biorationals when managing tomato blight were temperature, humidity, predation and wind.

Recommendations

It is recommended that farmers use a combination of *Caricapapaya* with *Phytolacca dodecndra* at a concentration of 50% to manage *Phytopthora infestans* in tomato plants. They should ensure that they enhance their efficacies by applying them during warm conditions, low humidity, little or no wind and support beneficial organisms.

References

Ankli *et al.* (1999). Medicinal Plants in Mexico: Healers' Consensus and Cultural Importance Soc. Sci. Med. Vol. 47, No. 11, pp. 1859±1871, Great Britain.

D.A. Fontem (2003). Quantitative Effects of Early and Late Blights on Tomato Yields in Cameroon Tropicultura, 2003, 21, 1, 36-41.

Gary L., Obenauf, 1999. *Propargyl bromide, biorationals, and use of alternative fumigants during the spring.* New York: 6 (4) pp.19-31.

Haryan R. A, *et el.* 1979. *"Plasmid DNA from Bacillus thuringiensis ". Microbiologiya* 48(2)226–9.

Henry Elwell and Anita Maas 1996. *Natural pest and disease control.* University press, London.

Kakudidi E.K. (2004). Folk plant classification by communities around Kibale National Park, western Uganda. Afr. J. Ecol., 42: 57-63.

Rosskopf Erin, Ables Camilla, Albano Joseph, I997. *Screening of biorationals for control of phytophthora capsici*. London: 17th International Pepper Conference.

Ssekyewa, C. 2001. *Major Horticultural Crops Diseases Handbook*. UMU: Spiral bound.

Mwine Julius *et al.* 2011. Ethnobotanical survey of pesticidal plants used in South Uganda: Case study of Masaka district Journal of Medicinal Plants Research Vol. 5(7), pp. 1155-1163.

Influence of Tillage Systems on Diversity and Abundance of Insect and Nematode Pests of Maize in Malete, Kwara State, Nigeria

*Aderolu, I.A., Lawal O.O, Wahab A. A., Alabi, K.O, Osunlola, O.S. and M.A. Giwa

Department of Crop Production, Kwara State University, P.M.B. 1530, Malete, Ilorin, Nigeria

*Corresponding Author: adeisma@yahoo.com

Keywords:
Quality Protein Maize, Pest, Tillage Practices and Management

Abstract

Pests are major biotic factors causing up to 45% yield reduction in maize production in sub-Saharan Africa. To develop improved methods for maize management, the species and abundance of insects and nematodes associated with ten quality protein maize varieties (QPMVs) were evaluated with two commonly used tillage practices, 'plough only plots (POP)' and 'plough and harrow plots (PAHP)'. The experiment was carried out using QPMVs at the Teaching and Research Farm of the Kwara State University, Malete, Nigeria, and arranged in a randomized complete block design with 11 treatments replicated 3 times, including local check "pambo". A total of 833.1±4.0 and 799.3±3.4 arthropods specimens were collected from POP and PAHP, respectively, comprising 8 orders and 18 families. Ootheca mutabilis was the most abundant species with 5.47% (POP) and 5.68% (PAHP) and the least abundant was Rhopalosiphum maidis 1.82% (POP) and 1.80% (PAHP). As indicated by Shannon-Wiener (3.46±0.023) and Simpson indices (0.97±0.0008) there are even distribution in the tillage practices. Three genera of plant parasitic nematodes (PPNs) were identified, Meloidogyne spp. (POP (78.33±19.65), PAHP (1.33±0.33), Pratylenchus spp. (POP (41.67±9.26), PAHP (5.00±2.31), and Helicotylenchus spp. (POP (58.33±38.35), PAHP (23.33±14.50). The use of PAHP tillage practices is effective in reducing insects and nematodes associated with maize in Nigeria and therefore recommended for the management of both pests in maize production.

Introduction

Maize (*Zea mays*) is a cereal crop that belongs to grass family *Poaceae*. It is a crop of global importance with a significant adaptability in a wide range of climates and more diversely distributed than any other cereal crops (Ibeawuchi *et al*., 2008). It was introduced to West Africa by the Portuguese in the 16th century (Oladejo and Adetunji, 2012). Maize is one of the most important grain crops in Nigeria, not only on the basis of the number of farmers that engaged in its cultivation, but also in its economic value. Maize *is* a major fodder and grain crop being cultivated in the rainforest and the derived savannah zones of Nigeria (Hussan *et al*., 2003) and has been in the diets of Nigerians for hundreds of years. Maize was cultivated initially in Nigeria as a subsistence crop and since has become more important commercially, as many agro-based industries depend on it for raw materials (Iken and Amusa, 2004). Maize is a versatile crop as each part of the plant has economic value. Its grain, foliage, stalk, tassel and cob can all be used to produce a large variety of food and non-food products (IITA, 2001). Its yield, among other grass family, is the most affected by variations in plant density due to its low tillering ability and the presence of a short-lived flowering period (Vega *et al*., 2001). In the study carried out by (Abdulrahaman and Kolawole, 2008), about 28 food items and 6 medical values of maize were discussed.

Maize production is constrained by climatic factors, edaphic or soil factors, differences among cultivar yields, birds, weeds, insect pests and diseases (caused by fungi, bacteria, viruses, and plant- parasitic nematodes). More importantly, insects and nematodes cause serious yield and quality reduction in maize production. In different part of the world, over 60 nematode species have been found associated with maize and most of these have been recorded from roots, or soil around maize roots (Keetch, 1989). It is therefore essential to identify and estimates these pests in order to formulate appropriate management strategies. This project therefore aims at studying the diversity, damage and assessment of insect pest and nematodes of maize in Malete, Moro local Government, Kwara State, Nigeria. The objective of this study was to evaluate ten quality protein maize varieties for pest occurrence, abundance and diversity and to evaluate the influence of tillage practices in the management of these pests.

Materials and Methods

This study was carried out during the 2015 rainy season at the Teaching and Research Farm of Kwara State University (KWASU), Malete (latitude 08^{0} 71'N; longitude 04^{0}44'E) at 360m above sea level (Olowoake *et al*., 2015). KWASU is located in Malete, Moro Local Government Area of Kwara State, Nigeria. The inhabitants of the community are engaged more in farming, hunting, transport, riding and trading. This experiment was conducted on Ferric Acrisol under rain fed conditions using POP and PAHP tillage practices. The QPMVs were evaluated for diurnal insect and nematode occurrence, abundance and diversity. The experiment was arranged in a randomized complete block design in four replicates on primary and secondary tillage plots. Data were collected on insect and nematode populations and yield parameters on each maize variety. Data collected were analyzed using analysis of variance (ANOVA) with descriptive statistics. Paleontological Statistics 3.14 (PAST, 2016) software was used for measuring standard diversity indices such as Shannon Weiner index (H), Simpson diversity index (1-D).

Results

Abundance and diversity of diurnal insects associated with maize in KWASU teaching and Research (T & R) farm varied significantly between the ploughed only plot (POP) and ploughed and harrowed plot (PAHP). A total of 883.1 ±4.0 individuals in POP and 799.3 ± 3.4 in PAHP comprising adults and immature stages of different insects from 17 families and 8 orders of insects were encountered during the field assessments. The six most abundant species in ploughed only plot were *Ootheca mutabilis* 48.3 ± 4.5(5.47%), *Locusta migratoria migratoroides* 43.1± 4.3 (4.88%), *Podagrica sjostedti* 34.9± 4.6 (3.95%), *Leucania convecta* 34.34 ± 4.8 (3.89%), *Diabrotica barberi* 33.1 ± 4.0 (3.75%), and *Zonocerus variegatus* 32.1± 4.1 (3.63`%) while ploughed and harrowed plot were *Ootheca mutabilis* 45.4 ±4.5(5.68%), *Locusta migratoria migratoroides* 39.7 ±4.5 (4.97%), *Podagrica sjostedti* 33.6 ±4.4 (4.20%), *Leucania convecta* 31.6 ±4.5 (3.95%), *Diabrotica barberi* 30.6 ±3.8 (3.83%) and *Zonocerus variegatus* 30.8 ±4.2 (3.85%). In PAHP, the populations of *Ootheca mutabilis* 45.4 ±4.5 and *Locusta migratoria migratoroides* 39.7 ±4.5 were not significantly (P>0.05) different from POP, and no significant (p>0.05) difference were recorded in the population of *Podagrica sjostedti* 34.9± 4.6 (6.13%), *Leucania convecta* 34.34 ± 4.8, *Diabrotica barberi* 33.1 ± 4.0 (5.50%), and *Zonocerus variegatus* 32.1± 4.1 (3.99%) from that of POP. The most abundant species encountered during the study period was *Ootheca mutabilis* with a total of 48.3 ± 4.5 in POP and 45.4 ±4.5 in PAHP. This was followed by *L. migratoria migratoroides* with a total of 43.1± 4.3 in POP and 39.7 ±4.5 individuals in PAHP. The species were highly diversified with Simpson diversity index of 0.97±0.00 in POP and this was not significantly ($p>0.05$) different with species diversity recorded in PAHP. Similarly, the index of evenness was high being 0.95 ± 0.02 and 0.92 ± 0.02 for POP and PAHP respectively. However, the defoliation inflicted by the insect species on maize plant was higher in POP (58.5%) than PAHP (41.5%) as shown in Table 4. On the whole plant stand, the number of leaves infested was higher in PAHP (64%) than in POP (35.6%). From the soil samples collected from both tillage practices, three genera of plant parasitic nematodes (PPNs) namely: *Meloidogyne* spp (POP = 78.33 ± 19.65, PAHP = 1.33 ± 0.33), *Pratylenchus* spp (POP = 41.67 ± 9.26, PAHP = 5.00 ± 2.31), and *Helicotylenchus* spp (POP = 58.33 ± 38.35, PAHP = 23.33 ± 14.50) were identified. At the end of the experiment, maize cobs were harvested, shelled, dried to safe moisture (13.5^{0}C) and weighed. In POP, variety PVASYN11F$_2$ had the highest yield (2173.3 ± 792.1Kg/ha) while variety TZE QI20 recorded the highest yield (1729.3 ± 546.1) in PAHP. The local variety 'PAMBO' recorded least yield in both tillage practices (POP = 406.3 ± 12.2 and PAHP = 908.0 ± 4.6).

Discussion

Pests are the most important factors limiting the quality and yields of maize production in Nigeria. In this study, *Ootheca mutabilis*, leaf eating beetle was the most devastating and abundant coleopteran pest while *Locusta migratoria migratoroides* was the most abundant Orthoptera pest causing considerable damage by defoliating leaf of maize plant. This finding was previously described in detail by Aderolu *et al*., 2013 who conducted similar studies on Amaranth. Also, Akinlosotu, 1977 found that *Hypolixus truncatulus* was the most abundant coleopteran pest causing considerable damage to amaranth.

The Shannon Weiner and Simpson indices of diversity revealed that there is no species dominance among the identified arthropods as the species were evenly distributed and highly diversified in both tillage practices under consideration implying the ease of using natural enemies and other eco-friendly methods in managing the identified pest species. This is in line with the findings of Aderolu *et al*., 2013.

However, secondary tillage may enhance significantly higher physiological growth and yield performance. This is similar with earlier report of Borin *et al*., 1995, that among conventional tillage, minimum tillage and no-tillage in maize growing, the highest yield had been obtained with the conventional tillage. Maurya, 1988 reported lower maize grain yield achieved with no-till system than with conventional tillage. Furthermore, conventional tillage improved the soil environment, resulted in increased maize yield and reduced insect infestation as poinyed out by Paramu *et al*., 2016. On the contrary, no-till farming may cause soil compaction and increase weed infestation which could harbour insect pests. Secondary tillage could lead to improved soil structure and texture which supported easy percolation of water and air into the soil thereby improving activities of soil organisms which transform organic matter into nutrients that were assimilated by maize plants (FAO, 2005). The organic matters could also bind the *soil* particles into aggregates, maintain tilth, improve root penetration and minimize erosion.

Generally, maize plants infected with plant-parasitic nematodes are prone to root necrosis, galling and lesions (and other symptoms similar to that caused by fungal and bacterial infections) causing reduced quality and yield (John, 1988). From the soil extraction in this study, three genera of plant parasitic nematodes were associated with maize plant including *Meloidogyne* spp, *Pratylenchus* spp and *Helicotylenchus* spp were identified. This findings are different from earlier reports by Fawole, 2009 and Nicole *et al*., 2011, who reported that between 11% -38% annual losses in production are caused by plant parasitic nematodes namely: *lance nematode (Hoplolaimus spp),* root lesion nematode, *(Pratylenchus spp)*, root-knot-nematodes (*Meloidogyne spp), dagger nematode, (Xiphenema spp)*, *needle (Longidorus spp), and spiral (Scutellonema spp)*. However, the nematode observations were in agreement with Keetch, 1989 who stated that the most important groups of plant parasitic nematodes demonstrated to be significant limiting factors in maize production from all over the world include the root knot nematodes, *Meloidogyne* spp., the root lesion nematodes, *Pratylenchus* spp. and the cyst nematodes, *Heterodera* spp. Moreover, the intensity of soil cultivation and plant cover has been reported to impact the diversity and number of soil invertebrates more than fertilizers and herbicides (Wang and Hook, 2011). Therefore, the variation in nematode genera could be due to soil variations in the experimental sites.

The pulverized soil in plough and harrow plot resulted in a reduction in nematode population when compared with plough only plot. This was probably due to exposure of nematodes in the secondary tillage practice to intense heat from sun rays. Hence, the outermost layer of the nematode cuticle is a thin, *thermolabile*, lipoid membrane (Southey, 1978) and could be easily destroyed by exposure to sunlight.

Conclusion

The results of this study showed that ploughing followed by harrowing tillage practice significantly suppresses insect infestation and damage and improve growth rate and yield of maize varieties. There is no significant different in insects' diversity in both PAHP and POP tillage practices. Hence, arthropod diversity in the maize field was homogenized and field margins had a high diversity. However, insect infestation and nematode population were higher in POP than in PAHP thus implying suitability of PAHP for nematode management in Maize production. Also, the quality protein maize variety (TZE QI 20) had better yield with minimal insect infestation and nematode infection under PAPH. Therefore, among other quality protein maize, TZE QI 20 is recommended for breeding programme considering its nutritive attribute, lowest insect infestation, lower nematode infection and high yield potential compared with local check, pambo.

References

Hussan, W.U., Haqqani, A.M. and Shafeeq, S. Knocking the doors of Balochistan for fodder crops production. *Agridigest - An in house J. ZTBL (Pakistan), 2003; 23: 24-30.*

Ibeawuchi, I. I, Matthews-Njoku, Edna; Ofor, Miriam O; Anyanwu, Chinyere P and Onyia; V. N. African Journal of Biotechnology, 2008; 3(4): 102-107.

Iken, J. E., and Amusa, N. A. Maize Research and Production in Nigeria. African J. Biotechnol., 2004; 3(6): 302-307. http://dx.doi.org/10.5897/AJB2004.000-2056

International Institute of Tropical Agriculture, Ibadan (IITA), Oyo State. Annual Report on Maize Production, 2001.

Oladejo, J.A. and Adetunji, M.O. Economic analysis of maize (*Zea mays* L.) production in Oyo state of Nigeria. Agricultural Science Research Journals, 2012; 2(2): 77-83, Available online http://www.resjournals.com/ARJ ISSN-L: 2026-6073 ©2012 International Research Journals

Vega, C.R.C., Andrade, F.H., and Sadras, V.O. Reproductive partitioning and seed set efficiency in soybean, sunflower and maize. Field Crops Res., 2001; 72: 165-173.

Effect of Different Organic Substrates on Reproductive Biology, Growth and Offtake of the African Night Crawler Earthworm (*Eudrilus eugeniae*)

Fred Kabi[1], Denis Kayima[1], Abasi Kigozi[1], Eric Zadok Mpingirika[2], Ronald Kayiwa and Dorothy Okello[3]

[1]Department of Agricultural Production, College of Agricultural and Environmental Sciences, Makerere University, P. O. Box, 7062, Kampala, Uganda.

[2]The American University in Cairo, New Campus: AUC Avenue, Department of Biology, P.O Box 74, New Cairo 11835, Egypt.

[3]Resilient Africa Network (RAN), Makerere University School of Public Health P.O. Box 7072, Kampala Uganda

Corresponding author:
fred.kabi@gmail.com

Keywords:
Clitellum, Cocoon initiation, Earthworm biomass, Hatchlings, Vermibeds, vermicomposting

Abstract

Rapid growth and high fecundity of Eudrilus eugeniae makes it a commercial vermicomposting agent. The worm is also a rich protein source (50-70%CP) in livestock diets. The major question, however, is how do we promote earthworm production as a strategy for ecological livestock intensification and integration with crops through earthworm domestication as a source of protein and vermicompost. Reproduction characteristics, growth and offtake of E. eugeniae were studied using four organic substrates including abattoir waste (AW), cattle manure (CM), soya bean crop residue (SBCR) and a mixture of cattle manure and soya bean crop residue (CM+SBCR) aged 15 days. Irrespective of the substrate, length and biomass of earthworms increased at a decreasing rate between the 1st and 8th weeks. Clitellum appearance was initiated at 31.5±2.4, 32.8±3.2, 33.7±3.3 and 35.5±2.4 days for AW, CM,CM+SBCR and BCR, respectively, while cocoon initiation was at 69.0±1.4 (AW), 54.9±2.3 (CM), 51.7±1.7 (CM+SBCR) and 60.0±2.4 (SBCR) days. Organic substrate used affected reproductive biology,

Introduction

That earthworms can reproduce parthenogenetically is not only surprising but that *E. eugeniae* is one of the fastest growing (280 mg/week) and productive tropical earthworm species when grown in animal organic waste is remarkable. With a sexual maturation time of 45 days, a life cycle of 60 days, a relatively high cocoon production rate (0.42 – 0.51), a short incubation time of 17 days, a high mean number of hatchlings per cocoon (2.7) and a mean body mass of 2100 mg (Viljoen and Reinecke, 1989; Lalander et al., 2015) makes *E. eugeniae* an ideal species for vermiculture. In order to design sustainable but intensive feeding programs based on earthworm meal as a substitute for the more expensive silver fish (*Rastrineobola argentea*) in poultry and fish diets, it is important to understand the reproductive biology, growth and offtake of the *E. eugeniae*. However, there is a paucity of information about the reproductive performance, growth and offtake of *E. eugeniae* when grown using different organic substrates and yet these parameters are crucial for mass production of earthworm. The objective of this study was, therefore, to assess effects of different organic substrates on reproductive biology, fecundity, longevity and offtake of *E. eugeniae* as an alternative source of livestock protein and vermicompost.

Material and methods

Study site and experimental design

Experiments to assess the effects of different organic substrates on reproductive biology, fecundity, longevity and offtake of the *E. eugeniae* earthworms were conducted at Makerere University Agricultural Research Institute Kabanyolo (MUARIK). The experiment consisted of four types of organic substrates used in three phases to culture *E. eugeniae* earthworms. Four types of test substrates namely cattle manure (CM), abattoir waste (AW) and soya-bean crop residue (SBCR) and a mixture (CM+SBCR) were used. In the first phase, a pair of clitellate worms was introduced into each of the digit and colour-coded buckets containing the respective test substrates. Ten replicates were made for each substrate making 40 experimental units. The second phase contained the same arrangements of 40 units with similar substrate replications into which the cocoons produced by worms from their respective substrate counterparts in phase one were incubated. The third phase consisted of the same arrangements of substrates as in phases one and two for raising hatchlings hatched from buckets in the second phase but with AW waste aged for 4 weeks.

Preparation of feeding material

Soya bean crop residue was obtained from the crop field at the study site; cattle manure mixed with urine was obtained from a local cattle farm at the study site while AW was obtained from a local abattoir. All the organic substrates were aged for 15 days for microbial composting and thermo-stabilization in phase 1 and 2. This was intended to expel toxic gases like ammonia and increase microbial population interaction. The moisture content of the beddings was maintained at 60 – 70 % by sprinkling with water regularly.

Source of Earthworms

Sexually mature adult earthworms (clitellate stage) of *E. eugeniae* were obtained from the earthworm production facility set up at MUARIK, which was maintained by regular feeding with aged cattle manure substrate collected from the study site. Pre-composted organic feeding material weighing 250 g were mixed with 500 g DM of soil and introduced into digit and colour-coded plastic buckets of 20 cm height, 28 cm diameter and covered with a mesh net for ventilation while excluding pests at the same time. Substrate to dark loam soil ratio of 1:2 for CM, SBCR, AW and a binary combination of (SBCR +CM) with the dark soil in the ratios of 1:1:4 on dry matter basis was used. A pair of randomly selected earthworms that were originally bred on cattle manure was then inoculated into each of the experimental buckets referred to as the vermibeds with different substrates. The earthworms in phase 1 were allowed a period of one week to acclimatize to their respective substrates into which they were initiated under dark and humid environment at room temperature.

Cocoon production data, hatchlings per cocoon, fecundity, growth rate of hatchlings, earthworm offtake were estimated according to Karmegam & Daniel (2000).

Chemical analysis

Physico-chemical composition of the substrates was determined at the soil science laboratory. The substrates were analysed for organic Carbon (C), total Nitrogen (N), total phosphorus (P), potassium (K), Carbon to Nitrogen ratio (C:N), pH and Cation exchange capacity (CEC).

Statistical analysis

Least square means for increase in biomass/worm/day, length/worm/day, cocoon production/worm/day, cocoon length, hatchling success, days to cocoon initiation, survivability, growth and offtake were analysed using a one-way ANOVA with SAS (2000). Probability of difference option of SAS was used to separate the means at $P < 0.05$.

Results

Physico-chemical characteristics differed ($P<0.05$) for all aged substrates used as growth media for culturing the earthworms except for calcium (Table 1). Growth rate was 17.7, 15.8, 15.6 and 14.3 mg/worm/day when earthworms were fed AW, CM+SBCR, CM and SBCR, respectively. Irrespective of the substrate, length and biomass of earthworms increased at a decreasing rate between the 1st and 11th weeks (Fig. 1). Clitellum appearance was initiated at 31.5±2.4, 32.8±3.2, 33.7±3.3 and 35.5±2.4 days for AW, CM, CM+SBCR and SBCR, respectively (Table 2), while cocoon initiation was at 69.0±1.4 (AW), 54.9±2.3 (CM), 51.7±1.7 (CM+SBCR) and 60.0±2.4 (SBCR) days (Table 3). Cocoon production rate (0.41 cocoons/worm/day) was highest ($P<0.05$) in earthworms fed CM+SBCR but abnormally lowest for AW. Cocoon incubation period ranged between 9 and 16 days for CM but was 11 to 16 days for SBCR and CM+SBCR. However, no sufficient cocoons were available for incubation from AW. Hatching success was 88%, 82% and 68% in CM, CM+SBCR and SBCR, respectively. Similarly, highest mean number of hatchlings per cocoon was 3.08±0.73 from CM. Consequently; earthworm offtake in CM, CM+SBCR, AW and SBCR was 86%, 78%, 70% and 62%, respectively.

Table 1. **Physiochemical composition of substrates**

Parameters	CM	AW	SBCR	CM:SBCR(1:1)	SEM	P Value
K (%)	1.8165^{a}	0.8148^{b}	0.4716^{b}	1.1066^{b}	0.174	0.011
Ca(%)	0.31	0.32	0.25	0.29	0.013	0.226
P (%)	0.41^{a}	0.24^{b}	0.13^{c}	0.25^{b}	0.031	<0.0001
pH	8.27	8.03	7.4	8.4		
CEC	24.33^{a}	21^{ab}	3^{c}	13.5^{b}	2.710	0.002
C (%)	31.7^{b}	45.7^{a}	30.0b	34.5b	2.3	0.03
N (%)	1.8^{a}	0.6^{b}	0.3^{b}	1.4^{a}	0.2	0.001
C:N	17.5^{c}	82.7^{b}	101.4^{a}	27.0^{c}	12.7	0.001

Table 2. **Effect of the different organic substrates on clitellum development in *Edrilus eugeniae* earthworms**

Treatments	Age(days)	Number of clitellates	% clitellate worms
Abattoir Waste (AW)	28	6	12
	29	10	20
	30	22	44
	31	26	52
	32	36	72
	33	41	82
	34	46	92
	35	50	100
	31.5±2.4		
Cattle Manure (CM)	27	3	6
	30	10	20
	31	20	40
	32	28	56
	33	35	70
	34	39	78
	35	45	90
	36	48	96
	37	50	100
	32.8±3.2		
Crop Residue (SBCR)	32	3	6
	33	16	32
	34	24	48
	35	27	54
	36	36	72
	37	38	76
	38	41	82
	39	50	100
	35.5±2.4		
Cattle Manure+Soya Bean Crop Residue	29	2	4
	30	12	24
	31	16	32
	32	18	36
	33	23	46
	34	32	64
	35	39	78
	36	43	86
	38	45	90
	39	50	100
	33.7±3.3		

Table 3. **Effect of different organic substrate on average weekly and daily cocoon production, time for cocoon initiation and cocoon average weight of *Eudrilus eugeniae* earthworms**

Variables	Treatments				SEM	P-Value
	AW	CM	SBCR	CM:SBCR		
Average cocoon production per worm per day	0.0007[c]	0.23[a]	0.15[a]	0.41[b]	0.1696	<0.001
Average weekly cocoon production	0.005[c]	1.625[a]	1.045[a]	2.870[b]	0.18656	<0.001
Time for cocoon initiation	69.0[a]	54.9[c]	60.8[b]	51.7[d]	1.1085	<0.001
Cocoon Average weight (mg)	-	15.8[a]	11.6[b]	14.6[a]	0.42885	<0.001

**CM= cattle manure; AW= abattoir waste; SBCR= soya bean crop residue; CM and SCBR= a mixture of CM and SBCR in the ratio of 1:1 w/w*)

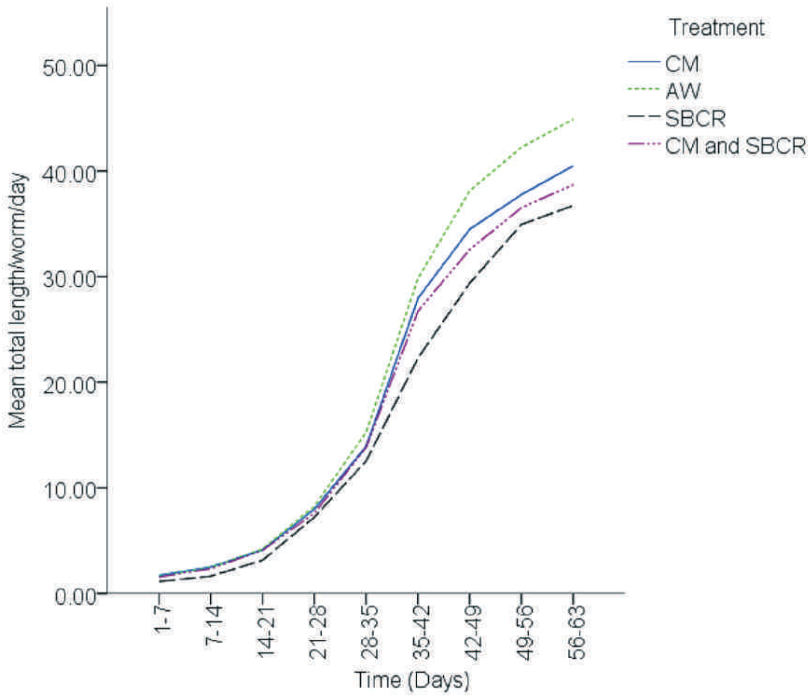


Figure 1: **Growth (length) of *E. eugeniae* cultured on different organic substrates (CM= cattle manure; SBCR= soya bean crop residue; CM and SCBR= a mixture of CM and SBCR in the ratio of 1:1 w/w) for a period of 9weeks**

Discussion

Rate of cocoon production, cocoon initiation and cocoon weight as influenced by substrate type are related to cocoon production efficiencies of *E. eugeniae* as it interacts with the physco-chemical properties of the substrate. While the binary combination of CM+SBCR resulted into cocoon production rate of 0.41/earthworm /day similar to earlier values of 0.42 -0.51 cocoons/earthworm /day (Viljoen and Reinecke 1989), lower values of 0.15 and 0.23 cocoons/earthworm/day were observed in SBCR and CM manure, respectively. Increase in biomass at a rate of 17.7 mg/worm/day was highest in AW aged for four weeks, followed by CM, CM + SBCR and least in SBCR. Similar trends were also observed for increase in earthworm length. Higher rate of increase in length of earthworms in AW may mean that if well aged, the substrate has some unidentified growth factors that favour rapid growth rate but with delayed stimulation of reproduction in *E. eugeniae*.

Acknowledgments

The Makerere University School of Public Health's Resilient Africa Network (RAN) and Partners supported this work. This was made possible by the generous support of the American people, through the United States Agency for International Development (USAID) - [Project ID AID-OAA-A-13-00018]. The contents of this work are solely the responsibility of the authors and do not necessarily represent the official views of the supporting organizations.

References

Karmegam N,Daniel T (2000) Growth, reproductive biology and life cycle of the vermicomposting earthworms, Perionyx ceylanensis Mich. (Oligochaeta: Megascolecidae). Bioresource Technology 100:4790-4796.

Lalander CH, Komakech AJ, Vinnerås, B (2015) Vermicomposting as manure management strategy for urban small-holder farms – Kampala case study. Waste Management, 39, 96 -103.

Viljoen SA, Reinecke AJ(1989). Life cycle of the African night crawler, *Eudrilus eugeniae* (Oligochaeta). *S. Afr. J. Zool*, *24*(1), 27-32.

Ecological Agriculture as an Integral part of Permaculture

Paul Yeboah

Ghana Permaculture Institute,
Box TM 390,
Techiman – Brong Ahafo
Region, Ghana

Corresponding author:
permacultureghana@gmail.com

Keywords:
Ecological agriculture,
permaculture, process,
farming

Abstract

Ecological agriculture is an integral part of permaculture. Permaculture refers to "permanent agriculture" but has not been expanded to mean "permanent culture" as it embraces the social aspects that focus on truly sustainable system. Permaculture also focuses on ecological method of design that shapes many practices, including farming. Permaculture is associated positively with ecosystem mimicry, perennial polycultures, agroforestry, agroecosystem design, and agrobiodiversity. Ecological agriculture is truly sustainable – it can regenerate and fertilize the degraded and damaged agricultural soils that cover most of the world, and will allow us to continue producing food on that land indefinitely. Conventional agriculture degrades and depletes the soil, and so cannot continue to feed us, and the "progress" made in agriculture in the last decades has come at an enormous environmental and social cost. Ecological agriculture also has the potential to offer higher economic returns than conventional or industrial agriculture as it gives a combined and continual yield from land, instead of one or two big monoculture harvests per year. And it is much more efficient in energy and financial terms when we consider the cost and embodied energy of conventional farming's chemical inputs. Ecological agriculture gives us a much better output for our input. This review discusses ecological agriculture as an integral part of permaculture in the light of organic agriculture.

Ecological Agriculture and Permaculture

Ecological agriculture is an integral part of permaculture. Permaculture's emphasis on whole systems design is heavily influenced by the work of ecologist H.T. Odum (Holmgren, 1992).

The Permaculture Concept

Permaculture refers to "permanent agriculture" (Paul 2011) but has not been expanded to mean "permanent culture" as it embraces the social aspects that focus on truly sustainable system. Permaculture also focuses on ecological method of design that shapes many practices, including farming. Permaculture is associated positively with ecosystem mimicry, perennial polycultures, agroforestry, agroecosystem design, and agrobiodiversity (Francis and Porter 2011).

Permaculture is a design system that aims to create stable, agricultural productive systems that provide for human needs, harmoniously integrating the land with the people not only for today but also into the future. It is a holistic approach that goes beyond simple food production and encourages us to work with every aspect of life with an ethical base of Earth Care, People Care and Fair Share (Holmgren, 2002). A well designed functional Permaculture System can restore degraded land and landscapes using simple low cost strategies such as earthworks, rainwater harvesting, appropriate and mixed planting, composting and much more. The ecological and biological processes of the land, plants, animals, nutrient cycles, climatic factors, and weather cycles are all examined and incorporated into productive, functional Permaculture Systems. Elements in each system are viewed in relation to each other, and the outputs of one element become the input of another. Inhabitants' needs are provided for through proven technologies for food, energy, shelter, and infrastructure. Within Permaculture Systems, work is minimized, "wastes" become resources, productivity and yields increase, and the environment is restored.

Permaculture is a major tool for earth restoration and care of people. The result is productive, stable communities with functional, agriculturally productive ecosystems, which have the diversity, stability, and resilience of natural ecosystems. Ecological agriculture means growing food in diverse systems that are 100% organic (chemical free) and which do not use monocultures. They build and maintain soil fertility through maintaining the right mix of plant species (including nitrogen fixers) on the land all year round and make more use of multifunctional trees and other perennial plants. Any fertilisers or sprays are made from plant materials, such as compost teas or neem insect repellent. It is natural-system-based farming.

Ecological agriculture is truly sustainable – it can regenerate and fertilize the degraded and damaged agricultural soils that cover most of the world, and will allow us to continue producing food on that land indefinitely. Conventional agriculture degrades and depletes the soil, and so cannot continue to feed us, and the "progress" made in agriculture in the last decades has come at an enormous environmental and social cost.

Ecological agriculture also have the potential to offer higher economic returns than conventional or industrial agriculture as it gives a combined and continual yield from land, instead of one or two big monoculture harvests per year. And it is much more efficient in energy and financial terms when we consider the cost and embodied energy of conventional farming's chemical inputs. Ecological agriculture gives us a much better output for our input.

Evidence to Act

Our earth's ecosystems are in crisis. Healthy ecosystems are fundamental to successful, sustainable businesses and vibrant social communities. Indeed, people's health and well-being are intricately linked with the earth's health and well-being. These issues need to be addressed as one. The greatest problem in Africa is poverty, as seventy per cent of the people are living below the poverty line. Many youths and women have remained unemployed for years and are fast losing any hope of getting out of the trap of poverty. The situation needs immediate reversal in the form of capacity-building and the creation of employment. This widespread poverty also traps people in environmentally destructive systems, as they lack access and means to other knowledge and possibilities. Through no fault of theirs, the people continue using their land and local ecosystems in ways that further degrade them. Strict legislations that prevent poor people from accessing the resources in their communities without offering them alternatives have also brought futile outcomes as the lives of this resource poor communities is tied to the biodiversity resources around them.

Thus, adopting the ecological approach to farming will lead to ecological balance, where resources are utilised sustainably by the current generation and posterity is the way to go. The collapsing of soil systems, ecosystems and biodiversity has huge impact on the climate change affecting everyone negatively; permaculture have proven solutions to meet these challenges (Veteto and Joshua, 2008). Rhodes (2012) confirms that, permaculture has "a low-impact method which uses perennial cultivation methods to produce food crops in harmony with nature".

References

Francis, C.A and Porter, P. (2011): Ecology in sustainable agriculture practices and systems. Critical Reviews in Plant Sciences 30:64–73. doi:10.1080/07352689.2011.554353

Holmgren, D. (2002). Permaculture: Principles & Pathways Beyond Sustainability. Holmgren Design Services. p. 1. ISBN 0-646-41844-0.

Paull, J. (2011): The making of an agricultural classic: Farmers of Forty Centuries or Permanent Agriculture in China, Korea and Japan, 1911-2011, Agricultural Sciences, 2 (3), pp. 175-180.

Rhodes, C.J. (2012): Feeding and healing the world: through regenerative agriculture and permaculture. *Science Progress*, 95(4):345.

Veteto, J.R. and Joshua L. (2008): Environmental Anthropology Engaging Permaculture: Moving Theory and Practice Toward Sustainability. *Journal of Culture and Agriculture*, 30(1-2): 47–58.

Determination of Pesticide Residues in Organic and Conventional Exotic Vegetables

Kenyanya Teresa Mogoi,
Wilkister Nyaora Moturi,
Jane Nyaanga,
Joseph Kinyoro Macharia
and Rhoda Jerop Birech

Department of Environmental Science, Egerton University, Kenya

Corresponding author:
tkmogoi@gmail.com

Keywords:
Pesticide residues, Vegetables, Cypermethrin, Lambda-cyhalothrin

Abstract

There have been concerns over indiscriminate use of pesticides by farmers to grow vegetables especially for local markets since there are no guidelines on Maximum residue levels. This study was done to determine the concentration of cypermethrin and lambda-cyhalothrin pesticide residues in Collard (Brassica oleracea var. acephala) Tomatoes (Solanum lycopersicum) and swiss chard (Beta vulgaris subsp. cicla). The samples included both organic and conventional vegetables that use chemical pesticides. Experimental study design was used which involved laboratory analysis of the samples. Sample extraction was done using AOAC official method 2007.01 known as Quick, Easy, Cheap, Effective, Rugged and Safe (QuEChERS) method. The method involves use of Acetonitrile, sodium chloride and anhydrous magnesium sulphate for extraction. Clean-up was done using dispersive-solid phase extraction method using Primary-Secondary Amine and anhydrous magnesium sulphate. Residues analysis was done using Reverse-phase High Performance Liquid chromatography. Peak areas of the curves were calculated using Motic Images plus 2.0 and data analysis was done using SPSS 22. Recovery rates of pesticide ranged from 87.78% to 97.93% for cypermethrin and 90.65% to 95.72% for lambda-cyhalothrin. The results indicated that organic vegetable samples had pesticide residues below detectable levels while conventional vegetable samples had levels ranging from 2.495mg/kg to 0.238mg/kg for cypermethrin and 0.352mg/kg to 0.119mg/kg for lambda-cyhalothrin. The residues of both pesticides were above the recommended, this is likely to cause negative health effects such as uncoordination, whole-body tremors and seizures. This indicates that conventional vegetable consumers are exposed to pesticide residues. Farmers should strictly adhere to good agricultural practice to reduce pesticide residues.

Introduction

Pests and plant diseases have been a problem to vegetable farmers and a threat to food security globally as they destroy crops and reduce yields hence financial losses. Pests are organisms that feed on plants as a source of food (Ata *et al*., 2013). Pests can be carriers of plant pathogens which also exist in soil. Farmers use pesticides to control the pests and plant diseases. Pesticides have been in use since early years by Sumerians where they used compounds of sulphur to control mites and insects 4500 years ago. They also used mercury, lead, zinc and arsenical compounds to grow vegetables and fruits (Unsworth, 2010). Before the invention of chemical industries, most pesticides were derivatives of plants and animals (Fishel, 2013).

Chemical pesticides are widely used globally as they are perceived to be more effective and relatively cheap. Kenya being a country that widely relies on agriculture, there is widespread use of chemical pesticides to control plant diseases and pests. This is in effort to improve yield and produce blemish-free products. Emergence of new diseases and pests has led to the need of better pesticides to counter this problem. Farmers are encouraged to embrace new methods of controlling plant diseases and pests such as integrated pest management to reduce reliance on chemical pesticides. Despite this effort, use of chemical pesticides is still wide spread in the country.

Most chemical pesticides cause negative health effects to human beings especially if exposed to high doses. They can affect the respiratory system, nervous system and interfere with the function of cell membrane of target and non-target organisms (Corbett, 1974). For this reason, it is important to prevent excessive exposure of humans to pesticides. Occupational exposure to these pesticides can be controlled by educating the handlers on use of protective equipment during usage. Dietary exposure to pesticides through residues can also be controlled by ensuring that farmers adhere to good agricultural practices, practicing organic agriculture and complying with the recommended maximum residue levels (MRLs).

The objective for this study was to determine the concentration of pesticide residues in locally consumed vegetables. The hypothesis was that pesticide residues in locally consumed vegetables were above the recommended Maximum residue Levels.

Materials and Methods

Study Areas

Nakuru town and parts of Nairobi were the study areas included in the study. Three open air markets in Nakuru town were selected, they included, Soko-mjinga, Ponda-mali and Main Municipal Markets for conventional vegetables. Kalimoni Greens, Carre four supermarket and Karen Organic Market located in Nairobi for organic vegetables also included in the study. The two study areas were chosen since they had similarities in pesticide use.

Sampling of vegetables for analysis

The vegetables included in the study were Collard greens (*Brassica oleracea var. acephala*), Tomatoes (*Solanum lycopersicum*) and Swiss chard (*Beta vulgaris subsp. cicla*). The samples included both conventional and organically grown vegetables. The vegetables were randomly sampled and were bought in triplicates. They were packaged in polythene bags, labelled and stored at temperatures below $5^{\circ}C$ for transportation to the laboratory.

Extraction of Pesticide residues from vegetables

Quick, Easy, Cheap, Effective, Rugged and Safe Method also known as the QuEChERS was used in the analysis of pesticide residues (Anastassiades *et al.,* 2003). This method is also registered as AOAC 2007.01 official method for pesticide residue analysis. Triplicates of vegetable samples were chopped and shredded in a blender to obtain a homogeneous composite sample. 10g of the homogenized sample was weighed into 50mL Teflon centrifuge tube. 10mL of MeCN was added using a dispenser (pipet), and the sample was vigorously shaken for 1min using a Vortex mixer at maximum speed. 4 g anhydrous $MgSO_4$ and 2g NaCl was added and mixed immediately on a Vortex mixer for 1 min. This was done immediately to prevent formation of $MgSO_4$ conglomerates. 40 mL Internal standard solution was added, mixed on a vortex mixer for another 30 s, and extract was centrifuged for approximately 5 min at 5000 rpm. 1 mL aliquot of upper MeCN layer was transfered into 1.5 mL microcentrifuge test tube containing 25 mg PSA sorbent and 150 mg anhydrous $MgSO_4$ and capped. The mixture was then shaken with Vortex mixer for 30 s. Extracts were centrifuged for 1 min at 6000 rpm to separate solids from solution, and 0.5 mL of extract was transferred to HPLC analysis.

High performance liquid chromatography machine Waters 600 Controller model was used for analysis. The machine was connected to a detector Waters 484 Tunable Absorbance Detector model.

Acetonitrile and water were used as mobile phase in a ratio of 80:20 v/v respectively. The column (LiChrospher® 100 Rp-18, 5µm) was at room temperature while the flow rate was 1ml/min. The wavelength of the detector was set at 205nm with a sensitivity of 0.5. 20µL of extract was injected into the HPLC machine for analysis using a micro-syringe.

Data Analysis

Peak areas were calculated using Motic Images plus 2.0. The formula used was; Peak area=concentration of pesticide residues. The data was then transferred to Microsoft Excel for more analysis.

Results

Recovery Assays

Fresh vegetable samples (Collard greens, tomatoes and swiss chard) were gotten from a home vegetable garden that has never been sprayed with pesticides. They were used in testing the recovery rates of the pesticides using the QuEChERS method. The samples were first analysed to ascertain that they really had no pesticide residues since the farmers do not use chemical pesticides. The vegetables were spiked with known concentration of pesticide standards. Extraction of pesticide was done using the procedure and analysed to determine the recovery rate. This was done in triplicates for the three types of vegetables. The results of the recovery percentages from the vegetables were as indicated in Table 1.

Table 1. **Mean Recovery rates of pesticides**

Vegetables	Cypermethrin (% Mean±SD)	Lambda-Cyhalothrin (% Mean±SD)
Collard greens	95.7±0.01	91.97±0.019
Tomatoes	87.78±0.014	90.65±0.049
Swiss chard	97.93±0.006	95.72±0.023

Concentration of lambda-cyhalothrin and Cypermethrin in vegetables

Table 2. **Concentration of Cypermethrin and Lambda-Cyhalothrin residues**

Markets	Vegetables	Cypermethrin (Mean±SD)mg/kg	Lambda-cyhalothrin (Mean±SD)mg/kg
Soko-mjinga	Collard greens	1.397±0.478	0.262±0.108
Ponda-mali	Collard greens	0.982±0.265	0.341±0.164
Main Municipal Market	Collard greens	0.238±0.132	0.219±0.427
Kalimoni Greens	Collard greens	B.D.L	B.D.L
Carre Four	Collard greens	B.D.L	B.D.L
Karen Organics	Collard greens	B.D.L	B.D.L
Soko-mjinga	Swiss chard	2.458±0.298	0.352±0.193
Ponda-mali	Swiss chard	2.495±0.109	0.24±0.045
Main Municipal Market	Swiss chard	1.462±0.239	0.28±0.365
Kalimoni Greens	Swiss chard	B.D.L	B.D.L
Carre Four	Swiss chard	B.D.L	B.D.L
Karen Organics	Swiss chard	B.D.L	B.D.L
Soko-mjinga	Tomatoes	0.232±0.085	0.081±0.037
Ponda-mali	Tomatoes	0.296±0.076	0.046±0.049
Main Municipal Market	Tomatoes	0.401±0.052	0.119±0.052
Kalimoni Greens	Tomatoes	B.D.L	B.D.L
Carre Four	Tomatoes	B.D.L	B.D.L
Karen Organics	Tomatoes	B.D.L	B.D.L

Generally, the results indicated that the concentration of pesticide residues in all organically grown vegetable samples were below detectable levels while conventional vegetable samples had pesticide residues as shown in table 2. The concentration of cypermethrin residues was higher in all conventional vegetable samples than lambda-cyhalothrin. The concentration of cypermethrin in conventional composite vegetable samples ranged between 0.232 and 2.495 mg/kg with a mean of 1.107±0.912 mg/kg. On the other hand, the concentration of lambda-cyhalothrin ranged between 0.046 and 0.352mg/kg with a mean of 0.216±0.11 mg/kg.

It was also noted that swiss chard had the highest concentration of pesticide residues among all the vegetables. The concentration of pesticide residues in swiss chard ranged between 1.462 and 2.495 mg/kg for cypermethrin and between 0.352 and 0.24 mg/kg for lambda-cyhalothrin. On the other hand, tomatoes had the lowest residues of both pesticides which ranged between 0.232 and 0.401 mg/kg for cypermethrin and between 0.046 and 0.119 mg/kg for lambda-cyhalothrin.

Discussion

The concentration of pesticide residues in all organic vegetable samples were below detectable levels. This hence confirms that farmers practicing organic agriculture adhere to the principles of organic agriculture which discourages use of chemical pesticides. Hence organic produce are safer since during analysis, there were no peaks produced to indicate that there were other detectable pesticides.

The concentration of Lambda-cyhalothrin in conventional vegetable samples were lower than Cypermethrin. This is because farmers may be spraying more Cypermethrin oftenly than labda-cyhalothrin. The low residue concentration of lambda-cyhalothrin can also be attributed to its shorter half-life compared to Cypermethrin. This means that it degrades faster in the vegetables or on the surface than Cypermethrin hence the low concentration in them.

The maximum residue levels for Cypermethrin in collards, swiss chard and tomatoes are 1mg/kg, 2mg/kg and 0.2mg/kg respectively (FAO/WHO, 2009). Collard greens from Soko-mjinga (1.397±0.478mg/kg), swiss chard from Soko-mjinga (2.458±0.298mg/kg) and Ponda-mali (2.495±0.609mg/kg) and tomatoes from all the three markets exceeded the recommended level. Swiss chard from the two markets were 1.229 and 1.248 times higher than the recommended level respectively. Tomatoes from Soko-mjinga, Ponda-mali and Main Municipal Market markets had residues levels that were 1.16, 1.48 and 2.005 times higher the recommended level respectively.

The recommended residues levels for Lambda-Cyhalothrin is 0.3mg/kg in the vegetables (FAO/WHO, 2009). Collard greens from Ponda-mali (0.341±0.164mg/kg) and swiss chard from Soko-mjinga (0.352±0.193mg/kg) exceeded the recommended levels. This shows that consumers are likely to suffer negative chronic health effects due to exposure to the pesticide. Tomatoes from Soko-mjinga and Ponda-mali had the least residue levels of 0.081±0.037 and 0.046±0.049 respectively. This is 3.703 and 6.522 times lower than the recommended residue level respectively.

Conventionally grown Swiss chard had the highest concentration of both pesticides than collard greens and tomatoes. This is because, swiss chard plants are shorter than collard green plants hence if intercropped, the leaves hence less sunlight reaches swiss chard leaves. This reduces the rate of photodegradation of pesticides on its leaves. In addition, swiss chard leaves are dull and wrinkled compared to collard green leaves that are shiny and smooth. This makes it difficult for pesticides to wash off from swiss chard leaves even when it rains. On the other hand, conventional tomato fruits hand the lowest concentration of both pesticides. This can be attributed to its smooth surface that makes it easy to wash off the pesticides when it rains. In addition, farmers use less of the two pesticides on tomatoes since during analysis, other pesticides that were not of interest had higher peaks.

Exposure to high doses of synthetic Pyrethroids such as Lambda-cyhalothrin and Cypermethrin affect the nervous system. This is because they act on sodium channels of nerve cell axons leading to hyperexcitation (Macan *et al.,* 2006 & Bradberry *et al.,* 2005). Other health effects include uncoordination, whole-body tremors, chloreoathetosis and seizures (Ray *et al*., 2000).

In conclusion, organic vegetable samples are safer than conventionally grown vegetables as the concentration of pesticide residues were below detectable levels. Consumers of conventional vegetables are exposed to pesticide residues which can cause negative health effects.

It is recommended that farmers should be encouraged to practice organic agriculture to safeguard their health as well as those of consumers as it reduces exposures to pesticides.

Acknowledgement

We would like to acknowledge Egerton University Alumni Association and Ecological Organic Agriculture Initiative, Egerton University for their support.

References

Anastassiades M. & Lehotay S. J. (2003). Fast and Easy Multiresidue Method Employing Acetonitrile Extraction/Partitioning and "Dispersive Solid-Phase Extraction" for the determination of Pesticide residues in Produce. *Journal of AOAC International* 86(2).

Ata, S., Wattoo, F. H., Feroz, M., Wattoo, M. H. S., Tirmiz, A. S., Wadood, A. & Gulfraz, M. (2013). Analytical investigation of selected pesticide residues from fruits and vegetables by improved extraction method using reverse phase high performance liquid chromatography. *Pakistan Journal of Biochemistry and Molecular Biology*, 46(1):1-4.

Bradberry S.M., Cage S.A. Proudfoot A.T. & Vale J.A. (2005). Poisoning due to Pyrethroids. *Toxicol Rev*. 2005;24(2):93-106.

Corbett J.R.(1974). Mode of action of pesticides. In 'The biochemical mode of action of pesticides'. Academic press, 23-24

FAO&WHO, (2006). *Chapter 8; Updating the Principles and Methods of Risk Assessment: Maximum Residue Levels (MRLs) for pesticides and Veterinary drugs.*

Fishel, F. M., (2013). Management and pesticides: A historical perspective. *University of Florida.*

Hossain, M.S., Fakhruddin, A.N.M., Chowdhury, A.Z.M., Rahman, M.A. &Alam K.M. (2015). Health risk assessment of selected pesticide residues in locally produced vegetables of Bangladesh. *International Food Research journal* 22(1): 110-115.

Macan J., Varnal V.M. & Turk R. (2006). Health effects of pyrethrins and Pyrethroids. *Arh Hig Rada Toksikol.* 57(2):237-243.

Malhat, F., Loutfy, N.M. & Ahmed, M.T. (2016). Dissipation pattern and risk assessment of the synthetic pyrethroid lambda-cyhalothrin applied on tomatoes under dryland conditions, a case study. *International Journal of Food Contamination,* 3(2016):8.

Ray D.E., Ray D. & Forshaw P. J. (2000). Pyrethroid Insecticides: Poisoning Syndromes, Synergies and Therapy. Journal of toxicology: Clinical Toxicology. 38(2):95-101.

Unsworth, J., (2010). *History of pesticide use. International Union of Pure and applied chemistry.*

Improving Yield of *Corchorus olitorus L.* with legacy fertility of Jackbean Fallow and Compost amendments in an Organic Production System

AdeOluwa O.O.,
Oyewole, O.M. and
Soetan, G. O

Department of Agronomy,
Faculty of Agriculture,
University of Ibadan,
Ibadan, Nigeria

Corresponding author:
adeoluwaoo@yahoo.com

Keywords:
Compost, soil fertility, organic, *Corcohrusolitorus,* Jack bean

Abstract

Ability of applied soil fertilizer to sustain crop production beyond a cropping season is an advantage to farmers, especially resource-constrained organic farmers who cannot afford repeated application of synthetic fertilizers. Thus, this report presents evaluation of legacy soil fertility (residual) influence of previous Jack bean-fallow and a commercial compost application on the yield of corchorus in an organic production system in two cropping seasons of 2014. The experiment was conducted at the Organic Vegetable Garden of Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. Corchorus seeds were sown in plots of Brewery Waste Compost grades A and B, Brewery Waste Compost grade A + Jack bean residual fertility, Brewery Waste Compost grade B + Jack bean residual fertility, Jack bean residual and Control (no soil additive). The experiment was laid out in a Randomized Complete Block Design (RBCD) replicated four times. Data collected were subjected to statistical analysis of variance using GENSTAT edition 5 and means were separated using least significant difference (LSD) at (p≤ 0.05). In the first season, Brewery Compost Grade B resulted into the highest dry weight of corchorus (1.93 t/ha) which was not significantly higher than that of combination of Brewery Compost Grade A+ Jack bean (1.84 t/ha), while Brewery Compost Grade A+Jack bean (2.21 t/ha) resulted into highest dry matter yield in the second cropping. Thus, it could be concluded that combination of Brewery Compost Grade A + Jack bean could be used for producing corchorus by resource constraint farmers who may not be able to apply additional fertilizer in second cropping.

Introduction

Poor soil fertility as a result of unsustainable agricultural practices is one of the major threats to agricultural productivity and food security in the smallholder farming systems in the tropics (Sanchez and Leakey, 1997). Each year, tropical soils' finite capacity to grow food and fibre has progressively decreased, largely because of the decline in soil fertility (Adeoye *et al*., 2009). Therefore, the management of the soil in order to prevent further degradation and soil productivity is imperative. Legumes can play an important role in management of soil fertility for vegetable production, especially in tropics where low native fertility is a major constraint to crop production. In the same vein, composts are widely used as soil amendments to improve soil structure, provide plant nutrients and facilitate the re-vegetation of disturbed soils (Bradys and Weil, 2002). However, the use of either leguminous crops or compost for soil fertility purpose in organic farms has financial implications which most resource constraint farmers may not be able to adopt at all times. Thus, there is a need to investigate the influence of legacy (residual) soil fertility as influenced by the previously applied fertilizers for crop production.

While most farmers are familiar with improving crop yields with application of fertilizers, there is a dearth of information on the influence of residual (legacy) fertility of previously applied fertilizers on subsequent crops. Legacy soil fertility (Güerena *et al.,* 2016) is very important for resource constraint farmers who may not have the capability of applying fertilizers to soils frequently.

Jack bean (*Canavaliaensiformis*) is a legume cover crop that is an efficient, low-cost source of nitrogen with considerable potential to improve soil fertility in intensified cropping systems (Carsky *et al.,* 1998). *Corchorus olitorus* also is a leafy vegetable consumed many parts of West Africa, Asia and in the Middle East (Akoroda and Akinlabi, 1987). Thus, investigating the influence of legacy fertility of compost-Jackbean on yield of corchorus is imperative.

Materials and methods

The experiments were conducted at the Organic Vegetable Garden Teaching and Research Farm, University of Ibadan, Nigeria. It is located in the derived savannah South-west Nigeria which lies between latitude 7°24'N and longitude 3°54'E with elevation of 62m above sea level. The mean monthly temperature ranges between 24°C and 30°C and the mean annual rainfall ranges between 1800 mm to 2100 mm.

This investigation was based on legacy fertility (residual) effects of the treatments previously applied which were Brewery Waste Compost grades A and B, Brewery Waste Compost grade A +Jack bean residual fertility, Brewery Waste Compost grade B + Jack bean residual fertility, Jack bean residual and Control (no soil additive). In previous experiment, composts were applied at the rate of 100 kg N/ha in an inter-crop of Jackbean and corchorus with resultant yields of corchorus under compost grade B (31.24t/ha^{-1})> grade A (26.80t/ha^{-1}) > grade B + Jack-bean > and compost grade A + Jack-bean. Thus, no fertilizer was applied during the reported investigation. Pre-cropping soil analysis was carried out using chemical standard procedures. The experiment was laid out in a Randomized Complete Block Design (RBCD) replicated four times having a total land area of 166.4m^2 with 24 beds of 1.5m x 1m each. The soil texture ranged from sandy to loamy sand which is slightly acidic. The residual effect of the soil amendment is being evaluated on yield of *Corchorus olitorious*.

Corchorus seeds were sown in March and July 2014, respectively for first and second planting on different plots, using drill method with spacing of 0.3m inter-row and 0.5m inter-bed spacing. The plants were thinned to an average of 270 plants/ bed which equate to an average population of 1.8 million plants/ hectare. The dry weight was obtained after five weeks sowing by destructive sampling offive representative plants on each bed in an oven of temperature 65°C until constant weights. Plant yield data were subjected to statistical analysis of variance using GENSTAT edition 5 and means were separated using least significant difference (LSD) at ($p \leq 0.05$).

Results

Tables 1 and 2 show the pre-planting chemical properties for both planting cycles. The result show that soil pH range of the first planting was moderately acidic (5.9 - 6.1) while that of the second plots was slightly acidic to moderately acidic (5.6 - 5.7). The Organic carbon across the two planting cycles ranged 3.2 - 4.9 g/kg, which was below the critical range (20 g/kg) according to FFD, (2002). The pre-planting total nitrogen content of all the plots was low (0.1-0.2 g/kg) according to FFD, (2002). Available phosphorus was very high in the dry season (43-50 mg/kg), but low during the second planting (14 -26 mg/kg) this may be due to leaching and fixation (Mengel and Kirkby, 2001). Potassium was very high (6.2 cmol/kg) in the control plot in the dry season compared to the amended soils. It was however, high in the rainy season (5.1-7.6 cmol/kg).

In the first season, Brewery Compost Grade B application resulted in the highest dry weight of corchorus (1.93 t/ha) which was not significantly higher than that of combination of Brewery Compost

Grade A+ Jack bean (1.84 t/ha) and Brewery Compost Grade B + Jack bean (1.67 t/ha). Brewery Compost Grade A had the lowest dry weight of 1.24 t/ha and it performed lower than Jack bean (1.42 t/ha) and control (1.51 t/ha) at the end of the first planting. At the end of the second planting, the highest dry weight was produced by soils treated with Brewery Compost Grade A+Jack bean(2.21 t/ha), followed bycontrol (1.99 t/ha), with the least from Jackbean fallow.

Table 1. **Influence of soil fertility methods on legacy chemical properties of the experimental soil at first planting**

Treatments	pH(H_2O)	Organic C g/kg	Total N g/kg	Avail. P mg/kg	Ca cmol/kg	Mg	K
Control	6.1	4.9	0.1	50	5.1	0.1	0.1
BCGA+Jb	6.1	3.9	0.1	43	3.8	0.1	0.1
BCGB+Jb	6.0	3.7	0.2	49	4.3	0.1	0.1
BCGA	5.9	3.2	0.1	47	2.1	0.1	0.1
BCGB	6.0	3.2	0.1	45	2.9	0.1	0.1
JB	6.0	4.9	0.2	46	3.0	0.1	0.1
MEAN	6.0	3.9	0.1	46	3.5	0.1	0.1
SD	0.1	0.6	0.1	2.7	1.1	0.1	0.1

Table 2. **Influence of soil fertility methods on legacy chemical properties of the experimental soil at second planting**

Treatments	pH(H_2O)	Organic C g/kg	Total N g/kg	Avail. P mg/kg	Ca cmol/kg	Mg	K
Control	5.7	3.5	0.2	26	3.0	1.3	0.2
BCGA+Jb	5.6	3.4	0.2	23	1.7	1.3	0.1
BCGB+Jb	5.6	3.3	0.2	23	1.6	3.5	0.1
BCGA	5.6	3.4	0.2	14	2.4	1.5	0.1
BCGB	5.7	3.2	0.2	21	1.8	1.9	0.1
JB	5.6	4.0	0.2	26	2.1	1.2	0.1
MEAN	5.6	3.5	0.2	22	2.1	383	6.8
SD	0.1	0.3	0.2	4.4	0.6	24.9	1.0

Legend
BCGA - BREWERY COMPOST GRADE A
BCGB - BREWERY COMPOST GRADE B
JB- Jack bean
SD- standard deviation

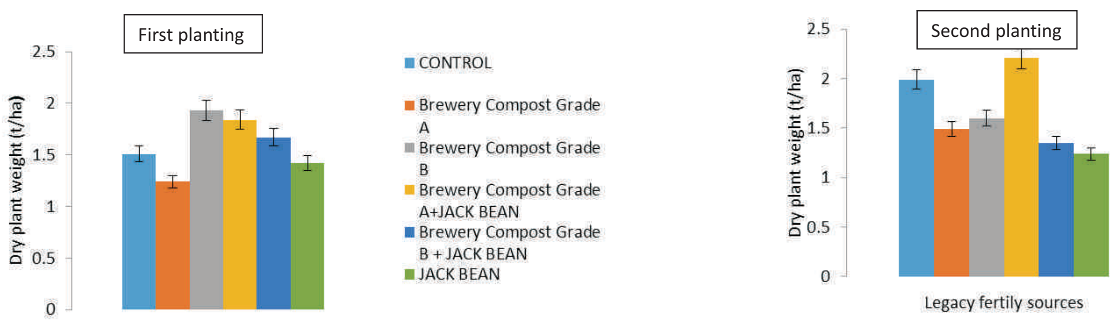


Figure 1. **Dry yield of corchorus at 5 weeks after sowing as influenced by different legacy fertility sources**

Discussion

Despite the fact that the experimental soils have been previously used to raise corchorus, low soil nitrogen and no other form of fertilizers were supplied, the dry plant yields obtained from all the treatments were higher than the range of 0.66 – 1.34 t/ha reported by Adediran *et al.* (2015). The better legacy soil fertility effect of the combination of Brewery Compost grade B and Jack bean implied that the combination of this compost and Jackbean (a legume) increased yield of *Corchorus olitorus* L. when compared with control of no previous soil additive. This is in consonance with the report of AdeOluwa and Bello*,* 2017 and Abedi*et al.,*2010 where residual effects of organic nitrogen fortifiers and composts produced high yield of *Amranthus caudatus* and wheat, respectively. Olanikan (2006) reported that organic fertilizers increased organic matter status of the soil and enhanced crop production; it could have resulted into the significant difference observed in the dry yield of corchorus. Tanimu *et al,* (2007) also reported that forage leguminous fallow increased the yield of maize when compared to control. All these align with the fact that organic fertilizers and leguminous crop could improve soil nutrients, thereby increasing the yield of crop.

Conclusion

The result of this investigation revealed that the legacy soil fertility from combination of Brewery Compost grade B and Jackbean could increase the yield of corchorus, hence recommended as an alternative soil fertility measure for organic corchorus production.

References

Abedi T, Alemzadeh A, Kazemelni S. A (2010). Effect of organic and inorganic fertilizers on grain yield and protein banding pattern of wheat. Australia Journal of Cropscience4:384-389.

Adediran, O. A., H. Ibrahim, K. D. Tolorunse and U. I. Gana (2015).Growth, Yield and Quality of Jute Mallow (*Corchorus olitorius* L.) as Affected by Different Nutrient Sources. International Journal of Agriculture Innovations and Research Volume 3, Issue 5, ISSN (Online) 2319-1473.

AdeOluwa, O.O. and Bello, A. (2017).Influence of velvet bean fallow and compost amendments on amaranths (A*maranthuscaudatus*) yield and soil properties in an organic cropping system. *Nigerian Journal of Soil Science Vol.27*.53 – 62.

Akoroda, M.O. & O.A. Akinlabi, (1987). Seed Production in Corchorus olitorius. Acta Horticulture, 123:231- 236.

Bradys, N C and Weil, R.R. (2002).The nature and properties of soil. Macmilllan; New York. Pp 616-660.

Carsky, R.J.,S.A. Tarawali ,M. Becker, D.Chikoye, G. Tian, and N. Sanginga. (1998). Mucuna herbaceous cover legume with potential for multiple uses. Resources and crop Management Research Monograph No.25.IITA, Ibadan, Nigeria. Chemical fertilizer use in Nigeria. Nigeria Journal of Horticultural science 3:1-9.

Güerena, D. T., JosephKimetu, Susan Riha, Henry Neufeldt , Johannes Lehmann (2016). Maize productivity dynamics in response to mineral nutrient additions and legacy organic soil inputs of contrasting quality. Field Crops Research 188 (2016) 113–120

FFD 2012.

Mengel K and Kirkby, E. A. (2001).Principles of Plant Nutrition. Springer-Science+Business Media, B. V. 807 pp

Olanikan P.C. (2006). Organic manure as soil amendments in eroded Tropical soils of South western Nigeris. Journal of Tropical Solis. 5(3): 11-18.

anchez, P. A., Sheperd K.D., Soule M.J., place F. M.,Buresh R. J., and Izac A.M.N (1997) and Miller, R. H. (1986) Organic matter and soil fertility replenishment in Africa. An investment in natural resource capital. *Transactions of XIII congress of international soil science Society.* 5.

Tanimu J., Iwuafor E.N.O., Odunze A.C. and Tian. G. (2007).Effect of Incorporation of Leguminous Cover Crops on Yield and Yield Components of Maize. World Journal of Agricultural Sciences 3 (2): 243-249.

Analyse du consentement des consommateurs à payer les légumes biologiques au sud du Bénin

Gbèlidji T. Vodouhê[1]
and Simplice DavoVodouhê[2]

[1]Faculté des Sciences Agronomiques, Université d'Abomey-Calavi, FSA/UAC, Bénin

[2]Organisation Béninoise pour la Promotion de l'Agriculture Biologique, OBEPAB, Bénin

Corresponding author:
vogtov@gmail.com

Keywords:
Consentement à payer, consommateurs, légumes biologiques, Bénin

Résumé

L'étude porte sur l'analyse du consentement des consommateurs à payer les légumes biologiques. L'objectif général de l'étude est d'analyser les préférences des consommateurs à payer les légumes biologiques. L'enquête s'est déroulée auprès de 200 consommateurs de légumes biologiques et ceux qui ne connaissent pas les légumes biologiques. Les communes de Cotonou, Sèmè-Kpodji, Porto-Novo et Abomey-Calavi constituent les zones d'étude. La régression hédonique est utilisée pour analyser les premiums de prix implicites qu'accordent les consommateurs aux différents attributs des légumes biologiques. Le modèle Logit multinomial est utilisé pour la détermination des facteurs socio économiques et culturels qui affectent les consentements à payer et à accepter des consommateurs des légumes biologiques. L'étude a révélé que les légumes biologiques bien qu'ils soient connus par la population, sont très peu consommés. Ils ne savent le lieu d'approvisionnement en légumes biologiques. L'analyse des coefficients individuels des variables montre que les principaux déterminants du consentement à payer des consommateurs pour les légumes biologiques sont le sexe, le niveau de revenu, la fermeté, le goût, la couleur, l'absence de dégâts, la valeur nutritive. À l'exception de la couleur, toutes ces variables agissent positivement sur le Consentement à payer.

Introduction

Les légumes ont une grande importance nutritionnelle pour l'alimentation humaine. Au Bénin, le besoin de produire de grandes quantités de légumes frais tout au long de l'année a créé une nouvelle source de revenus pour les femmes et les jeunes en situation de chômage (Soumahoro, 1999; Hounkpodoté et Tossou, 2001; PADAP, 2003). Le maraîchage a pris de l'ampleur et contribue à la sécurité alimentaire et à la réduction de la pauvreté des ménages, et en particulier celle des femmes (James et *al.,* 2005). Les attaques de ravageurs, les maladies, l'insuffisance ou le manque de crédit, la pauvreté des sols et l'insuffisance de la main-d'œuvre en certaines périodes du cycle de production demeurent les principales contraintes de la production horticole (Adekambi et Adegbola, 2010). Le problème de la gestion des ravageurs est la plus importante contrainte soulevée. Pour faire face à ce problème de gestion des ravageurs des légumes, la plupart des maraîchers utilisent le plus souvent les une diversité d'insecticides et de fongicides à des doses inappropriées et certains insecticides coton comme Dursban (chlorpyriphos-éthyl), Cotalm (cyperméthrine + diméthoate), endosulfan etc., interdits sur les légumes sont utilisés ; avec des doses moyennes appliquées comprises entre 1,5 et 5 fois celles recommandées (Amoussogbo, *op. cit*.,). De telles pratiques ont des conséquences sur la santé des consommateurs du fait de la présence des résidus dans les légumes et sur l'environnement par contamination de la nappe phréatique (Vodouhê, 2000). La recherche a proposé plusieurs méthodes alternatives de production allant de la production dite saine à celle biologique. Des maraichers conscients des dangers que représentent les pesticides sur les légumes, ont commencé par produire des légumes sains à l'aide de l'utilisation des extraits aqueux de neem et des bio fertilisants dans leur système de production. Ces légumes produits sont mis sur le marché. La question est de savoir si les légumes biologiques mis sur les marchés sont connus et appréciés par les consommateurs. Les consommateurs sont disposés à acheter les produits issus des pratiques biologiques de production et à quels prix. Une augmentation de la demande en légumes biologiques pourra motiver les producteurs à adopter de nouveaux systèmes de productions à base des extraits aqueux botaniques moins toxiques.

Le présent article porte sur l'analyse du consentement des consommateurs à payer les légumes biologiques. L'objectif de l'étude est d'analyser les préférences des consommateurs à payer les légumes biologiques afin de mieux comprendre l'acceptabilité de ces produits et d'identifier les stratégies de sensibilisation à grande échelle de la population à produire et à consommer les légumes biologiques pour préserver la santé des consommateurs et l'environnement.

Démarche méthodologique

Enquête quantitative

Les consommateurs sélectionnés au hasard ont été individuellement interviewés à l'aide d'un questionnaire structuré conçu avec l'application ODK.

La taille de l'échantillon a été déterminée à l'aide d'un calculateur en ligne utilisant la formule de Dagnelie en situation de taille de population inconnue. La formule utilisée par le calculateur est la suivante : $n = \frac{z^2 p(1-p)}{e^2}$ où n est la taille de l'échantillon, z est une constante issue de la loi normale selon le seuil de confiance 95% et z=1,96, p : est le pourcentage de gens qui représente le caractère observé et e est la marge d'erreur d'échantillonnage choisie.

Avec l'hypothèse que 95% de la population consomment des légumes, la taille optimale minimale doit être 139 avec l'application de la formule statistique. Au total, 200 consommateurs de légumes dont 136 femmes (soit 68%) ont été choisis au hasard au sein de la population des communes enquêtées. L'enquête s'est déroulée dans les communes de Cotonou, Sèmè-Kpodji, Porto-Novo et Abomey-Calavi.

Approches d'analyse

Les statistiques descriptives appuyées de tests non paramétriques et la régression multiple ont servi de cadre d'analyse aux données issues de l'enquête. Les statistiques descriptives calculées sont relatives aux moyennes, écart-types, fréquences et aux tableaux croisés. Elles ont servi à la caractérisation des consommateurs interviewés. Les perceptions ont été analysées à l'aide du test non paramétrique W de Kendall. L'objectif est de tester la concordance dans les avis des enquêtés. L'analyse des déterminants du consentement à payer des consommateurs pour les légumes biologiques été effectuée à l'aide d'un modèle Logit.

Présentation des résultats

Connaissance des légumes biologiques

Le tableau 1 montre que, malgré que l'existence des légumes biologiques soit bien connue par 85% de la population, ils sont très peu consommés. A peine 15% des interviewés ont admis ne pas connaitre les légumes biologiques tandis que le pourcentage le plus élevé de consommation de produits biologiques est enregistré au niveau de la carotte avec 18% de l'échantillon.

Tableau 1. **Connaissance et consommation des légumes biologiques**

Variables	Modalités	Départements			Ensemble
		Abomey-Calavi	Cotonou	Porto-Novo, Sèmè	
Connaissance des légumes bio	**Non (%)**	**27,14**	**10,61**	**6,25**	**15**
Consommation de tomates bio	Oui (%)	11.43	16.67	14.06	14
Consommation de laitues bio	Oui (%)	12.86	13.85	11.11	12.63
Consommation de carottes bio	Oui (%)	21.43	20.00	11.29	17.77

Source: Enquête auprès des consommateurs de légumes, Mai 2017

Ces statistiques peuvent être expliquées par le manque de visibilité des produits biologiques qui rend difficile la différenciation entre le conventionnel et le biologique sur le marché. En effet, 85% des enquêtes s'approvisionnent au marché et non chez les producteurs. Les consommateurs ont une connaissance des légumes biologiques, ils en entendent parler des bienfaits pour la santé, mais ils ont déclaré qu'ils ne connaissent pas les lieux de vente de légumes biologiques. En effet, les légumes biologiques sont vendus dans les lieux spécifiques connus de certains consommateurs et il y a très peu de politique de visibilité pratiquée. Quand les produits bio sont mis sur le marché ordinaire, ils sont vendus comme tous les autres produits maraichers sans une distinction particulière. De même sur les marchés, de loin il n'y a pas une différenciation entre légumes bio des légumes conventionnels.

Consentement à payer pour les légumes biologiques

La figure 1 présente les résultats du consentement ou non des consommateurs rencontrés à payer pour les légumes biologiques.

Au total, 67% des consommateurs rencontrés ont déclaré être prêts à payer pour les légumes biologiques et 33% des consommateurs ne sont pas prêts à payer pour les attributs des légumes biologiques (cf. figure 1). Soixante sept pour cent des consommateurs qui consentent à *payer pour les légumes biologiques sont prêts à payer un premium (coût supplémentaire) variant de 15 à 500 Francs CFA le kilogramme*.

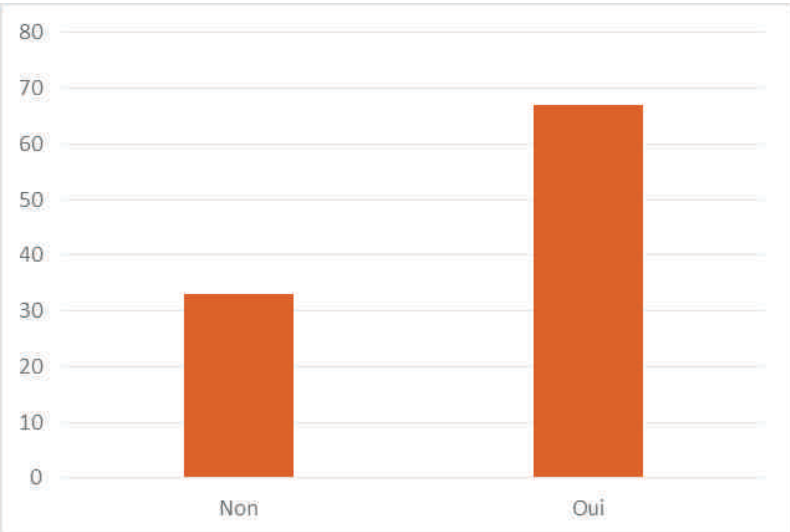


Figure 1: **Consentement des consommateurs à payer pour les légumes biologiques**
Source : Enquête terrain, 2017

Les résultats de la régression du modèle Logit relatif au consentement des consommateurs à payer les légumes biologiques sont présentés dans le tableau 2. Les variables intrinsèques inclues dans le modèle sont choisies sur la base de la hiérarchisation des attributs faite par les consommateurs.

Tableau 2. **Résultats de l'analyse économétrique pour le CAP des légumes biologiques**

Variables dépendantes : CAP pour légumes bio	**Coefficients**	**Erreurs standard robustes**	**Statistiques Z**
Sexe	**2.350*** **	**0.638**	**3.690**
Age	0.001	0.004	0.250
Taille du ménage	-0.041	0.084	-0.490
Niveau moyen de revenu	**0.813***	**0.505**	**1.610**
Propreté	-1.447	0.931	-1.550
Fraîcheur	-0.851	1.113	-0.760
Taille	-1.011	1.006	-1.010
Fermeté	**2.670*** **	**0.861**	**3.100**
Goût	**4.735*** **	**1.808**	**2.620**
Durée de conservation	0.169	0.575	0.290
Couleur	**-1.759***	**1.011**	**-1.740**
Absence de dégâts	**1.712***	**0.929**	**1.840**
Valeur nutritive	**3.354** **	**1.559**	**2.150**
Constante	0.060	1.584	0.040
Wald Khi-deux (ddl)	**30,30(14) *** **		
Pseudo R2	0,5095		
Taux de bien classés	88,27%		
Aire sous la courbe ROC	0,9332		
Nombre d'observations	179		

**** significatif au seuil de 1% (p< 0,01) ; ** significatif au seuil de 5% (p< 0,05) ; * significatif au seuil de 10% (p<0,10).*

L'analyse des coefficients individuels des variables montre que :
À l'exception de la couleur, toutes ces variables agissent positivement sur le CAP. Les **principaux déterminants du consentement à payer des consommateurs pour les légumes biologiques sont *i) le sexe, ii) le niveau de revenu, iii) la fermeté, iv) le goût, v) la couleur, vi) l'absence de dégâts, et vii) la valeur nutritive.***

Parmi les attributs des légumes identifiés, la fermeté et le goût se sont révélés les plus significatifs.
La corrélation négative trouvée entre le CAP pour les légumes biologiques et la couleur des légumes en générale peut être expliquée par le fait que le consommateur devienne suspicieux sur le caractère naturel/biologique des produits lorsque la couleur est trop vive. *Si un légume a une couleur trop vive, les consommateurs doutent si ce légume est biologique et en sont méfiants. Les hommes ont plus tendance à consommer les légumes biologiques (coefficient =2.350***> 0 et hautement significatif) que les femmes à cause de leur niveau d'éducation plus élevé que le niveau d'éducation des femmes.* Les

individus instruits sont en contact avec l'information, sont plus soucieux de ce qu'ils mangent et perçoivent mieux les avantages de consommation des légumes biologiques des légumes conventionnels. Le niveau du revenu influence positivement (coefficient =0.813*> 0 et significatif à 10%) l'achat des légumes biologiques. Les produits biologiques sont des produits qui ont des prix un peu supérieurs (premium) au prix des produits conventionnels. Plus le pouvoir d'achat est élevé, plus le consommateur a tendance à acheter des légumes biologiques.

Conclusion

Les résultats de l'étude ont montré que 75% des consommateurs des zones périphériques et urbaines du sud Bénin connaissent l'existence des légumes biologiques mais très peu les consomment. Elles sont, cependant, prêtes à payer un premium variant de 15 à 500 francs CFA par kilogramme de légumes biologiques. La faible visibilité, le manque d'information et l'absence de différenciation (pas de label) sont les principales contraintes identifiées pour la consommation des légumes biologiques. L'analyse des déterminants du consentement à payer a montré que la fermeté, le goût, l'absence de dégâts, la valeur nutritive, le niveau de revenu, la distance au lieu d'achat sont les principaux facteurs qui influencent positivement la décision d'acheter les légumes biologiques. La couleur (trop vive) influence négativement la décision des consommateurs d'acheter les légumes biologiques.

Pour que les légumes biologiques soient acceptés des consommateurs, il importe que ces légumes présentent des aspects attrayants, et aient une bonne saveur. L'implication est que le producteur qui désire produire du légume biologique doit mettre l'accent sur la fraicheur, l'attractivité de son produit. Il doit faire faire une bonne gestion des ravageurs pour que la qualité (attractivité et saveur) de son légume biologique soit préservée et ne soit pas détériorée par les ravageurs.

La campagne de sensibilisation sur la consommation des légumes biologiques doit se poursuivre pour permettre à la population d'avoir une grande connaissance des bienfaits de la consommation des légumes biologiques sur la santé. Des points de vente complémentaires des produits biologiques doivent être installés dans de nouvelles zones pour faciliter le rapprochement des consommateurs des légumes biologiques et les rendent plus accessibles.

Références bibliographiques

Adekambi S.A., Adegbola P.Y., and Arouna A. (2010). Perception paysanne et adoption des biopesticides et/ou extraits botaniques en production maraîchère au Bénin. African Association of Agricultural Economists (AAAE). 2010 AAAE Third Conference/AEASA 48th. Conference, September 19-23, 2010, Cape Town, South Africa, 22.

Amoussougbo Y. (1993). Enquête sur l'usage des pesticides en cultures maraîchères au Sud-Bénin et expérimentation de trois nématicides dans la lutte contre les nématodes à galles. Thèse d'ingénieur agronome, FSA / UNB, 116P, Bénin.

Assogba-Komlan F., Anihouvi P., Achigan E., Sikirou. R, Boko. A, Adje C., Ahle V., Vodouhe R. and Assa A.(2007).Pratiques culturales et teneur en éléments anti nutritionnels (nitrates et pesticides) du *Solanum macrocarpum* au sud du Bénin. African Journal of Food Agriculture Nutrition and Development, 2007, vol4, pp 1-15.

FAO (1994). Les femmes, l'agriculture et le développement rural. Fiche documentaire : Bénin. FAO, Rome, Italie.

Hounkpodoté M. et Tossou C. (2001). Profil des interactions entre la problématique foncière et le développement de l'agriculture urbaine dans la ville de Cotonou et environs (RéNatPAU), Bénin, 61 p.

Hounkponou K. S. (2003). Urbanisation et agriculture : analyse de l'évolution de pression foncière sur les activités de maraîchage dans le Sud Bénin. Cas de Cotonou, Ouidah et Grand-popo. Thèse d'ingénieur agronome, FSA / UAC, Bénin. 92 p.

James B., Atcha C., Godonou I. and Baimey H. (2005).Healthy vegetables through participatory IPM in periurban areas of Benin. Technical Report IITA, June. 49 pp.

PADAP (2003). Programme d'appui au développement agricole périurbain Sud-Bénin, Etude de faisabilité, tome : 1, 2, 3, 4. Cotonou, Bénin.

Soumahoro S., (1999). Agriculture et emploi des jeunes : cas de la production maraîchère à Cotonou et dans ses quartiers périphériques. Thèse d'ingénieur agronome. FSA / UNB, 169 p.

Vodouhè G.T. (2007). Contribution du genre dans la production de légumes sains et perceptions des maraîchers sur l'utilisation des biopesticides en zones urbaines et périurbaines au Sud Bénin. Thèse d'ingénieur agronome, FSA/UAC, 150p.

Vodouhè, S.D., S. Tovignan, and P. Ton. (2000). Endosulfan deaths and poisonings in Benin. UK Pesticide News Bul. 47:12–14.

Analyse de la performance économique de production de Chou *Brassicaoleracea* biologique dans les communes de Cotonou et de Sèmè Kpodji au Sud-Bénin

Justin A. Houeto[1]and Simplice D. Vodouhe[2]

[1]Faculté des Sciences Agronomiques, Université d'Abomey-Calavi, FSA/UAC, Bénin

[2]Organisation Béninoise pour la Promotion de l'Agriculture Biologique, OBEPAB, Bénin

Corresponding author:
justinhoueto@yahoo.fr
dsvodouhe@yahoo.com

Mots clés:
chou, biologique, conventionnel, performance économique, Bénin, Afrique de l'Ouest

Résumé

Le chou, une importante culture maraîchère des communes de Cotonou et de Sèmè-Kpodji, est l'objet d'une forte pression parasitaire. Il est en conséquence objet de beaucoup de traitement à base des pesticides chimiques et source de contamination pour les consommateurs. Face à ce problème, les producteurs du réseau AMAP (Association pour le Maintien d'une Agriculture Paysanne) ont adopté la production de chou biologique. La production de chou biologique est-elle performante économiquement? Notre étude se propose d'analyser la performance économique de production de chou biologique. Les données ont été collectées auprès de quarante (40) producteurs de chou biologique et quarante (40) producteurs de chou conventionnel. Les résultats ont montré que le rendement de chou biologique était inférieur à celui de chou conventionnel. La valeur ajoutée, l'excédent brut d'exploitation et le résultat net d'exploitation de chou biologique étaient supérieur à ceux de chou conventionnel. La proportion de revenu net annuel apporté par la production de chou biologique dans la dépense totale annuelle de consommation du ménage de producteur était 78,5%. La dépense alimentaire annuelle des ménages de producteur de chou biologique représentait 49,5% dans la dépense totale annuelle de consommation. Le revenu net annuel apporté par la production de chou biologique dans le ménage du producteur était élevé pour nourrit le ménage du producteur. La production de chou biologique permet de nourrir le producteur et son ménage.

Introduction

Le chou pommé est un légume-feuille exotique cultivé dans les communes de Cotonou et de Sèmè-Kpodjipour ses valeurs nutritives (Adekambi *et al.,* 2008). En effet, les feuilles de chou contiennent des glucides, protéines et divers éléments essentiels tels que le calcium, le fer, la vitamine C et de l'eau (James *et al.*, 2010).

La production de chou est limitée par un certain nombre de facteurs dont les majeurs sont les dégâts causés par les ravageurs principalement les chenilles dont la teigne du chou (*Plutellaxylostella*), *Hellulaundalis*, mais aussi les pucerons (faux puceron de chou : *Lipaphyserysimi*) et les maladies fongiques et bactériennes (James *et al.*, 2010). Les maraîchers, dans le contrôle de ces ravageurs, font recours aux produits chimiques (Adekambi *et al.,* 2008). Le lambda et le laser restent les pesticides chimiques les plus utilisés pour lutter contre les ravageurs de Chou, suivis de thian, de cidym, de pacha et d'attack.Le risque lié à l'emploi de ces produits est leur accumulation dans le sol voire dans les plantes, pouvant conduire à l'intoxication de l'homme à travers la chaîne alimentaire (Lanmafankpotin, 2010). Pour preuve, l'étude de Sæthre et al. (2011) ont décelé des résidus de pesticides dans des légumes commercialisés dans les marchés du sud-Bénin. Face à ces problèmes, les maraîchers des communes de Cotonou et de Sèmè-Kpodjide l'Association pour le Maintien d'une Agriculture Paysanne du Bénin (AMAP)ont adopté la production de chou biologique. Les aliments biologiques sont souvent perçus comme étant meilleurs pour la santé, principalement en raison de l'absence de résidus de pesticides

(AAC, 2010a; ERS, 2009a; Hoefkens et coll., 2009).

Malgré les bienfaits de chou biologique pour le consommateur, les indicateurs de performance économique de sa production sont-ils comparables à ceux de chou conventionnel ?Pour répondre à cette interrogation, la présente étude vise à analyserla performance économique de production de chou biologique dans les communes de Cotonou et de SèmèKpodji au Sud du Bénin

Matériel et méthodes

Zone d'étude et collecte de données

L'étude a porté sur deux communes où le maraîchage biologique et le maraîchage conventionnel sont pratiqués : la commune de Cotonou dans le département du Littoral et la commune de Sèmè-kpodji dans le département de l'Ouémé situées toutes deux dans la huitième zone agro-écologique du Bénin. Ce choix a été guidé par les critères de l'importance du volume produit et l'ancienneté dans la production du maraîchage biologique.

Les unités de recherche sont les producteurs de chou biologiques et conventionnels des sitesmaraîchers de forte production des communes de Cotonou et de Sèmèkpodji. Ainsi, 80producteurs de chou, choisis au hasard, ont été enquêtés à raison de 40 producteurs de chou biologique et 40 producteurs de chou conventionnel. La collecte des données s'est faite sur la base de questionnaires individuels et des entretiens semi-structurés.

Approche d'évaluation des indicateurs de performance économique

Pour Guyomard *et al*, (2013), la performance productive des productions végétales est classiquement mesurée par le rendement qui rapporte la quantité produite (tonnes ou quintaux) à la surface mobilisée à cette fin (hectares), il s'agit de la productivité physique partielle de la terre.

Dans la littérature, il existe plusieurs méthodes d'évaluation des indicateurs de rentabilité d'une activité ou d'un système de production. Il s'agit par exemple de la Matrice d'Analyse des Politiques (MAP) (Houndékon, 1996; Ibro et al, 2001; Fanou, 2008), de la méthode basée sur le bilan ou celle utilisant le compte de résultat ou compte d'exploitation (Mensah, 2006; Yegbemey, 2009; Biaou, 2010). Compte tenu de la simplicité de la méthode basée sur le compte d'exploitation, c'est cette dernière qui a été retenue pour la présente étude. Le compte de résultat est un document comptable synthétisant l'ensemble des charges et des produits d'une entreprise pour une période donnée appelée exercice comptable. Sous sa forme classique, le compte de résultat est présenté sous forme de tableau dans lequel les soldes intermédiaires de gestion sont définis. Ces soldes intermédiaires de gestion sont les suivants (Tableau 1): la Marge brute; la Valeur Ajoutée; l'Excédent Brut d'Exploitation; le Résultat d'Exploitation;Résultat Courant Avant Impôt (RCAI). Ces différents soldes permettent de mieux expliquer le résultat qui est l'indicateur de rentabilité.

Tableau 1. **Calcul des différents indicateurs de rentabilité d'une exploitation agricole**

Opérations imputées	Indicateurs de rentabilité
Ventes	Produit Brut (PB)
+ Subventions	
- Charges opérationnelles	Marge Brute (MB)
- Charges fixes	Valeur Ajoutée (VA)
- Charges de main d'œuvre salariée	Excédent Brut d'Exploitation (EBE)
- Taxes	
- Dotations aux amortissements	Résultat d'exploitation
+ Produits financiers	Résultat Courant Avant Impôt (RCAI)
- Charges financières	

Source: (Latruffe *et al*, 2013)

En désignant par u1 et u2 les moyennes respectives des différents indicateursrésultant de la production de chou biologique et celle de chou conventionnel, l'estimation de la performance relative de chou biologique a consisté à comparer les deux moyennes. Ainsi pour indicateur, l'hypothèse nulle H0 a été testée contre l'hypothèse alternative H1.

Soit : H0: u1 - u2 = 0 contre H1: u1 $\neq$u2

Dans la pratique, le logiciel statistique utilisé (ici MINITAB 16.0) donne la valeur de la statistique t de Student, son degré de liberté (ddl) et sa probabilité de signification P. De même, il fournit la valeur de la différence des 2 moyennes. Si le P donné est inférieur au seuil critique de 5% et que la différence des 2 moyennes est positive, alors nous pouvons conclure que par rapport à la production de chou conventionnel, celle du chou biologique est plus performante. La même méthodologie a été adoptée pour analyser les autres indicateurs.

Pour apprécier la proportion de revenu net annuel apporté par la production de chou biologique dans la dépense annuelle totale de consommation de ménage de producteur de chou biologique, il a été calculé le rapport $\frac{\sum_{i=1}^{n=40}\frac{Ri}{Di}}{40}$ x 100 avec **Ri** = le revenu net annuel apporté par la production de chou biologique dans le ménage du producteur et **Di** = la dépense annuelle totale de consommation du ménage d'un producteur de chou biologique. La dépense annuelle totale de consommation du ménage d'un producteur de chou biologique est obtenue en faisant la somme des dépenses des différents postes de consommation suivant : alimentation ; boissons ; articles d'habillement et chaussures ; Logement, eau, électricité, gaz, et autres combustibles ; meubles, articles de ménages et entretien courant du foyer ; Santé ; Transport ; Communication ; Loisir et culture ; et l'éducation.

Résultats et discussion

L'objectif de cette étude était d'analyser la performance économique de production de chou biologique dans les communes de Cotonou et de SèmèKpodji. Les résultats obtenus sont présentés ci-dessous :

Tableau 2. **Rendement chou en kilogramme par hectare (kg/ha)**

	Chou biologique	Chou conventionnel	Probabilité t-test
Rendement	32 555	40 675	0,000***
Ecart-type	±3763	±3583	

Source: Données Mémoire Master Houeto A. Justin 2016

De l'analyse du tableau 2, le rendement moyen de choubiologique (32555 kg/ha) était significativement différent de celui de chou conventionnel (40675 kg/ha). Cette différence était significativement positive en faveur de la culture de chou conventionnel. Le rendement de choubiologique était moindre de 19,96% à celui de chou conventionnel. Ce résultats était en concordance avec les résultats de de Ponti el al. (2012) qui a conclu que les rendements moyens des productions végétales sont sensiblement plus faibles d'environ 20% en agriculture biologique qu'en agriculture conventionnelle.

La différenceobservée au niveau des rendements moyens entre la production de chou biologique et la production de chou conventionnelétaient attribuables à l'effet des engrais et des produits phytosanitaires utilisés. Il s'agissait du compost et de la fiente de volaille qui libèrent lentement les éléments minéraux comparativement aux engrais NPK et l'Urée. De plus, les bio-pesticides ont un rôle plus préventif que curatif. Néanmoins, d'autres facteurs peuvent expliquer ces différences. Parmi ces derniers, il y a l'entretien apporté à la culture par chaque producteur, la quantité d'engrais apportée, les dates de semis, de récolte et la fertilité initiale des terres.

Ainsi, de tout ce qui précède, la production de chou biologique était moins performante que celle de chou conventionnel par rapport à la quantité récoltée sur un hectare.

Tableau 3. **valeur ajoutée, excédent brut d'exploitation et résultat net d'exploitation de production de chou en FCFA/ha**

		chou biologique	chou conventionnel	probabilité t-test
Valeur ajoutée	**moyenne**	**9 269 792**	**6 910 222**	**0,000*****
	écart type	±791117	±382738	
Excédent brut d'exploitation	**moyenne**	**9 195 417**	**6 819 597**	**0,000*****
	écart type	±782950	±378461	
Résultat net d'exploitation	**moyenne**	**8 589 046**	**6 349 009**	**0,000*****
	écart type	±1164271	±507829	

Source: Données Mémoire Master Houeto A. Justin 2016

L'analyse des soldes intermédiaires de gestion a montré que la valeur ajoutée ou marge brute créée par hectare était de 9 269 792 ± 791 117 FCFA chez les producteurs de chou biologique et de 6 910 222 ± 382 738 FCFA chez les producteurs de chou conventionnel. Après le paiement des frais de personnel ou de la main d'œuvre salariée, l'excédent brut d'exploitation obtenu par unité de surface cultivée était de 9 195 417 ± 782 950 FCFA dans la production de chou biologique contre6 819 597 ± 378 461 FCFA dans la production de chou conventionnel. Après la déduction des charges fixes constituées exclusivement des frais d'amortissement d'outillage utilisé par les producteurs enquêtés un résultat net ou revenu net par hectare a été obtenu et de l'ordre de 8 589 046 ± 1164271 FCFA chez les producteurs de chou biologique et de 6 349 009 ± 507 829 FCFA chez les producteurs de chou conventionnel, avec une différence significative ($p < 0,05$) de 2 240 037 FCFA.

Les indicateurs de performance économiques (valeur ajoutée, excédent brut d'exploitation et résultat net d'exploitation) obtenus au niveau de la production de chou biologique étaient significativement différents de ceux obtenus au niveau de la production dechou conventionnel. Les différences étaient positives en faveur de chou biologique. La production de chou biologique était donc plus performante que celle conventionnelle par rapport aux revenus qu'elle génère. Gibbon *et al.* (2007) ont réalisé une étude comparative sur la rentabilité de l'agriculture biologique dans les pays d'Afrique tropicale. Les résultats ont montré que les producteurs biologiques perçoivent des revenus bruts plus élevés que les producteurs conventionnels. Le bénéfice net des producteurs biologiques excède par conséquent celui de leurs homologues traditionnels. Cette différence est statistiquement significative.Houndekon (2010), a réalisé une étude sur l'analyse comparative des systèmes de production du coton biologique et du coton conventionnel au Bénin. Les résultats révèlent que les valeurs moyennes des marges brutes et nettes réalisées sur les exploitations du coton biologique sont plus élevées que celles réalisées sur les exploitations du coton conventionnel. Nos résultats sont similaires avec ceux de Gibbon et al. (2007) et de Houndekon (2010).

Les résultats concernant l'évaluation de la proportion de revenu net annuel apporté par la production de chou biologique dans la dépense totale de consommation de ménage de producteur ont révélé que Le revenu net moyen annuel apporté par la production de chou biologique dans le ménage du producteur était de 893 200FCFA/an et la dépense moyenne annuelle de consommation du ménage d'un producteur de chou biologique était de 1 111225 FCFA/an. Le rapport $\frac{\sum_{i=1}^{n=40} \frac{Ri}{Di}}{40}$ x 100 était de78,5%. Ce rapport a montré que la proportion de revenu net annuel apporté par la production de chou biologique dans la dépense totale de consommation de ménage de producteur était de 78,5 %. Ainsi, le revenu net annuel apporté par la production de chou biologique dans le ménage du producteur lui permettait de couvrir 78,5% des dépenses de consommation de son ménage. La dépense alimentaire annuelle des ménages de producteur de chou biologique représentait49,5% dans la dépense totale annuelle de consommation. Le revenu net annuel apporté par la production de chou biologique dans le ménage du producteur était élevé pournourrit le ménage du producteur.

Conclusion

Cette étude basée sur l'analyse de performance économiquede production de chou biologique a permis de déterminer les rendements, la valeur ajoutée, l'excèdent brut d'exploitation et le résultat net d'exploitation auprès de quarante (40) producteurs de chou biologique et de quarante producteurs de chou conventionnel. Les résultats ont révélé que la valeur ajoutée, l'excèdent brut d'exploitation et le résultat net d'exploitation de chou biologique sont supérieur à ceux de chou conventionnel. Mais, le rendement de chou biologique est inférieur à celui de chou conventionnel. Le revenu net annuel apporté par la production de chou biologique dans le ménage du producteur permettait de couvrir 78,5% des dépenses de consommation du ménage de producteur. La dépense alimentaire annuelle des ménages de producteur de chou biologique représentait 49,5% dans la dépense totale annuelle deconsommation La production de chou biologique permet de nourrir le producteur et son ménage. La production de chou biologique est donc performante.

Références bibliographiques

AAC [Agriculture et Agroalimentaire Canada]. (2010a). *Tendances du marché : produits biologiques.* Ottawa: AAC, Bureau des marchés internationaux, Rapport d'analyse du marché, novembre 2010, 14 p.

Adekambi, S. Adegbola, P. (2008). *Analyse des systèmes de production des légumes*. INRAB, 33p.

De ponti, T. Rijk, B. Van ittersum, M.K. (2012).*The cropyield gap betweenorganic and conventional agriculture.Agricultural Systems,* 108, 1-9.

Gibbon, P. Bolwig, S. (2007). The economics of certifiedorganicfarming in tropical Africa : apreliminaryassessment. DIIS (Danish Institute for International Studies) workingpaper n°2007/3, 3p.

Houndékon, V. A. (1996). Analyse économique des systèmes de production du riz dans le Nord-Bénin. Thèse de Doctorat de troisième cycle en Sciences économiques, FASEG/ Côte d'Ivoire, 160 p.

Houndekon, V.A. (2010).*Analyse comparative des systèmes de production du coton biologique et du coton conventionnel au Bénin*. UAC, 13p.

James, B., Atcha-Ahowé, C., Godonou, I., Baimey, H., Goergen, G., Sikirou, M., Toko, M. (2010). *Gestion intégrée des nuisibles en production maraîchère : Guide pour les agents de vulgarisation en Afrique de l'Ouest.* Institut International d'Agriculture Tropicale (IITA), Ibadan, Nigeria, 120 p.

Lanmafankpotin, G. (2010). *Lutte contre la pauvreté au Bénin : le programme filière maraîchère et son impact sur l'environnement urbain*. Cotonou, ABPEE, 11p.

Latruffe, L. Desjeux, Y. Nauges, C. Guyomard, H. (2013). *Les performances économiques.* In Guyomard, H. vers des agricultures à hautes performances. Volume 1. Analyse des performances de l'agriculture biologiques. Inra, 368p.

Mensah, E.R. (2006).*Etude de la viabilité des exploitations aulacodicoles au Bénin : Détection précoce des élevages à risque.* Mémoire de 3èmeCycle, ENA, Meknès/Maroc, 186 p.

Sæthre, M.G. Svendsen, N.O. Holen, B. Assogba-Komlan, F. Godonou, I. (2011). *Pesticide residuesanalysis for threevegetablecrops for urbanconsumers in Benin. Bioforsk Report*, 6: 1 29.

Comparative Training needs' Assessment of Actors within the Ecological Organic Agriculture value chain in Northern Nigeria

[1]Olayinka J. Yusuf,
[2]Adebayo A. Olowoake,
[2]James A. Ojo and
[2]Isaac A. Afe

[1]Department of Agricultural Economics and Extension Services, Kwara State University, Nigeria

[2]Department of Crop Production, Kwara State University, Nigeria

Corresponding author email:
olayinkaj.yusuf@kwasu.edu.ng

Keywords:
EOA, organic systems, response mapping, gender mainstreaming.

Abstract

The study assessed the training needs of EOA practitioners in Northern Nigeria, with a view to identifying core areas where interventions are required. Purposive sampling procedure was used in selecting one state from each of the three (3) zones in Northern Nigeria, viz; Yobe state in North-east, Kebbi state in North-west and Niger state in North-central because these states are prominent in practicing organic farming in Northern Nigeria. Simple random sampling procedure was then used to select fifty-one (51) farmers, fifty-two (52) extension agents and fifty-two (52) marketers across the states, giving a total of one hundred and fifty-five (155) respondents sampled for the study. Data were collected using a structured questionnaire and analyzed using descriptive statistical tool while 'Response Mapping' of mean score was used for comparative analysis of actors' training needs. Results showed that majority of the respondents were male {farmers (92.2%), extension agents (82.7%) marketers (76.9%)}. Mean age of farmer was 53.9 years, while those of extension agent and marketers were 39.0 and 40.1 years, respectively. EOA actors mostly sourced information through training/workshop, NOAN and TV. Response mapping of training needs indicated that 'composting/vermin composting', 'Biological method of Pest andDisease control', 'Bio-fertilizer' and 'Bio-rotation method of Pest and Disease management techniques' were EOA components where actors mostly needed training. The study concluded on urgent need for gender mainstreaming and young farmers' involvement in organic agriculture.

Introduction

Organic agriculture as a way of farming seeks to be in harmony with natural world. While seeking to produce healthy food, giving cognizance to maintaining ecological balance is a priority. To meet the objective of producing healthy food while preserving natural resources, organic agriculture farmers need to implement a series of practices that optimize nutrient and energy flows and minimize risk, such as crop rotations and enhanced crop diversity, different combinations of livestock and plants, symbiotic nitrogen fixation with legumes, application of organic manure, and biological pest control. All these strategies seek to make the best use of local resources, including solar or wind energy, beneficial biodiversity such as soil organisms, predators, parasitoids, pollinators, etc., and biologically fixed nitrogen and other nutrients released from organic matter or from soil reserves(Altieri *et al*., 2016). Technical capabilities of smallholder organic farmers in developing countries in undertaking the above series of practices are often major constraints in the implementation of organic agriculture. In addition, other challenges, according to Seufert, (2017) facing organic farmers in developing countries include access to international markets, costly certification and increased demand for labour. These constraints constitute shortcomings which hamper the potentials of organic systems in attaining sustainable agricultural development in developing countries.

In addressing the foregoing, organic farmers' capabilities, knowledge and abilities required to operate successfully within the organic system must be upgraded. This requires a sort of training after first identifying the gap in knowledge, skills and capabilities of the farmers. As farmers are only a component within the organic agriculture system, a holistic approach focusing on other important stakeholders of the organic system necessitates a value chain approach. Therefore, not only farmers, who are producers of organic product, should be the target. Extension agents who, apart from disseminating information to farmers on novel practices, also have responsibility of building their capacities to function well in their enterprises are also focused on in the study. In the same vein, marketers, who are middle-men between the producers (i.e farmers) and final consumers of organic products, are equally targeted in the study.

Several studies on organic agriculture often focused on either the producers/farmers or extension professionals or academic experts separately, thus eliciting information based on a single component or actor of the EOA value chain. For instance Yadav *et al*. (2013) assessed training needs of extension workers about organic farming in North-western Himalayas, while Altarawneh's (2016) determined barriers to organic agriculture implementation in Jordan focusing on experts within the ministry of Agriculture and Universities as subject of the study. Similarly, Bamigboye *et al*. (2014) assessed utilization of organic farming practices among arable crop farmers, in Ekiti State, Nigeria. While, study by Yekinni and Ladigbolu (2017)assessed training needs of actors about ecological organic practices in south-western Nigeria, focused on several actors of the organic system value chain, the current study did not only dothis, but further provided disaggregated data of these actors thus facilitating comparative responses among them. This study therefore aimed at undertaking comparative training needs assessment of actors within the ecological organic agriculture value chain in Northern Nigeria. Specifically, the study described socio-economic characteristics of EOA actors (producers, extension agents and marketers), documentedactors' information sources about ecological organic agriculture and determined their training needs.

Methodology

The study was carried out in Northern Nigeria. The region comprises North-central, North-western and North-eastern geopolitical zones. The respondents were actors involved in EOA. Specifically, smallholder farmers, extension agents and marketers were subjects of the study. Purposive sampling procedure was used in selecting one state from each of the three (3) zones in Northern Nigeria, viz; Yobe state in North-east, Kebbi state in North-west and Niger state in North-central because these states are prominent in practicing organic farming in Northern Nigeria. Simple sampling procedure was then used to select fifty-one (51) farmers, fifty-two (52) extension agents and fifty-two (52) marketers across the states, giving a total of one hundred and fifty-five (155) respondents sampled for the study. Data was collected with structured questionnaire and analyzed using descriptive statistical tools. Actors' personal characteristics such as age, sex, type of crop grow were measured at ordinal, nominal and interval level of measurement as the case dictates. The training needs of the respondents about ecological organic agriculture (EOA) was measured at ordinal level of measurement by stating some subject matter that actors need training on and they were asked to state whether their needs was high (3), moderate (2), low (1) or not needed (0). Weighted mean score was then computed for each subject matter. Comparative assessment was done through response mapping of WMS obtained among the EOA actors by comparing and contrasting their responses.

Results and Discussion

Selected personal characteristics of EOA actors

Results in Table 1 show that majority (92.2%) of the farmers sampled for the study was male. Very few (7.8%) were female. Similarly, majority (82.7% and 76.9%) of the extension agents and marketers included in the study were equally male. The results indicate that males were more prominent in practicing of organic agriculture in the study area. The result is similar to that obtained in a related study in Southwestern Nigeria by Yekinni and Ladigbolu (2017) where about of the 73% of the respondents of the study were male. This finding underscore for the need for gender mainstreaming in organic agriculture. Efforts have to be exerted to ensure female practitioners are equally engaged as males in the practice of organic agriculture in Nigeria. As shown in Table 1, slightly above half (51%) of the farmers were aged between 41 and 60 years, while close to half (47.1%) were aged between 21 and 40 years. Mean age of farmer was 53.9 years. On the other hand, while most (57.7%) of the extension agents fell between 21 and 40 years age bracket, slightly above half (51.9%) of the marketers were aged between 41 and 60 years. However, mean age of extension agent (39.0 years) and marketers (40.1 years) were about same. While it may be said that the duo of extension agent and marketers were more vibrant and within productive age range, the farmers, however, were much older among the practitioners of organic agriculture sampled in the study. The findings imply the non-involvement of youth in the practice of organic agriculture in the Northern region of Nigeria.

Table 1. **Personal characteristics of respondents**

Personal characteristics	Farmer (n=51)	Extension Agent (n=52)	Marketer (n=52)
Gender			
Male	47(92.2)	43(82.7)	40(76.9)
Female	4(7.8)	9(17.3)	12(23.1)
Age (years)			
21-40	24(47.1)	30(57.7)	25(48.1)
41-60	26(51.0)	22(42.3)	27(51.9)
60 and above	1(2.0)	0(0.0)	0(0.0)
Mean	53.9	39.0	40.1

Source: Field survey, 2017

Information sources used by EOA actors

Results of response mapping in Table 2 show that training/workshop, NOAN and TV were mostly used information sources by the actors in Northern Nigeria. Also, mobile phones and print media recorded high extent of use common to both extension agents and marketers. The findings underscore the significant role of the National Organic Agriculture Network in championing the course of organic agriculture Nigeria.

Training needs of EOA actors

Response mapping of training needs of actors, as shown in Table 3, indicate that 'composting/vermin composting', 'Biological method of Pest and Disease control', 'Bio-fertilizer' and 'Bio-rotation method of Pest and Disease management techniques' were EOA components where training are mostly needed across board. The findings underscore significance of plant protection as core area of training needs among the actors. This is similar to the submission of Yadav *et al.* (2013) who reported high training needs of respondents in this area.

Table 2. **Response mapping of five most prominent information sources used by EOA actors**

Information source ranking Actors	1	2	3	4	5
Famer	Extension Agent	Training/ Workshop	NOAN	Radio	TV
Extension Agent	NOAN	TV	Training/ Workshop	Print media	Mobile phones
Marketer	NOAN	Training/ Workshop	TV	Internet	Print media/ phone

Source: Field survey, 2017

Furthermore, results in Table 3 show 'market location' and 'credit sources' were EOA components where both farmers and extension agents needed training most, while 'weed control' was an area common to both farmers and markers. The foregoing areas common across actors in the value chain indicate EOA components where priority attention should be given to mostly during intervention endeavours. However, for overall improvement of the organic system, enhancing the knowledge, skills and capabilities actors in all areas where mean score of training needs were 2 and above becomes very necessary. The findings are similar to those obtained by Okanlawon (2014) and Olajide, (2009) who reported need for more training on core organic agricultural practices and minimal training on land dispute, land tenure system and commercial insurance issues among vegetable and fruit farmers.

Table 3. **Response mapping of training needs (TN) of EOA actors**

TN-Ranking Actors	1	2	3	4	5	6	7	8	9
Farmers	Credit Source	Current& future market price	Biological method of Pest& Disease control	Bio-fertilizer	Bio-rotation method of Pest & Disease mgt. tech	Weed control	Market Location	Composting/ Vermin Composting	Crop rotation
EA	Composting/ Vermin Composting	Credit Sources	Market location	Biological method of Pest & Disease control	Bio-fertilizer	Bio-rotation method of Pest & Disease mgt. tech	Green manuring	Record keeping	**Grading/ Packaging & marketing of produce; Storage methods & procedure; Biodynamic Farming
Marketers	Composting/ Vermin Composting	Compost application	Weed Control	Biological method of Pest & Disease control	Seed treatment	Bio-rotation method of Pest & Disease mgt. tech	Bio-fertilizer	Land preparation	*Green manuring; Bio-dynamic farming; Credit sources

Source: Field survey, 2017

Conclusion and Recommendation

Males were more prominent in practicing of organic agriculture in the study area. Farmers were much older among the practitioners thus signifying non-involvement of youth in the practice of organic agriculture. TV, training/workshop and NOAN were mostly used information sources 'Composting/vermin composting', 'Biological method of Pest and Disease control', 'Bio-fertilizer' and 'Bio-rotation method of Pest and Disease management techniques' were EOA components where actors mostly needed training. Urgent need for gender mainstreaming and young farmers' involvement in organic agriculture is recommended. Prominent information sources, such as TV, training/workshop, NOAN, print media should be exploited as avenue for increasing technical capabilities, skills and knowledge of actors about ecological organic agriculture. There is also need by concerned stakeholders to organize capacity building training workshops or seminars for practitioners covering all identified areas of training needs to enhance their skills and technical capabilities in the practice of organic agriculture.

Acknowledgment Authors hereby acknowledge the financial support by the Swiss Agency for Development Cooperation (SDC) through Bio-vision Africa Trust for the project.

References

Altarawneh, M. (2016) Determine the barriers of organic agriculture Implementation in Jordan *Bulgarian Journal of Agricultural Science 22 (1): 10-15*

Altieri, M.A., Lana, M., Stein-Bachinger K. and Bachinger J. (2016) Ecology of Organic Agriculture. Online document accessed on 5th July 2017 from: http://www.oxfordbibliographies.com /view/document/obo-9780199830060/obo- 9780199830060-0157.xml

Bamigboye, E. O., Yusuf, O. J. and Kuponniyi, F. A. (2014). *Utilization of organic farming practicesby arable crop farmers in Ekiti State, Nigeria: Challenges for Extension. Journal of Organic Agriculture and Environment.* 2: 131 – 140.

Okanlawon, O.M. (2014). Need assessment of women vegetable farmers on organic agriculture in Akinyele Local Government area of Oyo state (A M.Sc. thesis submitted to Department of Agricultural Extension and Rural Development University of Ibadan) March, pp 90.

Olajide A. M. (2009). "Factors affecting production needs of short cycle fruit farmers in Oyo and Osun States. An unpublished M.sc thesis of the Department of Agricultural Extension and Rural Development, University of Ibadan, Nigeria. Pg 34.

Seufert, V. (2017) *Organic Agriculture as an Opportunity for Sustainable Agricultural Development* Institute for the study of International Development (ISID) Research to Practice Policy Briefs Policy Brief No. 13. 1-26p.

Yadav, D. S., Sood P.,Thakur S. K. and Choudhary, A. K. (2013). Assessing the training needs of agricultural extension workers about organic farming in the North-Western Himalayas *Journal of Organic Systems* 8(1): 17 – 27 .

Yekinni, O. T. and Ladigbolu, T. A. (2017). Actors' training need assessment of ecological Organic agriculture practices in south western Nigeria. *International Journal of Advances in Science Engineering and Technology*, 5 (2): 60-63.

L'agriculture Biologique en Afrique, un moteur technologique pour la sécurité alimentaire ?

Ludovic Temple[1,4],
Gérard Bayiya[1,2,4],
Hubert de Bon[3,4],
Eric Malézieux[3,4]
and Syndhia Mathe[1,4]

[1]Cirad. UMR Innovation.
73 rue Jean-François
Breton - 34398 Montpellier
Cedex 5, France.
E-mail : ludovic.temple@cirad.fr

[2]Université de Yaoundé II,
BP 1365 Yaoundé, Cameroun

[3]Cirad, UPR HORTSYS.
Campus international
de Baillarguet - 34398 Montpellier
Cedex 5, France.
E-mail : hubert.de_bon@cirad.fr

[4]Université de Montpellier,
F-34090 Montpellier

Corresponding author:
ludovic.temple@cirad.fr

Problématique

L'agriculture biologique a d'abord rassemblé des citoyens autour de la défense et la sauvegarde des sols et d'une alimentation naturelle. En dépit de nombreuses tendances, les quatre principes définis par l'IFOAM — santé, écologie, équité, responsabilité — structurent la pratique de l'agriculture biologique (AB) dans le monde. Notamment, les intrants chimiques de synthèse et les organismes génétiquement modifiés sont prohibés. Ce mode de production est parfois controversé dans la littérature professionnelle ou scientifique en particulier pour sa capacité supposée limitée à accroitre les rendements ou à réduire les inégalités alimentaires, et pour la «conventionalisation» (Darnhofer *et al.* 2010) impérative pour certains marchés.

En Afrique, les enjeux du développement de l'AB ont un caractère spécifique en raison du besoin de sécuriser l'alimentation d'une population dont la croissance démographique massive va accroitre la population rurale dans les années à venir malgré l'explosion urbaine. Plutôt connue par le biais de produits certifiés pour l'exportation et destinés aux consommateurs du Nord, l'AB en Afrique et son potentiel pour le développementdu continent restent encore peu éprouvés. Est-ce que l'ABqui allie production agricole, respect des ressources naturelleset intensité en travail, peut constituer une trajectoire technologique structurante du développement du secteur agricole et alimentaire enAfrique ?

Peu de travaux de recherche référencent la réponse à cette question au regard despotentialités de ce mode de production en Afrique. La reconnaissance, par les institutions, de l'agro-écologie conduit à des confusions par rapport à la spécificité et au rôle de l'agriculture biologique en termes de projet pour les transformations technologiques dans le secteur agricole.En corollaire, les politiques agricoles et alimentaires s'intéressent encore peu à l'agriculture biologique.Elles restent gouvernées par des objectifs d'intensification conventionnelle associés à la recherche de modernités, finalisés par des objectifs productivistes.La reconnaissance par les politiques publiques (agricoles, d'innovation et de recherche) de l'agriculture biologique comme levier du développement agricole africainest encore en émergence. Cette émergence se confirme clairement dans certainstravaux comme en Afrique de l'est, en Ouganda et au Kenya (Tankam, 2017). Elle vise alors principalement deux objectifs : i) saisir des marchés de niches dans les pays industriels pour diversifier les ressources d'exportations) ; ii) structurer des lieux d'expérimentation d'innovations radicales (test de nouveaux intrants) pouvant « nourrir » la transition vers l'agro-écologie ou une plus grande efficacité de l'agriculture conventionnelle.Pourtant, les marchés pour les produits biologiques en Afrique sont en plein essor. La société civile au sens large, via les organisations paysannes liées à l'agriculture familiale, les ONG (IFOAM) mais également les entreprises, et le secteur bancairequi commencent à investir ;suscitent des demandes d'accompagnement, de soutien ou de reconnaissance par la recherche et les politiques publiques.

Cadre conceptuel et méthodologique

Nous mobilisons deux sources complémentaires de connaissances et d'informations pour répondre à la question posée. La première compile des travauxet méta-analyses sur les indicateurs d'évaluationde l'agriculture biologique (Seufert *et al.*,2017 ; Lesur-Dumoulin *et al.* 2017). La seconde mobilise les résultats d'un projet collaboratif associant des institutions du Nord et du Sud sur l'évaluation des causalités entre l'agriculture biologique et la sécurité alimentaire (Temple *et al.* 2016). Les bases d'informations sont celle d'une enquête à dires d'experts respectivement au Burkina Faso, Bénin et Cameroun (50 experts). Cette enquêteutilise la méthode d'élicitation probabiliste de connaissances d'experts. Cette méthode constitue un outil statistique pour représenter les connaissances expertes sous la forme d'une distribution de probabilité (Garthwaite *et al.* 2005). Elle considère l'opinion subjective des experts comme une connaissance quantifiable. Cecroisement de différentes bases de connaissances et d'informationsapporte quatre résultats permettant de caractériser les conditions d'émergence et de reconnaissance de l'agriculture biologique comme levier du développement en Afrique.

Le premier résultat porte sur la caractérisation des systèmes de production qui permettent à l'agriculture biologique de répondre aux enjeux de sécurité alimentaire en Afrique.
Pour évaluer la contribution de l'agriculture biologique aux indicateurs de la sécurité alimentaire, nous construisons un cadre d'analyse typologique systémique des différentespratiques (production, commercialisation, consommation) qui permettent d'y parvenir. Cette typologie situedifférentes situations du point de vue des causalités entre l'agriculture biologique et la sécurité alimentaire. Elle souligneune critique transversale à laquelle ce mode de production doit faire face qui est sa capacité à répondre aux enjeux de la disponibilité c'est-à-dire d'un accroissement suffisant de la production. Un vecteur de cet accroissementest principalement le rendement.

Le deuxième résultat porte sur l'évaluation des performances de l'AB du point de vue des rendements
Nous proposons alors d'éliciterexpérimentalement les bases de connaissances du panel d'experts consultés pour mettre en exergue et discuter l'intensité et les caractéristiques dudifférentiel de rendementsentre l'agriculture biologique et l'agriculture conventionnellesur quelques filières.

Les résultats confirment pour partie ceux observés dans la littérature. Ils soulignent en moyenne des rendements plus faibles de l'ABen comparaison del'Agriculture conventionnelle (Seufert *et al.,* 2012).

On observe néanmoinsune dispersion de l'intensité de ce différentiel entre les productionscéréalières (maïs.) et horticoles (intégrant les tubercules et les bananiers)[1], entre les zones de production, entre les filières de commercialisation. Par ailleurs, les travaux sur la variabilité des rendements dans la zone intertropicale(intra-annuelle et inter annuelle comparée entre l'AB et l'agriculture intensive) dans un contexte d'instabilité climatique croissante,révèle des résultats nouveaux (Lesur-Dumoulin *et al.*2017).

[1]Au centre de la sécurité alimentaire de la région intertropicale est principalement

Or la variabilité des rendements, et celle des prix, sont des variables de risques qui bloquent les capacités d'investissement des agriculteurs dans l'innovation.

Le troisième résultat caractérise les contributions possibles del'AB à la sécurité nutritionnelle et sanitaire

La connaissance des autres causalités entre l'agriculture biologiques et la sécurité alimentaire apporte des solutions aux dimensions nutritionnelles et sanitaires de la sécurité alimentaire.

En effet en ce qui concerne la sécurité nutritionnelle,on observe une importance croissante des maladies non transmissibles (obésité, diabètes..) dans le contexte africain en relation avec l'évolution du mode de vie urbain (Sanne Schoonbeek *et al.* 2013, Dury *et al.* 2017, Tchibindat 2018).

En ce qui concerne la sécurité sanitaire, l'utilisation croissante de pesticides en Afrique (de Bon *et al.* 2014) se traduit par des contaminations en pesticides des eaux principalement dans les zones urbaines (Branch *et al.* 2018) dont les conséquences sur la santé publique sont de plus en plus reconnues dans la littérature scientifique.

Lequatrième résultat concerne l'évolution des conditions institutionnelles relatives aux formes de certification adaptées aux besoins de développement de l'AB en Afrique.

Les Institutions mises en place par les politiques publiques sont des élémentsessentiels qui accompagnent et structurent les trajectoires d'innovation (Faure *et al.* 2018). Par exemple, elles donneront un cadre pour substituer les intrants chimiques par d'autres ressources: écologiques, cognitives, travail, mécanisation, infrastructures, irrigation (Temple et Compaoré 2018). Un autre élément des conditions institutionnelles nécessaires, repose sur les dispositifs de normalisation et de certification (Fouilleux *et al.* 2017). Les différentes formes de certifications (par tierce partie, participative) sont analysées en fonction de leur capacité à rendre compte des conséquences de l'agriculture biologique sur la sécurité alimentaire.

Conclusion

De manière conventionnelle en Afrique l'agriculture biologique est souvent associée à une vision restrictive d'une opportunité permettant de se saisir de niches sur les marchés internationaux ou nationaux. Elle est souvent une situation de rente sur les marchés internationaux ou tente desaisir des « niches de marchéspour des populations aisées ou bien à une variante de l'agro-écologie. Elle estprésentée comme une variante technologique des transitions vers l'agro-écologie. Elle est pour l'instant peu reconnuedans les politiques agricoles et alimentaires publiques africaines. La synthèse des résultats présentés sur les conditions technologiques et institutionnelles d'activation d'une agriculture biologique qui réponde de manière performante à des enjeux de développement de sécurité alimentaire renouvelle la perception cognitive des possibilités pour ce mode deproduction de ne pas être considéré comme un « aboutissement possible » mais comme un « moteur » potentiel des transitions technologiques de l'agriculture en Afrique (Benoit *et al*. 2017). Elle invite dans cette proposition àrenouveler la conception de ce mode deproduction dans les contenus des politiques publiques.

Bibliographie

Andriamampianina L., Temple L., De Bon H, Malezieux E., Makowski D. (2018). Evaluation pluri-critères de l'agriculture biologique en Afrique subsaharienne par élicitation probabiliste des connaissances d'experts. Cahier agriculture, in press vol 27, n°4.

Branchet, P., Cadot, E., Fenet, H., Sebag, D., Ngatcha, B. N., Borrell-estupina, V., Gonzalez, C. (2018). Polar pesticide contamination of an urban and peri-urban tropical watershed affected by agricultural activities (Yaoundé, Center Region, Cameroon). Environmental Science and Pollution Research, 1-26.

Darnhofer, Ika, Lindenthal, Thomas, Bartel-kratochvil, Ruth Et Zollitsch, Werner, 2010. Conventionalisation of organic farming practices: from structural criteria towards an assessment based on organic principles. *A review. Agronomy for Sustainable Development* 30 (1): 67−81. DOI 10.1051/agro/2009011.

Benoît Marc, Tchamitchian Marc, Penvern Servane Et AL.,2017.Potentialités, questionnements et besoins de recherche de l'Agriculture Biologique face aux enjeux sociétaux*, Économie rurale,* 5 (n° 361), p. 49-69.

De Bon H, Huat J, Parrot L, Sinzogan A, Martin T, Malezieux, E, Vayssieres Jf. 2014. Pesticide risks from fruit and vegetable pest management by small farmers in sub-Saharan *Africa. A review. Agron. Sustain. Dev*. 34, 723–736.

De Bon H., Temple L., Malezieux É., Bendjebbar P., Fouilleux È., Silvie P., 2018. L'agriculture biologique : un levier d'innovations pour le développement de l'agriculture africaine. Cirad, Montpellier, *Perspective* xx. In press Septembre-Octobre 2018.

Dury S, Vall E, Imbernon J. 2017. Production agricole et sécurité alimentaire en Afrique de l'Ouest*. Cah. Agric*.26:61001 DOI:10.1051/cagri/2017047S.

Faure G, Chiffoleau Y, Goulet F, Temple L, Touzard Jm, (2018). Innovation et développementdans les systèmes agricoles et alimentaires. Edditions Quae, ISBN 9782759228126, Versailles, 259p.

Garthwaite, P.H., Kadane, J.B., And O'hagan, A. (2005).Statistical Methods for Eliciting Probability Distributions. J. Am. Stat. Assoc. 100, 680–701.

Fouilleux, Eve, and Allison Loconto. (2016).Voluntary Standards, Certification, and Accreditation in the Global Organic Agriculture Field: A Tripartite Model of Techno-Politics. *Agriculture and Human Values.*

Lesur-Dumoulin, C., Malézieux, E., Ben-Ari, T. *et al.* 2017. Lower average yields but similar yield variability in organic versus conventional horticulture. *A meta-analysis. Agronomy for Sustainable Development,* vol. 37, no 5, p. 45.

Seufert V, Ramankutty N, Foley J.A. 2012. Comparing the yields of organic and conventional agriculture. *Nature485*:229–232.

Sanne Schoonbeek H.Z , Hossein M., Ben Derudder P. Witlox F (2013). Organic Agriculture and Undernourishment inDeveloping Countries: Main Potentials and Challenges, Critical Reviews.*Food Science and Nutrition*, 53:9, 917-928, DOI: 10.1080/10408398.2011.573886

Tankam C. 2017. L'organisation des marchés de producteurs de fruits et légumes biologiques à Nairobi, Kenya. *Cah. Agric*. 26:35006.

Tchibindat F. 2017. Repenser les systèmes alimentaires en Afrique au regard des besoins nutritionnels et de santé. Conférence en ligne séminaire : Les défis alimentaires en Afrique, RRI, https://rrifr.univ-littoral.fr/seminaire-permanent-adu/, Centre L'Harmattan, Paris.

Temple L., Compaore Sawadogo Emf., (2018). Innovation Processes in Agro-Ecological Transitions in the Developing Countries, Collection ISTE, Série Innovation in Engineering and Technology 190 p - ISBN : 9781786302724 .

Temple L., Bayiha G., Nesme T., Mathe S., Kwa M. (2016). Agriculture biologique et sécurité alimentaire en Afrique sub-Saharienne: Rapport ABBAS Cameroun, Yaoundé, Bibliothèsque Agritop : CIRAD, 49 p http://agritrop.cirad.fr/583812/.

Assessment of Training Needs of Stakeholders on Ecological Organic Agriculture

Yekinni, O. T. and
T. A. Ladigbolu

Department of Agricultural Extension and Rural Development, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, Nigeria

Corresponding author:
adejojutemitope@gmail.com

Keywords:
Training needs, actors, EOA components and ecological organic agriculture

Abstract

Organic farming excludes the use of synthetically compounded fertilizers, insecticides, pesticides, growth regulators, and livestock feed additives. The use of these toxic substances is seen as inevitable by farmers, whereas such portend dangers to human health and environment. Having to carry out agricultural production activities without the toxic external inputs requires substantive technical knowledge. It is against this backdrop that the study investigated training need for ecological organic agriculture (EOA) actors by gender in the value chain. The study was carried out in Oyo, Osun and Ekiti states of southwest Nigeria. Multistage sampling procedure was used to select 25 farmers, 15 extension agents and 10 marketers in organic agriculture value chain in the selected states, giving 150 respondents. Questionnaire was used to gather the relevant data for the study. Data were analysed using descriptive inferential statistics. More (64.0%) of the respondents had substantial training needs, 62.0% had high level of knowledge of EOA whereas more (61.0%) of them had low level of use of ecological organic agriculture components. Significant use of EOA practices enabled more of them to have training needs for agriculture.

Introduction

Organic farming is based on renewal of ecological processes and strengthening of ecological functions of farm ecosystem to produce safe and healthy food sustainability (Environment, 2010). It is in contrast to modern/conventional systems. Organic agriculture represents a deliberate attempt to make the best use of local natural resources, with the aim of creating integrated, humane, environmentally and economically viable agriculture systems in which maximum reliance is placed on locally or farm-derived renewable resources.

It has been shown that ecologically-based organic production systems are capable of ensuring and sustaining local food security and sovereignty, ecosystem services for rural welfare and biodiversity conservation through increased uptake of agro-ecological innovations, practices and technologies. CBD (2001) recognises the importance of traditional knowledge in the conservation and sustainable use of agricultural biodiversity. UNEP also recognises the vital role of bio-cultural diversity as the fourth pillar in sustainable development. The smallholder farmers are often pitted against large-scale holders and outside investors who receive preferential state support despite strong evidence that the former are more equitable and more efficient in the use of their resources per unit of land (IFOAM, 2013).

Despite the prospects and benefits the organic agriculture has to improve farming and improve food security, farmers, marketers and consumers still practice and patronise conventional agriculture, which threatens sustainable agriculture and ultimately, the Nigerian economy. Use of toxic substances such as fertilizers, pesticides and insecticides portends dangers to human health and environment, soil degradation, erosion among others. The need to practice agriculture without the use of these harmful substances require technical wherewithal for adequate use of organic systems. It is against this backdrop that the study investigates training needs for EOA (farmers, extension agents and marketers) actors in the value chain.

The objective of the study is to determine the training need for EOA actors in the value chain. Specific objectives are to;

i. ascertain level of use of available EOA components to the respondents
ii. identify sources of information of the respondents about EOA
iii. ascertain respondents' knowledge level about EOA

The study hypothesised as follows;

$H_0$1: There is no significant relationship between the knowledge of the respondents and their need assessments on organic agriculture

$H_0$2: There is no significant difference between actors' training need about ecological organic agriculture

Materials and method

The study was carried out in southwest region Nigeria. The study population were actors (smallholder farmers, extension agents and marketers) involved in EOA. A purposive sampling procedure was used to select Oyo, Ekiti and Osun states from southwest Nigeria because these are states that have substantial practicing organic agriculture groups. Simple sampling technique was used to select 25 farmers, 15 extension agents and 10 marketers from each state, giving a total of 150 respondents for the study. Data was collected with the use of structured questionnaire. Data were analysed with the use of descriptive and inferential statistics.

Results and discussion

Result on Table 1 reveals that majority (54.6%) of the respondents were between the ages of 41 and 60 years, 73.3% were male, 81.3% were married and 66.7% of them had tertiary education. This implies that many of the respondents are educated and will not have problem dealing with the components of ecological organic agriculture which is in contrary to common opinion that all farmers are illiterate. The result also reveals that only 30.0% of the respondents do not grow any crop which may be due to their type of occupation (marketer or extension agents), while of those who grew crops, 40.0% grew only maize, 40.0% grew mixed crops combining maize, tomatoes and leafy vegetables.

Table 1. **Distribution of respondents by their characteristics**

Characteristics	Category	Percentage
Age	21 – 40	35.4
	41 – 60	54.6
	61 and above	10.0
Sex	Male	73.3
	Female	26.7
Marital status	Single	13.3
	Married	81.3
	Widowed	2.0
	Divorced	3.4
Education	No formal education	6.0
	Primary education	12.7
	Secondary education	14.7
	Tertiary education	66.7
Types of crop grown	Maize only	40.0
	Tomatoes only	8.6
	Vegetables only	11.4
	Mixed cropping of the three	40.0
	Total	**100**

Result on Figure 1 reveals that 61.3% of the respondents used available EOA components at low level, which implied that the practice is not pervasive among the farmers in the study area.

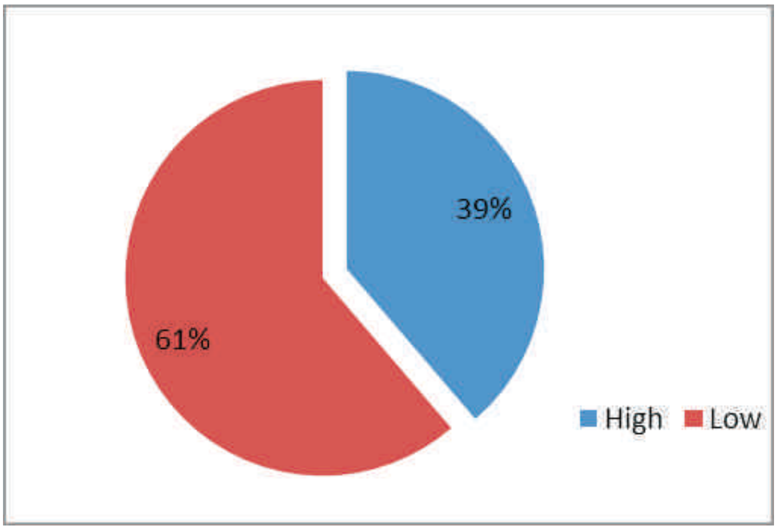


Figure 1. **Distribution of respondents based on level of use of available EOA components**

On Table 2, training on grading and packing was mostly needed by the respondents (268.6), this was followed by training needs on biological methods of pests and diseases (267.6), credit source (267.3), storage methods (263.9) and bio-fertiliser (259.3) and on seed treatment (256.1). Others are training needs on green manuring (255.0), current and future market prices (254.2) and market location (253.3).

Result on Figure 2 shows that 62.0% of the respondents have high level of knowledge about organic agriculture in the study area. The implication of this is that the respondents are knowledgeable in one way or the other about organic agriculture. This finding will likely engender the interests of the practitioners to be more involved in organic agriculture practices. This is in conformity with the findings of Oyesola and Obabire (2011) that good knowledge of respondents on organic farming could influence them convert from conventional farming to organic food production.

Table 2. **Distribution of respondents on training need about ecological organic farming components**

Subject matter of training needs	Not needed	Low	Moderate	High	Weighted score
Grading or packing and marketing of organic produce	0.7	8.0	13.3	78.0	268.6
Biological method of pest and disease control	1.7	6.7	14.2	77.5	267.6
Credit source	0.0	6.0	20.7	73.3	267.3
Storage methods and procedures	0.7	8.0	18.0	73.3	263.9
Bio-fertiliser	0.8	10.8	16.7	71.7	259.3
Seed treatment	1.3	8.0	24.0	66.7	256.1
Green manuring or green leaf manuring	0.0	10.0	25.0	65.0	255.0
Current and future market prices	0.0	8.7	28.7	62.7	254.2
Market location	0.7	7.3	30.0	62.0	253.3
Weed control	2.5	11.7	16.7	69.2	252.7
Bio-dynamic farming	1.7	15.8	14.2	66.7	244.3
Compost application	4.2	12.5	19.2	64.1	243.2
Record keeping and certification standards	0.7	10.7	34.0	54.6	242.5
Bio-rational pest and disease management techniques	1.7	14.2	29.2	55.0	237.6
Land preparation	10.7	7.4	17.2	64.8	236.2
Composting or vermin-composting	1.7	21.7	22.5	54.2	229.3
Crop rotation	10.8	11.7	40.0	37.5	204.2

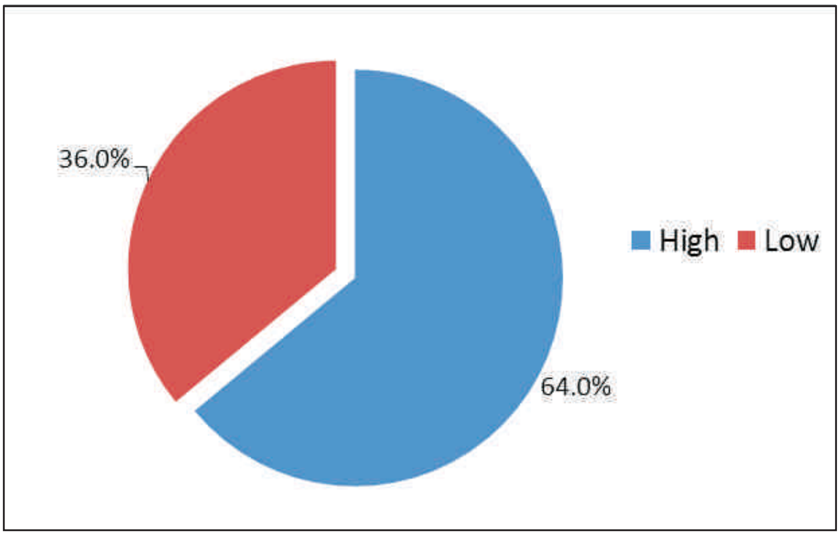


Figure 2. **Distribution of respondents by levels of training needs**

The study, on Table 3, established that educational attainment of the respondents was significantly ($r=-0.20$, $p=0.01$) was related to their training needs. The direction of the relationship revealed that those who had less of education needed the training more than those who are more educated.

Table 3. **PPMC for test of relationship between education of respondents and their training needs**

Variables	r- value	p-value	Decision
Training need index vs. Years of schooling	-0.20	0.01	Significant

Also, result obtained on Table 4 reveals that actors' knowledge (r=-0.21, p=0.01) was significantly related to their training need. This implied that those who had more knowledge about the EOA concept indicated needs for more training than those who had less of knowledge of EOA in the study area.

Table 4. **PPMC for test of relationship between respondents' knowledge and their training needs**

Variables	r- value	p-value	Decision
Training need index vs. knowledge index	-0.21	0.01	Significant

Result on Table 5 shows that the various actors had significantly different (F=171.03, p =0.00) training needs. This means that the respondents differed in their training need.

Table 5. **Test of difference between various actors' training needs**

Source of variation	Df	F value	p value	Decision
Between groups	2	171.03	0.00	Significant
Within groups	147			

Conclusion and recommendation

The study established substantial training needs among the respondents, a low level of use of ecological organic agriculture components and a high level of knowledge about EOA practices in the study areas. Therefore, fulfilling the training needs will improve the level of use of the EOA components. It is recommended that the extension services agencies should incorporate the EOA components to the various actors in the value chain.

References

Environment (2010). Ecological/Organic Agriculture. Definition of Organic Agriculture. Environment - Ecology - Nature - Habitat – Gaia - Permaculture. Accessed at URL http://www.environment.gen.tr /ecological-organic-agriculture.html on 12 Dec 2014.

Gurung, C. (2006). "The role of women in the fruit and vegetable supply chain in Maharashtra and Tamil Nadu India: *The New and Expanded Social and Economic Opportunities for Vulnerable Groups Task Order under the Women in Development.* IQC. USAID, Washington, DC.

IFOAM (2008). Basic Standards for Organic Agriculture and Processing. International Federation for Organic Agriculture Movement Tholey- Tholey.

Oyesola, O. B. and Obabire, I. E. (2011). "Farmers' perceptions of organic farming in selected Local Government areas of Ekiti State, Nigeria". *Journal of Organic Systems*, 6(1), Pgs. 21-22.

United Nations Environment Programme (2001). Climate Change Information Sheet.

The Position of Agroforestry to the Farmlands and Livelihood Improvement in Rwamiko Sector, Gicumbi District - Rwanda

*Mubashankwaya Isaac,[1, 2]
Mwine Julius[1], Ssekewa Charles,[1]
Ssekandi Joseph[1], Naigaga Hellen,[1]
Mukamana Vestine,[2]
Nyiransengiyumva Agnes[2]
and Umutesi Francoise[2]

[1]Uganda Martyrs University (UMU), Faculty of Agriculture, P.O. Box 5498 Kampala-Uganda

[2]University of Technology and Arts of Byumba (UTAB), Faculty of Agriculture, Environment Management and Renewable Energy, P.O. Box 25 Byumba Rwanda.

Corresponding author:
isaacdabraham@yahoo.fr

Keywords:
Agro forestry systems, Farmlands, Livelihoods

Abstract

The main purpose of this study was to evaluate the contribution of agro forestry to the farmlands and livelihoods improvement for the households considered as pioneers of agro forestry in Rwamiko Sector, Gicumbi District in Rwanda. Findings showed that, out of four (4) different agro forestry systems adopted in the study area, Agrosilvopasture system ranks the best with 71.8 % level of adoption while apisilviculture takes the lowest level of adoption with 7.8 %. The most used agroforestry practice was scattered trees with 87.5% of adopters. Agroforestry species commonly used among farmers were Grevillea robista (43.8%) and Alnus acuminate (37.5%). For agroforestry products, fire woods, timber, fodder and fruits were most recognized. A considerable income from agroforestry products help farmers to improve the well being of family members like payment of school fees and health insurance, renewing habitats, improving meal quality and purchasing households' equipments.

Introduction

The practice of agro forestry has been described as a win-win approach to farmland management, as it offers the opportunity for multifunctional land use, which can simultaneously benefit food and fuel production, environmental and biodiversity protection, and allow farms to adapt to or mitigate the effects of climate change, https://businesswales.gov.wales/farmingconnect/posts/agroforestry-opportunity-sustainable-intensification-farmland-improve-productivity-and-reduce. Agro forestry systems is a land use management system in which trees or shrubs are grown around or among crops or pastureland. It combines shrubs and trees in agricultural and forestry technologies to create more diverse, productive, profitable, healthy, ecologically sound, and sustainable land-use systems (Huxley, P.A., 1984). The trees are mostly preferred in this system due to their lower competition with crops and their capacity to improve soil fertility through litter fall and nitrogen fixation. Agro forestry via its diversified products contributes to the improvement of livelihood by generating income that helps in many activities such as health insurance, school fees payment, construction of houses, food security and others (FAO, 1991).

Materials and Methods

Description of the study area

Rwamiko Sector is characterized by a relief of steep slopes and mountainous topography character. It is located in the highland areas of Buganza with a succession of steep hills, rugged mountains and sometimes separated by deep and narrow valleys and high altitude varying between 1800 m and 2500 m. The agriculture sector plays a greater importance in Rwamiko Sector because it is the activity done by 92% of the active population. The great part of this sector is occupied by food crops such as irish potatoes, beans, sorghum, maize, banana, egg plants, cabbages, carrots, tomatoes, ground nuts, soya beans, and few cash and industrial crops such as sugar cane, sun flower and coffee. The types of animal farming systems practiced are semi-intensive and intensive systems (http://www.gicumbi.gov.rw).

Population and sampling

The population size of the study was 1650 agro forestry farmers distributed in three cells of Rwamiko Sector. The sample size was determined with the help of Alain BOUCHARD formula.

$$n = \frac{No}{1 + \frac{No}{N}}$$

n: Represents the sample size to be determined, **No:** Represents the sample size of 67 individuals for infinite population, **N:** Represents the size of the total population that practice agro forestry farming (1650 people).

$n = \frac{67}{1 + \frac{67}{1650}} = 64$, thereafter 64 agro forestry farmers were determined as respondents.

Results and Discussion

Classification of respondents based on socio-demographic characteristics

Table 1. **Characteristics of respondents**

Gender		Frequency	Valid Percent	Cumulative Percent
Valid	Male	42	65.6	65.6
	Female	22	34.4	100
	Total	**64**	**100**	
Age				
Valid	18-25	9	14.1	14.1
	26-35	18	28.1	42.2
	36-45	24	37.5	79.7
	46-65	13	20.3	100
	Total	**64**	**100**	
Marital status				
Valid	Married	56	87.6	87.6
	Widowers	6	9.3	96.9
	Single	2	3.1	100
	Total	**64**	**100**	
Education level				
Valid	Illiteracy	6	9.3	9.3
	Primary	44	68.7	78
	Vocational	3	4.7	82.7
	Secondary	11	17.3	100
	Total	**64**	**100**	

The high number of 65.6% for males against 34.4 % of females is associated to Rwandan culture where husband is regarded as head of the family and all trees grown at family level belong to him. It is now clear that gender disparities affect land access, tenure security and sustainability which make female more vulnerable to shocks (Ardayfio-Schandorf, 2007). The different ranges of ages are depending on several factors such as socio economic issues, active age, responsibility, family size, etc. The age distribution indicated that majority of the respondents were of the middle age class (36-45). According to Chandra M.P. (2005), many people of this class have access to land resources through individual ownership or communal land use or through inheritance from family members. For the marital status, the married people are dominating at a high rate (87.6%) due to early marriage is dominant by the time they are 18 years old in the study area. Girls are forced to be married by their parents or male abductors for various economic and cultural reasons (Mugarura R., 2014). In education sector, the high number of respondents (68.7%) in primary school is associated to the former education system in the country which did not interest young people to continue with their studies. This defy was confirmed by Gakuba (1991) by indicating that less than 10 per cent of primary leavers went on to secondary school in 1990. The transition rates from primary to secondary school were 7 per cent in 1972 and reached a level of 10 per cent by 1992.

Agro forestry species applied in Rwamiko sector

Table 2: Types of agro forestry species grown in farmlands

Valid	Frequency	Valid percent
Avocado	35	54.7
Grevillea robista	28	43.8
Calliandra spp	24	37.5
Alnus acuminate	21	32.8
Leuceana leucocephala	16	25
Cedrella serata	7	10.9
Papayer	6	9.4
Mangoes	3	4.7
Citrus	2	3.1

As shown in the table above, the large number of respondents (54.7%) who grow avocado may be to its role in livelihoods improvement as source of consumable fruits and money income. It is the same case for *Grevillea robista* (43.8%) that, apart from soil protection, provides timber as source of income in livelihoods improvement. A considerable number of leguminous trees such as *Calliandra spp*, *Leuceana leucocephala* are produced for animal feeding purpose (Sammy C. *et al.* 2013). Some fruits (mangoes, papaya and citrus) were appreciated by agro forestry farmers to be nutritious and making profits for their family. These findings are similar to results confirmed by Nair (1993), who said that agro forestry species may provide fruits, fiber, nuts, building and craft materials, medicines, timber, charcoal, and a host of other products which can be used on-farm or sold.

Agro forestry systems applied by farmers in Rwamiko Sector

Table 3. **Types of agro forestry systems adopted**

Valid	Frequency	Valid percent
Agrosilvopasture	46	71.8
Agrisilviculture	41	64
Silvopasture	12	18.7
Apisilviculture	5	7.8

Agrosilvopastoral system (combination of trees, livestock and crops) occupy the first place with 71.8%. It is highly practiced by farmers because it plays many purposes of producing food and increasing soil fertility. Most agroforestry species used in this system are *Grevillea robista*, *Calliandra*, A*lnus acuminate* and *Leuceana leucocephala.* For Agrisilviculture system (combination of crops and trees), 64% of agro forestry farmers used to mix big trees with some leguminous trees (*Leuceana leucocephala, Leuceana leucocephala)* for feeding their animals, mainly cattle in zero grazing system. Trees also act as windbreaks, preventing crop damage.

In silvopastoral system (combination of livestock and trees), 18.7% of small agro forestry species are mainly used for fodder production to animals. During the study, the researchers found that beekeeping is applied by few farmers (7.8%). Therefore it seems logical, compatible, and pragmatic to accept the components as the basic criteria in the hierarchy of agro forestry classification (P.K. Ramachandran Nair, 1993).

Agro forestry practices under agro forestry systems

Table 4. **Types of Agro forestry practices applied by farmers**

Valid	Frequency	Valid percent
Scattered trees /dispersed trees	56	87.5
Home and tree garden	52	81.3
Alley cropping/ hedgerows in cropland	27	42.2
Shade trees	16	25
Contour tree planting	14	21.9
Woodlot	8	12.5

The most agro forestry practice is scattered trees or dispersed trees (81.3%) on farms, whereby perennials were randomly grown in relatively wider spacing from each other. Home gardens are located either close to the homestead or a nearby cropland and agroforestry farmers (81.3%) incorporate and integrate crops and livestock with indigenous trees such as *Ficus* spp. *Erythrina abyssinica*, *Iboza riparia, Vernonia amygdalina* and some agro forestry species mentioned in table 2*. These trees* are also planted on contour land (21.9%) either for land demarcation, stakes, fire wood and/or timber production. For alley cropping (42.2%), crop strips alternate with rows of closely spaced tree or hedge species. In the similar study, Paul (2002) confirmed that alley cropping has been shown to be advantageous in Africa, particularly the sub-Saharan region and said that it facilitates agricultural activities and increases the cultured area.

As indicated by http://www.fao.org/docrep, the home garden is an extremely important piece of land in Africa and as its name suggests, it can be located either around or near the home operated by a rural household. The home garden produces many different things: food, income, fuel for cooking, herbs, spices and flowers. Other farmers (25%) used to select trees such as *Acacia* spp. with good canopies to provide shade for coffee and livestock against sun scorches.

Utility of agroforestry for livelihood improvement

Agro forestry products

Table 5. **Type of harvested Agro forestry products**

Valid	Frequency	Valid percent
Fire wood	64	100
Timber	56	87.5
Fruits	46	71.9
Fodder and forage	40	62.5
Charcoal	4	6.3

The highest use of agro forest products is associated with the production of fire wood, where all respondents affirmed to harvest mature branches of trees for preparing food at household level. As indicated by Thorlakson and Neufeldt (2012) in a similar study, where agroforestry is practised by smallholders, less fuel wood needs to be purchased, there is less reliance on collecting from natural stands and less time is involved in collection. This leaves more time for income-generating activities, especially for women, who are usually the major fuel wood collectors. Many agro forestry farmers grow agro forestry trees for the purpose of timbers. When trees get old, they are harvested for giving timbers and this is done by 87.5% of farmers. The fodder is used by 62.5% of agro forestry farmers in animal feeding while fruits are produced by 71.9% of respondents and avocado fruits come first to be produced at a high level. Only 6.3% of respondents got charcoal from trees and this small number is due to environment policies and legislations which discourage people to burn their forests.

Agro Forestry Services

Table 6. **Type of Agro forestry services for livelihood improvement**

Valid	Frequency	Valid percent
Shade and windbreak	64	100
Protection of soil from erosion and loss of nutrients	61	95.3
Improvement of soil moisture and fertility	54	84.4
Ability of health insurance payment	52	81.3
Ability of school fees payment for children	48	75
Increase of food security	43	67.2
Accessibility to household equipments	36	56.3
Saving and investments	28	43.8

All respondents were proud of the role of agro forestry trees in protecting both crops and houses against strong winds which can cause damage. In addition, these trees also improve the microclimate and beautification of the farmlands and households. 95.3% of respondents acknowledged the importance played by trees in soil conservation and fertility and enriching nutrients to soil while 84.4% appreciated how soil fertility was increased due to the availability of trees in their farmlands. For socio economy services, it was revealed that trees provided food, shelter materials, energy, medicine and cash income to meet social obligations like good health and education of family members. Trees used in agroforestry also provided a variety of services such as being a form of saving and investment for income generation activities.

Conclusion

In this study, findings showed that there are various agro forestry species mixed with crops and animals under different agro forestry practices in four main agroforestry systems which are agrosilvopastoral system, agrisilvicultural system, silvopastoral system and apisilviculture. Different products collected from agro forestry systems helped farmers to improve their livelihoods systems. Therefore, it was highlighted that agro forestry products made an increase of income generations and investments, improvement of education for family members, health insurance named *"mutuelle de santé",* and sustainability of food security. This study would like to advise the agricultural extension services in Rwanda to keep promoting agro forestry systems in different rural areas because this study has revealed that rural farmers were able to improve their livelihoods systems while boosting food security and assure farmlands management.

Acknowledgements

The authors would like to thank all respondents of the study and local leaders in Rwamiko Sector for providing the relevant information to conduct this research work.

References

Ardayfio-Schandorf, E. 2007. Gender Mainstreaming in Forestry in Africa, Ghana.Food and Agriculture Organization of the United Nations, Rome.

Beer, J., Muschler, R., Kass, D. & Somarriba, E. 1998. Shade management in coffee and cacao plantations. *Agroforestry Systems*, 38: 139-164.

Chandra M.P., 2005. A study on entrepreneurial behaviour of farmers in Raichur district of Karnataka.

FAO, 1991. Fuel wood supplies in the development countries. FAO Forestry paper N^{0} 42, FAO.55P.

Gakuba, E. 1991. Accroissement et amélioration de la qualité de l'éducation de base
http://www.fao.org/docrep/003/x3996e/x3996e03.htm
http://www.gicumbi.gov.rw
https://businesswales.gov.wales/farmingconnect/posts/agroforestry-opportunity-sustainable-intensification-farmland-improve-productivity-and-reduce.

Huxley, P.A., 1984. Education for Agroforestry. United Nations University, Tokyo, Japan.

Mugarura R., 2014. Rwanda: Why Child forced marriage is dominating Africa at a high rate

Nair P.K.R., (1993). An Introduction to Agroforestry: Kluwer Academic Publishers. Netherlands.

P.K. Ramachandran Nair, 1993. An introduction to Agroforestry

Paul A., 2002. Agroecological Perspectives in Agronomy, Forestry and Agroforestry. Science Publishers Inc., Enfield, NH, 356p.

Sammy C., Ben L., Judith S., and Charles W. 2013. Fodder trees for improving livestock productivity and Smallholder livelihoods in Africa Steven Franzel

Thorlakson, T. & Neufeldt H., 2012. Reducing subsistence farmers' vulnerability to climate change: evaluating the potential contributions of agroforestry in western Kenya. *Agriculture & Food Security,* available at: www.agricultureandfoodsecurity.com/content/1/1/15).

Organic Agriculture, Food Safety and Supply in Northern Ghana - CAOF's Strategy

Agana L. Gerard

Coalition for the Advancement of Organic Farming, Ghana

Corresponding author:
caofinfo@yahoo.com

Keywords:
Climate variability, CAOF, Organic Agriculture, Ghana

Abstract

Northern Ghana covers the three regions in the north of Ghana and parts of Northern Brong Ahafo Region and Northern Volta. It covers a large part of the Savannah vegetation of Ghana and suffers from declining soil fertility, food insecurity, climate variability and change. Organic agriculture has the potential to reverse these ills even though the advocates of conventional agriculture may disagree with this assertion. The Coalition for the Advancement of Organic Farming (CAOF) has seen organic farming as the way to tackling these challenges in a sustainable manner. CAOF has conducted various research, developed and implemented projects and has seen that this strategy is actually addressing these challenges. This paper presents CAOF's strategy in trying to address organic agriculture, food safety and supply concerns in Northern Ghana and highlights some of the successes so far. The paper also identifies some of the challenges so far in its work in the organic agriculture sector in Northern Ghana and concludes with the way forward for the coalition.

Introduction

The world today is facing a deep and growing crisis as a result of the way food is produced, processed and distributed, confounded by the ravaging effects of climate change. The planet's ecology, health of its inhabitants, societal stability, fairness and care are being threatened by the industrial revolution driven by greed and profits. Sustainability has been thrown to the back burner and children are born into an unsustainable future. The continent of Africa is not left out in this global industrial revolution as the multinationals see it us an untapped zone where huge profits can be raked-in. Unfortunately, this is done through African governments who trade the ecology, health, fairness and care of their people and the environment for self-profiteering and political capital.

The food economy is the biggest employer in West Africa. The various activities involved in producing food, from the farm to processing, packaging, transporting, storing, distributing and retailing, account for 66% of total employment, or 82 million jobs. While the majority of these jobs (78%) are in agriculture, off-farm employment in food-related manufacturing and service activities is growing in number and share[1]. In Ghana the story is not different from other African countries. Ghana's agriculture sector continues to be a central driver of the economy despite the structural modifications that have occurred over the years. For a sector that employs 44.7% of the active labour force as revealed in the Ghana Statistical Services Report[2], a substantial growth is likely to have a huge impact on the economy considering the fact that the sector is also a major source of revenue for the government. The sector

[1]Allen, T., P. Heinrigs and I. Heo (2018), "Agriculture, Food and Jobs in West Africa", *West African Papers*, No. 14, OECD Publishing, Paris
[2]Ghana Statistical Services 2014, Ghana Living Standards Survey Round 6

according to the Ghana Statistical Services (2017)[3] has expanded marginally from a growth rate of 2.8 percent in 2015 to 3.0 percent in 2016. Its share of Gross Domestic Product (GDP), however, declined from 20.3 percent in 2015 to 18.9 percent in 2016. The crops sub-sector remains the largest activity with a share of 14.5 percent of nominal GDP.

The sector has witnessed continuous use of synthetic inputs mainly because of a growing loss in soil fertility levels and the need to increase food production levels, enhance food security and reduce poverty levels. Farmers have particularly adopted strategies such as intensive use of land, agrochemical usage, irrigation, disease and pest resistant varieties and so forth to increase crops yields and guarantee food security. Farmers are highly motivated to using these strategies due to the emphasis placed by most agricultural development policies in Ghana which suggest the use of external inputs such as machinery and agrochemicals as the panacea to increasing food productivity. This has led to increasing the use of synthetic agrochemicals instead of the biological, cultural, and mechanical method for boosting production, controlling pest, weed, and disease (Mabe *et al,* 2017). According to Savci (2012), some of these chemical fertilizers are agricultural pollutants that can pose health problems such as cancer.

According to FiBL & IFOAM report (2015)[4], organic agriculture only uses 0.2% of Ghana's Agricultural land. This means that 99.8% of Agriculture in Ghana is inorganic and uses various chemicals that are hazardous to human health. The figure further reduced to 0.1% in 2016, meaning 99.9% of Ghana's agricultural land is inorganic. This development is very worrying and a lot of work needs to be done to change the trend.

Coalition for the Advancement of Organic Farming (CAOF)

CAOF, a membership coalition of organisations and individuals engaged in organic farming activities was formed in 2008/09 and is working with the Ghana Grows Organic project in order to create a "strengthened and vibrant movement of organic producers and consumers promoting Ghanaian organic products nationally and internationally." The organizations making up CAOF have been working with their farmers, training and educating them on the benefits of organic farming both in terms of income and environmental sustainability. It is a coalition of individuals, private, non-profit, voluntary non-governmental organizations in Ghana. The aim of the Coalition is to enhance the development of individuals, Private and Voluntary Organizations and actively engage in policy dialogue with Government to promote an environment, supportive of the development initiatives of its members.

CAOF was started by a few members who tried to get their small holder farmers certified as organic producers through foreign certifying bodies. This however was an expensive and unsustainable way to go. CAOF was therefore formed to mainly advocate for the promotion of organic agriculture in Ghana. However, based on the experiences in implementing the Ghana Grows Organic (GGO) project since 2010 and in piloting the Northern Ghana Green Market in the Upper East Region, the new direction of CAOF looks at moving away from a purely advocacy focus to practical work in supporting farmers to grow organic food, find markets for the produce and the development of the entire vegetable value chain. Currently, CAOF has a membership of 17 Organizations working closely to promote organic farming in Ghana. The members work with over 17,000 small holder farmers with women representing fifty-nine (59%) of the total number. However the current project is targeted at transitioning 3000 farmers to wholly organic practices.

[3]Ghana Statistical Services 2017, Provisional 2017 Annual Gross Domestic Product
[4]FiBL & IFOAM (2015): The World of Organic Agriculture 2015, Frick and Bonn

Food Safety Issues in Northern Ghana

Consumers world-wide are becoming concerned about the quality and safety of their food, given the effects of pesticides, fertilizers, livestock effluent and veterinary drugs on their health and livelihoods. Inappropriate use of chemical inputs has become a big problem in Ghana. The situation is even worse in the northern part as most farmers are illiterates (43% in rural areas) and tend to misuse chemical fertilizers and pesticides resulting in fatal accidents and sometimes death. For instance a farmer had to lose his life and that of his wife and two children in Zebilla (in the Upper East Region) due to a pesticide spillage in the food they carried to the farm for lunch[5].

Most of the irrigated lands have become acidic and cannot support all crops. According to the Upper East Regional Plant Protection and Regulatory Services Directorate (PPRSD) of the Ministry of Food and Agriculture (MoFA), Tono Irrigation area can no longer produce tomatoes due to over reliance on chemicals. The directorate also indicated that a Pesticide Regulation Policy exists but farmers were not adhering to it. However, consultations with farmers showed that they have little knowledge of the policy[6].

As a result of some of these challenges, food safety has become an issue, access to the supply of safe foods has become a problem due to the under developed nature of organic farming in northern Ghana. CAOF is therefore working towards addressing these issues through its strategic approach.

CAOF's Strategy

In the quest to achieve the aims and objectives of CAOF, the Coalition uses three main strategies that run through all its programming. These include research, advocacy and awareness creation and extension service delivery to farmers. All these are achieved through the building of strong institutions and policies and participation of members.

Research: Since its inception, the coalition has been researching into the organic sector in Ghana to get better informed to undertake its advocacy and project activities. In 2008 a survey was conducted to identify the various organizations that are into the organic sector and could join the coalition to advance its objectives.

In 2014, CAOF, through its Northern Ghana Green Markets project, commissioned the Savanna Agricultural Research Institute to conduct a research on the vegetables produced by its farmers in the Bolgatanga area and its environs and the key actors involved in the value chain. This research informed the direction of the next phase of the project. This year (2018) another research has been carried out to assess the extent to which organic agriculture has been considered in current government's policies and programmes.

Advocacy and awareness creation: CAOF as a coalition has its main focus on advocacy and lobbying of Government to create a suitable environment for the production and promotion of organic agricultural produce in the country. The coalition also lobby grass root institutions such as land owners to remove barriers to organic agriculture sector as land tenure systems that militates against organic farmers. Recently CAOF started another advocacy action that is seeking appropriate inputs and certification for organic farmers in Ghana. One of the key activities of the coalition is consumer education to create awareness on the consumption of organic products and to create local market for organic farmers.

[5]Experienced shared by his fellow farmers during a farmers forum in Zebilla in 2011

[6]Stakeholder Consultative meeting organized by CAOF in 2015

Extension service delivery: As a network with most members being Non-Governmental Organizations (NGOs), there is therefore the need to raise funds to implement projects and deliver innovative extension services to farmers. CAOF projects are designed using the Participatory Market Systems Development (PMSD) approach. PMSD is an approach designed by Practical Action to make markets more inclusive, reduce poverty on a large-scale and protect the environment. PMSD is designed to bring all of the key people (market actors) within a particular market together to build trust and a joint vision of change. They collectively identify obstacles and opportunities affecting their market system and come up with joint strategies and action plans that will overcome these obstacles. CAOF through this approach has therefore put in place systems and structures that help to design projects and raise funds for implementation. The projects are often monitored strictly by the executive committee and the secretariat to ensure that donors and the coalition get value for money. Each project is often evaluated at the end of the project and the next steps taken to ensure sustainability.

Some successes so far

CAOF over the years have undertaken various projects successfully, some of which include;

- Working with the Business Sector Advocacy Challenge (BUSAC) Fund to advocate on the dangers involved in the misuse of agrochemicals. This advocacy process was carried out to even the parliamentary select committee on Agriculture. This has contributed to the establishment of an organic desk at the Ministry of Food and Agriculture offices in Accra and there is hope that the next medium term agricultural policy of Ghana will include organic farming.
- CAOF has also featured in the Time for Climate Justice and "We HaveFaith" Conference and made contributions at COP17. Time for Climate Justice is a global movement led byAssociation of World Council of Churches related Development Organisations in Europe (APRODEV), the association of the 17 major development aid organizations in Europe and working in close partnerships in the global south.
- CAOF has been working with the Ghana Grows Organic Consortium which is made up of Christian Aid, Voluntary Service Overseas (VSO) and Concern Universal to implement the Northern Ghana Green Markets Projects since 2010. This project piloted the Ghana Green Label Standard in the north and contributed a lot to fine-tuning the Ghana Green Label scheme which was finally launched in September, 2015.
- CAOF is currently working with Christian Aid to promote and develop the value chains of selected vegetables in Ghana and with BUSAC Fund to advocate for appropriate inputs and certification for organic farmers in Ghana.

Challenges

Funding has been a major challenge as very few donor institutions are willing to fund organic projects. Membership dues and the few donors are not able to support the huge impact that the coalition wants to create.. Another serious challenge is the government's fertilizer subsidy program which has given a lot of conventional inputs to farmers. This affects the coalition's work negatively as farmers increasingly try to go for these inputs. They rely on these inputs as a result of the lack of local market segregation that offers premium for organic farmers.

Conclusion

In conclusion, it should be noted that in addressing the issues relating to the organic sector, food safety and supply, CAOF remains in a pole position to address them through its strategies. With the use of the

PMSD approach, CAOF is ready to develop various strong organic agricultural market systems in Ghana. The desire to engage government in dialogue (not antagonistic advocacy), is a high hope to get government support in the quest to increase the organic market share in Ghana. We will also continue to educate the consuming public, farmers and other key stakeholders on the benefits of organic agriculture to the environment, health and social justice (care and fairness). CAOF is looking forward to partners who share in this course and belief in our strategy.

References

Allen, T., P. Heinrigs and I. Heo (2018), "Agriculture, Food and Jobs in West Africa", *West African Papers*, No. 14, OECD Publishing, Paris.

Ghana Statistical Services 2014, Ghana Living Standards Survey Round 6.

Ghana Statistical Services 2017, Provisional 2017 Annual Gross Domestic Product.

FiBL & IFOAM (2015): The World of Organic Agriculture 2015, Frick and Bonn.

Impact of Climate Change on Cassava Farming a Case study of Wabinyonyi Sub county Nakasongola District

Magado Ronald and Ssekyewa Charles

Nakasongola District Farmers Association, P.O Box 1, Nakasongola District, Uganda

Corresponding author: rmagado@yahoo.com

Keywords:
Climate change, mitigation mechanism, mixed cropping system, cassava, food security

Abstract

Cassava is a potential crop to improve the livelihood of people but findings from this research through conducting interviews from respondents show that 97.8% responded that climate change contributed to the decline in yield. There is increased incidences of pest and diseases that cause rotting of the tubers that are the economic part used by the people. The study recommends that the Government of Uganda should strengthen climate change issues through line ministries such as Ministry of Agriculture, Animal Industries and Fisheries, Ministry of Lands, Housing and Urban development; Ministry of Water and Environment in terms of policies to support the development of smallholder farmers during this era of climate change. Nakasongola District Local Government and its development partners should strengthen agricultural service delivery in all areas particularly climate change smart agriculture and much attention should be put on cassava value chain from production, value addition and marketing as a high value crop for both food security and income generation.

Introduction

Cassava is widely grown and has the potential to alleviate poverty in Uganda. Cassava (*Manihotesculenta Crantz*) is an important food and cash crop for small holder farmers in Nakasongola District. Besides, it's a source of industrial raw material. Products obtained from cassava include chips//pellets for human consumption, high quality cassava flour for confectionery-(bread/cake making as a substitute to wheat flour), animal feed and starch for industries. However, recent studies show that the production of the crop is grossly constrained by poor agronomic practices, pests and diseases notably cassava mealy bug and African cassava mosaic disease (ACMD), cassava brown streak disease(CBSD) inadequate post-harvest technology; and poor marketing structure . Since 1987, cassava has been the major food crop in Nakasongola District.

Climate change is a term used to describe a gradual shift in the current state of climate over at least several decades; example the Sahara used to have a rainy climate and now has a dry one. Climate changeis directly or indirectly attributed to human activity which alters the composition of global atmosphere and additionally the natural climate variability observed over comparable time periods (Luziraa *et al.* 2007). The changes include erratic rainfall on-set which comes early or late, poor rainfall distribution, and little rainfall. The temperatures vary between too hot, moderate and extremes of too hot or too cold.

Around the world, the climate is changing. Average global temperatures are rising - the 20th century was the warmest the world has seen in 1,000 years, and the 1980s and 1990s were the warmest decades on record (Stern, 2006, ODI, 2007). Climate change affects food security system and all components of food security through multiple paths. A warmer world with a more intense water cycle and rising sea levels will influence many key determinants of wealth and wellbeing, including water supply, food production, human health, availability of land, and the environment. The poor will be hit earliest and most severely (Stern, 2006).

With climate change, people's ability to access food may be affected due to reduced income from loss of livelihood or slow macro economy due to low export market, poor or no transport to market, high price of food in the market, poor human health due to susceptibility to malaria and other climate change-induced diseases which undermine livelihood capability. As climate changes, the types of seed cultivars and varieties that can be grown also change.

According to the IPCC (2001, 2007 and ,) reports, global warming has accelerated in recent decades and that there is new and stronger evidence that most of the warming over the past 50 years is attributable to the increase in greenhouse gas emissions such as carbon dioxide, methane and nitrous oxide which are associated with human activities. During the past century, global surface temperatures have increased at a rate near 0.06°C/decade (0.11°F/decade) but this trend has increased to a rate approximately 0.18°C/decade (0.32°F/decade) during the past 25 to 30 years.

(Stephen *et. al.* 2007) asserts that climate change is more than a warming trend. Increasing temperatures is as a result in changes in many aspects of weather, such as wind patterns, the amount and type of precipitation and the types and frequency of severe weather events that may be expected to occur in an area. Climate change and the threat of related extreme conditions such as floods and droughts is a concern to all States. Climate change has serious implications on development, particularly for poor countries like Uganda and communities like in Nakasongola who have fewer resources to cope with the additional shocks and stress a changing climate will bring. The changes in climate, the impacts on physical and biological systems, the vulnerability of ecological and human systems, and the harmful and beneficial consequences for human well-being and sustainable development will be conditioned by exposures to other stresses and the capacity to cope, recover and adapt, all of which will vary across space and time. Global warming has far reaching implications on social and economic development and the entire global ecosystems. Indeed it threatens to undo many years of development efforts and frustrate poverty reduction programmes in developing countries and overall global development targets.

Climate change will therefore not only delay the achievement of the Sustainable Development Goals (SDGs) in many countries but escalate hunger and human suffering. Our actions now and over the coming years could create risks of major disruption to economic and social activity, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century and it will be difficult or impossible to reverse these changes (Stern, 2006).

Vincent et al. (2010) pointed out that projected climate change such as increase in temperature and reduction in precipitation will change the availability of natural resources such as forests and potentially affect the growth of staple crops due to increased drought and water shortages. Cassava being one of the staple crops is equally affected by climate change in terms of drying of cassava plants, increased incidences of pests such as mealy bugs and white flies which results in increased incidences of diseases such as CBSD. This leads to reduced yield as root tubers are rotten. There is scarcity of cassava planting materials as they are affected by CBSD and eventually leads to low cassava production which can result in food insecurity. Increased extreme weather events such as hailstorms, drought and floods can also damage cassava plants and eventually affect the livelihood of the people.

Cassava yields per unit area of production in Uganda like in other Sub Saharan African (SSA) countries is declining. The main contributing biophysical factors are nutrient or soil fertility depletion, low soil fertility particularly N and P deficiencies, cultivation of marginal land and continuous cropping; unreliable rainfall, increased incidences of pests, diseases, and increased temperatures due to climate change. These pose a threat to food security in the area.

Objective

The major objective of the study was to assess the effects of climate change on farmers' livelihoods in cassava agro ecological farming system in Wabinyonyi Sub County Nakasongola District.

Methodology

The researcher adopted a descriptive cross- sectional survey design. Both quantitative and qualitative design was used in data collection. This design facilitated the collection of both qualitative and quantitative information. This approach was used to get data from respondents. Data derived from quantitative by use of questionnaires, qualitative interview guide and focus group discussions (FGD_S) was edited, coded and analyzed using cross tabulation and chi-square in SPSS computer programme. Cross tabulation was frequently employed to examine the relationship between two variables usually nominal or ordinal. Chi-square determined whether or not there is a statistically significant association between two variables. If the variables are not associated, they are said to be statistically independent. As an inferential statistics it allowed to draw conclusions about the population on the basis of the sample results. Here half or close to half of the respondents were affected by climate change and the other half or close to half of the respondents were not affected by climate change. Photographs were taken during data collection to show actual physical features associated with the impact of climate change on cassava farming. Quantitative data obtained was analyzed using Statistical Package for Social Sciences (SPSS) computer program. Cross tabulation tables, chi-square and bar graphs were drawn to different variables to draw conclusions.

Area of study

Nakasongola is located in the central part of Uganda and boarders with the districts of Masindi and Kiryandongo in the west and north west, Luwero in the south, Mukono and Kayunga in the east, Lira and Amolatar in the north east, and Apac in the north.

According to National population and housing census results, UBOS (2014); there are 36,620 households in Nakasongola with a population of 181,800 of which 50% are pure crop farmers. 97% of the crop farmers do farming at subsistence level and do depend on family labour and rudimentary tools. Women and children provide most of the family labour, there is limited participation by men and youth. Approximated area of the District is 3424.4km^2; representing 1.412% of the country's total surface area. 321.6 sq. km is occupied by swamps (wetlands) and the lake. Approximate arable land is 912.6km2 and area under cultivation is 228.2km^2(Nakasongola district council, 2011/12- 2015/16).

Nakasongola district was created by the act of parliament and started operating on the 1/07/1997. Buruuli County that formed Nakasongola District was formerly part of Luwero District. The District has 8 sub counties and 3 town councils: Kakooge, Kalungi, Kalongo, Wabinyonyi, Lwampanga, Lwabiyata, Nabiswera and Nakitoma sub counties; Nakasongola, Migeera and Kakooge Town Councils (Nakasongola district council, 2011/12- 2015/16).

My scope of work for research study was in Wabinyonyi Sub County in Nakasongola District targeting 180 farmers and 20 other extension workers/leaders totaling to 200 respondents out of 380 stakeholders along cassava value chain. Wabinyonyi Sub County has a population of 13,816; 7,098 male and 6718 female; 2,408 households and eight parishes: Kageri, Ssasira, Kamunina, Kyamuyingo, Kiwongoire, Sikye, Wabigalo and Wampiti, (Nakasongola district council, 2011/12- 2015/16).

Wabinyonyi Sub County is one of cassava growing Sub Counties in the District. It is located in the centre of the District. Nakasongola Town Council was curved off from Wabinyonyi Sub County.

Farmers in this sub county grow cassava for both food security and income generation. It is one of the sub counties that is affected by climate change that consequently affect cassava production.

Sample size and sampling techniques

Stratified random sampling method was used in Sample selection. Stratified random sampling is a probability sampling technique where the subjects were grouped into different classification or strata such as age, gender and educational attainment. I selected 184 cassava farmers in Wabinyonyi Sub County of Nakasongola and other stake holders to represent the population of 380 cassava farmers in Wabinyonyi Sub County. This was determined with guidance of sample size determination tables designed by Amin (2005). The studies suggested that for every 320 potential subjects, 172 subjects should be considered for study. This means that an adequate representative sample should be more than 50% of a given population sample.

However, Sakaran (2003) asserts that, it would be practically impossible to collect data from all and every element of the study population. Therefore, in this study the researcher based on the above recommendations to come up with the selection of categories along the cassava value chain.

Data collection methods and instruments

The researcher used secondary data and primary data which were collected through: questionnaires, interviews, observations and group focus discussions.

Self-administered questionnaires

The questionnaires comprised of structured and semi structured questions based on the research hypothesis. The use of self-administered questionnaires on the selected respondents was being important as regards the sample in the study population. The various respondents were: farmers, traders, processors, extension workers and local leaders. It was be important to have a diversity of respondents in order to give in-depth information about the situation in the study area.

Semi qualitative interview guide

Studies carried out by Best and Kahn (1986) pointed out that nervous respondents are more willing to talk than write. This means if a good enabling environment with such respondents, where a friendly rapport was established, makes them avail sensitive information than telling them to write it. These two authors pointed out that by interviewing such respondents/farmers, the research could access useful research information better than any other ways. The researcher applied semi qualitative interviews on the farmers as they were the principal informants in this study. The use of interviews on farmers disclosed several issues that were important in this study to understand the impact of climate change on cassava farming in Wabinyonyi Sub County.

This method was administered to key respondents like farmers who could not write to get in depth sensitive information for the researcher. Face to face interviews immediately generated answers to the researcher and it reduced fears among respondents, hence confirming Best and Kahn (1986) study that pointed out that respondents are more willing to talk than write.

Observations and focus group discussions

This was guided by the themes arranged according to research objective. The researcher and respondents shared views about the effects of climate change on farmers' livelihoods in cassava agro ecological farming system in Wabinyonyi Sub County. During the discussions, the researcher took notes of the views from the respondents as well as observing their reactions and the area.

Data analysis

The researcher analyzed data by use of both descriptive and quantitative method of analysis with help of SPSS computer programme. The researcher generated categorical and numerical data from different categories of respondents. In descriptive (exploratory) statistics the presentation of the body of data was made in form of tables and graphs. At multivariate level (cross-tabulation) data was analyzed in frequency tables and data at univariate and bivariate level data was computed and presented in the form of figures. At inferential (confirmatory) statistics the sample was examined to reach the generalization about a population. This was done by hypothesis testing which involved the computation of population parameters for a hypothesized relationship between the variables for inference. Chi-Square test was also used to assess the significance of the difference between the proportions.

Methods of data presentations depended on nature of data obtained. In table, respondents view points were captured, grouped and analyzed both by statistically, frequencies and percentages.

184 respondents were served with questionnaires and interviewed for data collection in the study area. In this survey, focus group discussion was done and data was collected. After that data was coded, processed, analyzed and presented by use of SPSS with cross tabulation tables and chi-square. However, excel spread sheet was also used to come up with bar graphs.

Result presentation

Members of household in their cassava garden that appears to be clean but with rotten roots in figure 1

Figure 1. **Household members in their cassava garden. And without cassava, the household of this size with children is at the risk of food shortage and poverty**
Photo taken by Magado Ronald

i. 97.8% responded that they were affected by climate change as far as cassava farming was concerned at their households in terms of acreage labeled in figure 1 and table 1.
ii. 82.1% responded that cassava yield was affected by climate change.
iii. Cassava yield was declining due to pests and diseases such as CBSD and cassava tuber rotting as labeled in figure 2.
iv. Mitigation mechanism used by farmers was tree planting such as trees for fire wood, pine, oranges and mangoes. The households interviewed integrated cassava with other enterprises for sustainable development.
v. All households carry out mixed cropping system as a coping mechanism against climate change.

Table 1. **Respondents perception on the effect of climate change in cassava farming**

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
How many acres of cassava per year do you grow * Based on information provided have you been affected by climate change as far as cassava farming is concerned?	180	97.8%	4	2.2%	184	100.0%
What is the yield per acre * Based on information provided have you been affected by climate change as far as cassava farming is concerned?	151	82.1%	33	17.9%	184	100.0%

Source: Author's field results

Figure 2. **Cassava root tubers which are the economic part are affected by CBSD. Household members with such root tubers are at a risk of food insecurity.**
Photo taken by Magado Ronald

In figure 3, 39.4% observed that climate change was the major cause of pests and diseases in cassava.

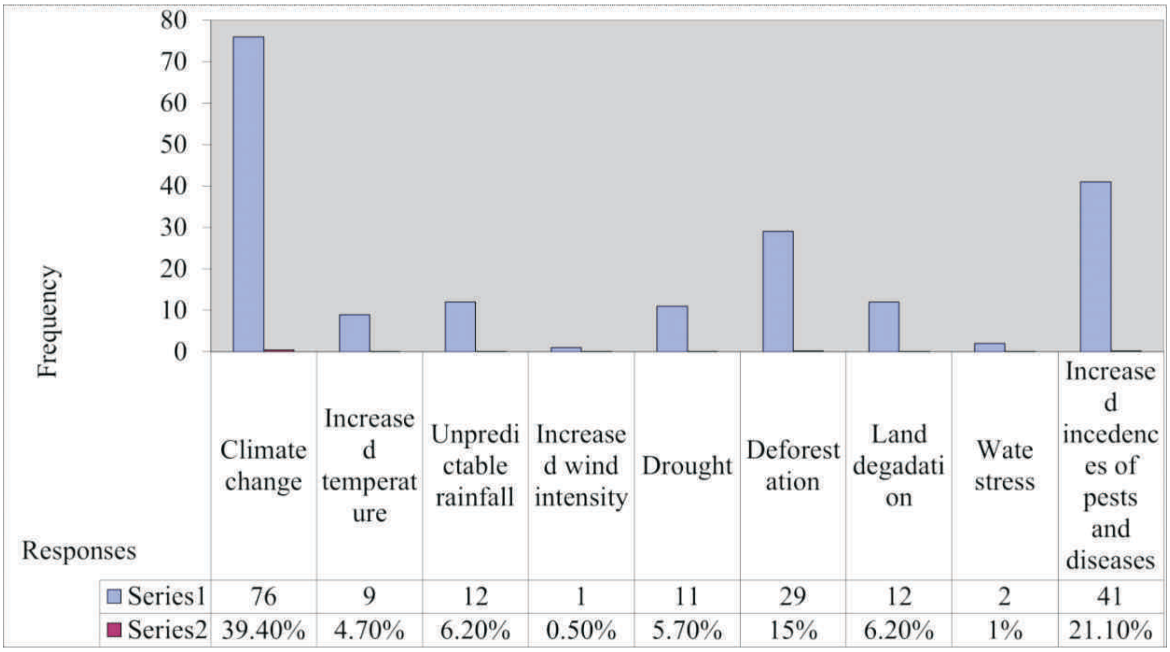


Figure 3: **Causes of pests and diseases in cassava**

The results further show that 60.9% were small holder farmers growing between 1-5 acres of cassava for their household livelihood. These farmers are affected by climate change due to increased incidences of pests and diseases as shown in Fig. 3 and insufficient soil moisture to support the growth and development of cassava plants. This was in agreement with Nakasongola district council, (2011/12 – 2015/16) integrated development plan.

As shown in Table 2, the value of the chi-squared statistics was 8.168. The chi-squared statistics has 2 degrees of freedom (from the df column). The last column gave the two-tailed p value that was associated with the chi-squared value. In this case, the p value equals .017. Therefore, the p value was larger than (0.05) so HI was true and could not be rejected. That is, there is sufficient evidence to conclude there is impact of climate change on cassava agro ecological farming system.

Table 2. **Chi-Square Tests**

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.168(a)	2	.017
Likelihood Ratio	10.223	2	.006
Linear-by-Linear Association	2.207	1	.137
No of Valid Cases	180		

Source: author's field results

This confirmed the hypothesis that there is impact of climate change on cassava agro ecological farming system in Wabinyonyi Sub County affecting farmers' livelihoods.

The researcher together with the farmer were in the field observing cassava field affected by the impact of climate change in figure 4.

Figure 4. **Magado Ronald with cassava farmer observing effect of climate change on cassava farming in Nakasongola District**

In figure 5, shows that planting resilient cassava varieties result into good yield.

Figure 5. **Improved cassava cultivars are quick maturing varieties. Farmers harvest cassava root tubers early as a coping strategy against climate change for both home consumption and income generation**
Photo taken by Magado Ronald

Discussion

The effects of climate change on farmers' livelihoods in cassava agro ecological farming system in Wabinyonyi Sub County

According to Luziraa *et al.* (2007) climate change affects agricultural production in a diverse and complex manner such as increase in temperature escalates soil chemical reactions leading to increase in decomposition of organic matter and therefore release of greenhouse gases like carbon dioxide, nitrous oxide and methane into atmosphere. This process also results in loss of fertility thus affecting yield negatively. On the other side increased temperatures can increase or decrease the yield of certain crops. Temperature increase can lead to extension of growing period for crops in high latitudes and an increase in yield at higher than normal. According to the same author continues to say that the effects of climate change are difficult to predict. Figure 3, shows that cassava farmers (39.40%) were affected by climate change in cassava farming and this qualifies the hypothesis that climate change affects cassava farming. Furthermore results disclosed that cassava farmers (60.9%) grow cassava between 1-5 acres on small scale and their cassava yield was declining due to pests and diseases such as CBSD and cassava tuber rotting that eventually lead to food insecurity at households in the long run. Table 1 shows that 81.2% of the respondents disclosed that their cassava types/varieties grown were affected by climate change leading to low yield. This is because most of cassava varieties released from NARO are just tolerant and not resistant to weather events, pests and diseases. And the other reason could be that most of the farmers have the habit of using the same seed year after year and even they may lack knowledge and skills of seed selection that is resilient to climate change leading to breakdown due to diseases, pests, extreme drought and increased temperatures.

According to Nakasongola district council, (2011/12-2015/16) integrated development plan, there is limited chance for established plants to absorb soil moisture for their physiological processes. Plants are miserable and retarded. And what happens is low yield, Pest and disease infestation (ACMVD/CBSD) has played the major setback of retarding cassava yields in the district. Leaves are malformed and turn yellowish leaving a small surface area for photosynthesis to take place due to *Mealy bug* infestation. The effect of this pest multiplies very fast during the dry season. Stems dry out, leaves shade off and the available tubers are rotten. This problem has been prevalent for the last four years, and it is still a big problem. Massive soil rich in humus is washed away during heavy down pours. This finds its way in valleys. There is no conservation measures put in place at holdings *(bibanja)*. It is common to find bare land without vegetation growth, a sign of land degradation. There is indeed high loss of bio-diversity and soil fertility, partly due to bush burning, charcoaling and poor cultivation methods. There is lack of water harvesting techniques in the field, such as retention ditches, terraces-*(fanyajuu and fanyachini)*. And low yield is expected on such a poor soil. Poor farmers just plant cassava-planting materials on the land, which is not well prepared. This limits the number of plants per unit area. And on top of this there is inadequate weeding, giving chance to the aggressive weeds to compete with the crops. Cassava plants elongate become weak and poor resulting into low yield. Farmers in Nakasongola have low literacy levels. The literacy rate among women stands as 54.7% while that of men is 63.7%. Farmers have inadequate agricultural knowledge and skills. They have limited exposure in agricultural education and training to follow the recommended practices in the cultivation of cassava crop. Many farmers have continued to plant local and diseased planting materials, season after season or year after year. There is insufficient improved cassava varieties owned by few individuals. And the only alternative to the majority of farmers is to plant diseased materials, which give poor yields. Over 90% of the population is subsistence farmers. Much of the food produced is consumed at home. And the levels of savings are very low, hence low income. Very few families have income generating activities. And very few farmers can afford to buy cassava cuttings, usually sold at Ushs. 20, 000 per bag or Ushs. 200 per stem. But still some farmers have negative attitude that cassava cuttings cannot be bought, even if they have money. This is because in the past the Government/Department of Agriculture and other NGO`s used to give farmers farm inputs free of charge (Nakasongola district council 2011/12-2015/16). The labour force used at household level is usually family labour. This involves husband, wife/wives, children and relatives in cassava production. They use rudimentary tools- mainly hand hoe. Women and children provide most of the labour. There is shortage of labour in production as women are involved in many other activities like fetching water, preparing food, looking for firewood and attending to children. In general men do less work as compared to women. Therefore, there is an unequal shared responsibility at household level, a factor that contributes to food insecurity. Inaccessible Extension services which is 0.6% only is a contributing factor to low cassava yields as compared to 90.2% farmers, revealed by the study. Many farmers at sub-county levels have little or no access to Extension Advisors. And where the Extension Advisor is available at the sub- county level, he is not well facilitated with transport and other logistics to enable him cover all the farmers. It is estimated that one Extension Advisor in a sub-county should visit 3000 farmers. This is quite impossible. This means there is communication break down between farmers Extension Advisors as far as new technology transfer is concerned. Farmers end up using their experience a thing that has contributed to low crop yield .The vagaries of weather in terms of the amounts, reliability and distribution of rainfall, constrains production of crops grown in the region. Many farmers in the fertile areas of the region fear to expand production due uncertainty of rainfall. And the findings in Wabinyonyi Sub County were in line with Koutsouris (2009) theory; where agricultural production depended on the hand-hoe resulting into poor tilling capacity, low soil and water conservation and low labour productivity. Inadequate input support: where only a few progressive farmers had access to improved seeds. The majority of the rural population lacked credit facilities and consequently could not afford to purchase agricultural inputs required to boost agricultural production.

Conclusion and recommendations

The study concludes that climate change increased incidences of pests, deforestation, unpredictable rainfall and land degradation as major impacts contributing to declining yield in cassava farming.
The study continues to conclude that cassava farmers' plant improved cassava cultivars such as Nase 1, TME 14, and Nase 14 labeled in figure 5 as a coping mechanism to adapt to climate change.

Furthermore farmers preserve cassava by chipping it, drying by solar energy and then milled to get cassava flour which can be stored for about 6 months given the right moisture content.

The study recommends that the Government of Uganda should strengthen climate change issues through line ministries such as Ministry of Agriculture, Animal Industries and Fisheries, Ministry of Lands, Housing and Urban development; Ministry of Water and Environment in terms of policies to support the development of smallholder farmers during this era of climate change.

More important crop insurance scheme should be high on agenda given the losses farmers experience as a compensation mechanism due to the impact of climate change in cassava farming.

The study also recommends National Agricultural Research Organization through the Root crop programme to strengthen their routine surveillance of re-emerging pests and diseases in a participatory and representation manner along the entire cassava value chain.

Furthermore this study recommends Nakasongola District Local Government and its development partners to strengthen agricultural service delivery in all areas particularly climate change smart agriculture particularly much attention should be put on cassava production, value addition and marketing as a high value crop for both food security and income generation.

Currently Operation Wealth Creation the Government programme under NAADS should continue with distribution of tolerant cassava varieties to Cassava Brown Streak Disease (CBSD) and Cassava Mosaic Disease (CMD) such as NARO CASS 1, NASE 14 in cassava growing areas for food and income security.

References

Amin, E. M 2005. Social science research, conception, methodology and analysis, Makerere University, Kampala.

Best, J & Kahn, V. J 1986. Research in education, London, Prentice Hall International.

Burns, A., Gleadow, R., Cliff, J., Zacarias, A., Cavagnaro, T., 2010. Cassava: The Drought, War and Famine Crop in a Changing World. Sustainability 2, 3572–3607. https://doi.org/10.3390/su2113572.

IPCC, 2001. Climate change ,Impacts, Adaptation and Vulnerability, Contributions of working group II to the third assessment report of the Intergovernmental panel on climate change -IPCC/WMO/UNEP. Available online at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

IPCC, 2007. Climate Change Synthesis Report, Summary for Policymakers, WMO,

IPCC, 2008. Intergovernmental Panel on Climate Change (ipcc).

Kazemier, B., Rensman, M., 2017. Sustainable development goals 74.

Koutsouris, A 2009. The effect of local versus regional data in water management planning, A Case Study in Kisumu, Kenya.

Luziraa, F. Yakobo, M. Otuba, S & Rugyendo, M (eds) 2007. National adaptation program of action on climate change. Government of Uganda. Kampala.

McIntyre, B.D., International Assessment of Agricultural Knowledge, Science and Technology for Development (Eds.), 2009. Sub-Saharan Africa (SSA) report, Agriculture at a crossroads. Island Press, Washington, DC.

Nakasongola District Council 2011/12 – 22015/16). A five year Development plan, Nakasongola.

ODI, 2007. Natural Resource Perspectives.

Otim, N. *et al,* 1994. Cassava Development in Uganda a Country Case Study towards a Global Cassava Development Strategy.

Roothaert, R.L., Magado, R., 2011. Revival of cassava production in Nakasongola District, Uganda. Int. J. Agric. Sustain. 9, 76–81. https://doi.org/10.3763/ijas.2010.0547

Sakaran 2003, Sampling techniques in Research, Mayoor Press, New Delhi.

Stephen, C Kevin, V 2007. Global warming. In Encyclopia of Earth. (Eds.) Cutler J. C. Environmental Information Coalition, National Council for Science and the Environment, Washington D.C., U.S.A.http://www.eoearth.org/article/global_warming.

Stern 2006, The Economics of Climate Change, London, United Kingdom.

VincenT, K. Wanjiru, L. Aubry. A. Mershon, A. Nyandiga, C. Cull, T & Banda, K 2010. Gender, Climate Change and Community-Based Adaptation, United Nations Development Programme 304 East 45th Street, 10th Floor New York, NY 10017, USA Available at www.undp.org.

Westby, A., 2002. Cassava utilization, storage and small-scale processing., in: Hillocks, R.J., Thresh, J.M. (Eds.), Cassava: Biology, Production and Utilization. CABI, Wallingford, pp. 281–300. https://doi.org/10.1079/9780851995243.0281.

Impact of Gateway Organic Fertilizer on Herbivorous and Non-Parasitic Nematodes Associated with *Telfairia Occidentalis* Hook F. Field

Atungwu, J.J.[1*], Yusuf, A.O.[1], Oladeji, O.A.[1], Aruna, W.O.[1], Joseph-Adekunle, T.T.[2] and Tijjani, I.[3]

[1]Department of Crop Protection,
[2]Department of Horticulture,
Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

[3]Department of Crop Protection, Bayero University, Kano, Kano State, Nigeria.

*Corresponding author:
jojerat1@yahoo.com

Keywords:
Free-living nematodes, herbivores, fluted pumpkin, organic farming

Abstract

Although fluted pumpkin (Telfairia occidentalis Hook F.) is cherished because of its nutritional, medicinal and industrial values, its profitable production and sustainability in agro-ecosystems is threatened by plant-parasitic nematodes. This study, therefore, tested the hypothesis that Gateway organic fertilizer can effectively suppress herbivorous nematodes while increasing the non-parasitic types. Gateway organic fertilizer (GOF) is one of the series of novel commercial fertilizers being utilized by organic farmers in South-Western Nigeria. In this assessment, GOF was applied at the recommended rate of 5 tha^{-1}. Application of 0 tha^{-1} served as control. Treatments were laid out in randomized complete block design and replicated four times. Nematode identification, census and population analysis were conducted following extraction from soil collected from the field. Six cores were randomly taken per plot at 0-30 cm, bulked to obtain homogenous composite sample out of which 250 g sub sample for nematode extraction. The procedure was repeated once every month for three successive months. It was evident from the results that six (6) genera of herbivorous (plant-parasitic) nematodeswere found associated with the fluted pumpkin, namely Rotylenchulus, Helicotylenchus, Hoplolaimus, Pratylenchus, Caloosiaand Meloidogyne. Total riddance (100%) was observed in GOF-treated plots ($P \leq 0.05$) compared to the control on herbivorous nematodes except for Helicotylenchus (100-36%). On the contrary the non-parasitic nematodes increased significantly ($P \leq 0.05$)in the treated plots (from 0 to 10 and to 81). This work demonstrated that GOF caused fewer parasitic and greater populations of beneficial nematodes in fluted pumpkin.

Introduction

Fluted pumpkin, scientifically known as *Telfairia occidentalis* Hook F. is one of the most important vegetables grown in Southeastern part of Nigeria, but now becoming popular in other parts of the country (Ndor and Dauda, 2013). It is a crop of commercial importance. Nigeria, Ghana and Serra Leone are the major producers of fluted pumpkin (Ononuju, Ekeoma, Orikara, and Ikwunagu, 2015). It is generally regarded as a leaf and seed vegetable. Tindall (1986) reported that fluted pumpkin is known for its high nutritional, medicinal andindustrial values, it has 29% protein, 18% fat and 20% minerals and vitamins. Apart from the leaf of fluted pumpkin, the seed is also an economic part which can be consumed by cookingor roasting or grounded and added as condiment to soup (Badifu and Ogunsua, 1991). Oil extracted from pumpkin seed can be used in industrial soap making and in cooking (Fashina *et al*., 2002). Precedent, fluted pumpkin had gained medicinal recognition, it has been discovered to be blood purifiers and could therefore be useful in maintaining good health (Aletor *et al.*, 2002).

Telfairia occidentalis is highly susceptible to nematodes, most especially to the root-knot nematodes, which cause reduction in the yield of fluted pumpkin as a result of conspicuous gall that affect water and nutrient uptake (Mai and Lyon, 1975; Ononuju *et al*., 2015). Organic fertilizers increase the yield and quality of crops as well as the soil properties. Al-Rehiayani (2001) stated that plants grown on less organic matter soil are prone severe nematode disease compare to plants grown on high organic matter soil. Therefore, organic crop production system must put in place a sound nematode control program.

The objective of this study, therefore, was to determine the effect of gateway organic fertilizer on herbivorous and non-parasitic nematodes in fluted pumpkin field.

Materials and Methods

Experimental location

Soil samples were collected on an established fluted pumpkin field set-up on organic agriculture skills demonstration plot of the Federal University of Agriculture Abeokuta (FUNAAB) between October and December, 2014. This site falls within forest-transition savannah ecological zone.

Experimental design and plot layout

The design used for the experiment was Randomized Complete Block Design (RCBD). The study was carried out an established fluted pumpkin plot aged 14 weeks fertilized with Gateway organic fertilizer at 5 tons ha-1 or 0 ton ha-1 which serves as the control and replicated fourtimes. The total land area for the experiment was 97.75 m^2. The experimental field consisted of 8 experimental units, each measuring 5 m x 1.5 m with a walkway of 0.5 m.

Sampling for nematode assay

Soil samples for nematode assay were collected in random sampling pattern from the fluted pumpkin plots around the rhizosphere early in the morning. Six core soil samples were collected per plot randomly at depth 0 – 30 cm and 2 – 4 cm away from the plant root in order not to destroy the root system, with the aid of a soil auger to form a composite soil sample. The soil samples were sealed in polythene bags, properly labeled and transported to Crop Protection Laboratory in FUNNAB for nematode extraction and identification.

Extraction of nematodes from soil

Each composite soil sample collected per plot was thoroughly mixed to form a homogeneous soil sample and 250 g sub-soil was taken for nematode assay using Whitehead and Hemming (1965) nematode extraction technique. Double-ply nematode extractor tissue paper was sandwiched between two plastic sieves of 15 cm inside diameter. Sieves were placed in a 25 cm inside diameter bowl, in which each 250 g of homogeneous soil was measured and spread evenly in the sieve, labeled and arranged carefully in the laboratory. Debris and pebbles were removed and soil lumps were carefully broken in order to allow free swimming of the nematodes out from the soil to water. Two hundred and fifty millimeter (250 ml) of water was gently poured to the extraction bowl and the set up was left undisturbed for 24 h. Thereafter, the plastic sieve containing the soil was removed briskly, allowed the last water to drop and the nematode suspension in the bowl was decanted into a 500 ml Nalgene wash bottle and topped up with water to factory-calibrated point and left undisturbed in the laboratory for 5 hrs to ensure that most nematodes settled down to the bottom. The supernatant was siphoned out with the aid of 3 mm inside diameter siphoning tube, the suspension containing nematodes was poured into McCartney bottle and immediately refrigerated at 15°C. Nematode suspension was quantified using Doncaster (1962) ringed nematode counting dish and examined under stereo and compound microscope.

Nematode assay and identification

Nematodes in the suspension poured into McCartney bottle were picked one after the other under the stereomicroscope after counting with the aid of stereomicroscope and placed on a glass slide covered with a cover slip, the nematodes were identified with the aid of compound microscope using the simplified nematode pictorial key of Mai and Lyon (1975).

Data collection and analysis

Soil sample collected each month were assayed for nematode presence, types and number of nematodes. Data collected on the number of nematodes were transformed to reduction percentage (Puntener, 1981).

Results

Six genera of herbivorous nematodes; namely *Rotylenchus, Helicotylenchus, Hoplolaimus, Pratylenchus, Caloosia* and *Meloidogyne* belonging to the order *Tylenchida* were found associated with *T. occidentalis* in Abeokuta, Ogun State between October and December 2014 (Table 1). The six genera belong to five different families which include *Nacobbidae, Hoplolaimidae, Hoplolaimidae, Pratylenchidae, Hemicycliophoridae and Meloidogynidae. Population of herbivorous nematodes encountered on T. occidentalis field was suppressed* ($P<0.05$) by 100% except for *Helicotylenchus* which was suppressed ($P<0.05$) from 36 - 100% on plots with 5tha^{-1} GOF. Non-parasitic nematodes were suppressed by 10 – 81% between November and December.

Table 1. **Taxonomy of herbivorous nematodes found on *Telfairia occidentalis* field within October and December 2014 in Abeokuta, Ogun State**

Genera	Family	Order
Rotylenchus	*Nacobbidae*	*Tylenchida*
Helicotylenchus	*Hoplolaimidae*	*Tylenchida*
Hoplolaimus	*Hoplolaimidae*	*Tylenchida*
Pratylenchus	*Pratylenchidae*	*Tylenchida*
Caloosia	*Hemicycliophoridae*	*Tylenchida*
Meloidogyne	*Meloidogynidae*	*Tylenchida*

Table 2. **Reduction percentage of herbivorous and non-parasitic nematodes found on** *Telfairia occidentalis* **field in October 2014 at Abeokuta, Ogun State**

TRT	ROT (%)	HEL (%)	HOP (%)	PRA (%)	CAL (%)	MEL (%)	NPN (%)
				October			
0 tha^{-1}	0	0	0	0	0	0	0
5 tha^{-1}	0	36	0	100	100	100	0
				November			
0 tha^{-1}	0	0	0	0	0	0	0
5 tha^{-1}	100	100	100	100	100	100	81
				December			
0 tha^{-1}	0	0	0	0	0	0	0
5 tha^{-1}	100	64	100	100	100	100	10

KEY: TRT - Treatment, ROT - *Rotylenchus,* HEL - *Helicotylenchus, HOP – Hoplolaimus,*PRA - *Pratylenchus, CAL - Calosia,* MEL – *Meloidogyne,* % - Percentage, NPN - Non-parasitic nematodes

Discussion

There are countless of research on nematode control using organic based fertilizer and organic soil amendment, this study also added additional information to the existing knowledge on the control of hidden enemy of farmers using Gateway organic fertilizer. This work showed that Gateway organic fertilizer had effect on the herbivorous nematodes population in the soil by reducing their numbers and thereby increased the non-parasitic nematodes population in the soil, which has been proven in the past that organic fertilizer reduced the plant-parasitic nematodes population in the soil (Atungwu *et al.*, 2010). Singh and Sitaramaiah (1970) documented that reduction in plant-parasitic nematodes population may be as a result of toxic by-product of decomposed organic amendment or biological antagonist stimulated by organic amendments.

References

Aletor, O., Oshodi, A. A. and Ipinmoroti, K. (2002). Chemical composition of common leafy vegetables and functional properties of their leaf protein concentrates. *Food Chemistry*, 78: 63-68.

Al-Rehiayani, S. M. (2001). Organic and inorganic fertilizers in relation to the control of the root-knot nematode, *Meloidogynejavanica* in infecting tomato. *Egypt Journal of Agronematology*. 5: 1 – 9.

Atungwu, J. J., Ajibike, W. A., Aiyelaagbe, I. O. O. and Kehinde, L. O. (2010). Impact of composted poultry manure on populations of plant-parasitic nematodes and growth of tomato: Implication for sustainable organic crop production system. *Nigerian Journal of Plant Protection.,* 24: 108 – 118.

Badifu, G.I.O. and A.O. Ogunsua, (1991). Chemical composition of kernels from some species of cucurbitacea grown in Nigeria. *Plant Food Human Nutrition*, 41: 35-44.

Doncaster C. C. (1962). A counting dish for nematodes. *Nematologica*, 7: 33 – 36.

Fashina, A.S., K.A. Olatunji and K.O. Alasiri, (2002). Effect of different plant populations and poultry manure on the yield of Ugu (*Telfairia occidentalis*) *in* Lagos State, Nigeria. In: Proceedings of the Annual Conference of Horticultural Society of Nigeria (HORTSON), 14th – 17th May 2002; NIHORT, Ibadan, Nigeria.

Mai, W. F. and H. H. Lyon (1975). Pictorial to genera of plant parasitic nematodes. 41st Edition Cornerstone Publishing Associates. A division of Cornell University Press. 219pp.

Ndor, E. and Dauda, N. S. (2013). Growth and yield performances of fluted pumpkins (*Telferiaoccidentalis*Hook F.) under organic and inorganic fertilizer on ultisols of north central Nigeria. *Global Journal of Plant Ecophysiology*. 3(1): 7 – 11.

Ononuju, C. C., Ekeoma, P., Orikara, C. C. and Ikwunagu E. A. (2015). Evaluation of the effect of some pesticides for the control of root-knot nematode (*Meloidogyne* spp.) on *T. occidentalis*. *European Journal of Experimental Biology*, 5(11): 1 – 5.

Puntener, W. (1981). *Manual for Field Trials in Plant Protection*. Agricultural Division, Ciba Geigy Limited, Basle, Switzerland, 205pp.

Singh, R. S. and Sutaramaiah, K. (1970). Control of plant-parasitic nematode with organic soil amendments. PANS. 16: 287 – 297.

Tindal, H. D. (1986). Vegetables in the Tropics: *Macmillan Education Ltd*. Houndmills, Hampshire. 533 pp.

Whitehead, A.G. and Hemming J. R. (1965). A comparison of some qualitative methods of extracting small vermiform nematodes from soil. *Annals of Applied Biology*, 55:25 - 38.

Comparative Assessment of Phytochemical Properties of Ethanolic Extracts of Barks of Two Herbal Trees

Ayoola, A.A., Muhammad, S. B. and Adewale, S. A.

Department of Animal Production and Health, Federal University of Agriculture,
P.M.B. 2240, Abeokuta,
Nigeria

Corresponding author:
Ayoola, A.A. as above

Keywords:
Phytochemicals, herbs, extracts and antibiotics

Abstract

This study serves to explore the chemical constituents of Azadirachtaindica and Mangiferaindica as a possible alternative sources of conventional antibiotics. Ethanolic extracts of Azadirachtaindica and Mangiferaindica stem bark were analysed for their chemical constituents. Phytochemical values for (Tannins, Oxalate, Phytate, Terpenoids, Trypsin inhibitor, Total Phenol, Total Carotenoids, Total Carotene Carotenes, Xanthophyll, Flavonoids, Alkaloids, Saponins and Antioxidant (DPPH Scanvenger) were revealed. The result were subjected to Studentized T-test as contained in SAS (1999). The result showed that all secondary metabolites analyzed were present in the bark of the two plant species studied but at different concentrations. The concentration of Tannin (1510.00 mg/kg), Oxalate (139.20 mg/kg), Phytate (15.55 mg/kg), Trypsin inhibitor (730.00 mg/kg), Flavonoids (78.50) and Saponins (17.71%) contents of Mango stem bark were found to be more than in Azadirachtaindica. However, Azadirachtaindica contained the highest Terpenoids (43.85mg/kg), Total Phenol (34.00mg/kg), Total Carotenoids (89.59 g/kg), Total Carotene Carotenes (69.88 g/kg), Xanthophyll (19.71 g/kg), Alkaloids (19.50%) and Antioxidant (68.65%) than the of M.I stembark respectively. It can therefore be concluded that stem bark extracts, besides serving as good source of pharmacologically active phytochemicals may also be useful as supplements in human and animal nutrition particularly that the components are biodegradable compared to synthetic antibiotics.

Introduction

Medicinal plants are part and parcel of human society to combat diseases, from the dawn of civilization. Any part of the plant may contain active components (Parekh *et al*.,2006).

Plant derived substances have recently become of great interest owing to their versatile applications. Medical plant are the richest bio-resource of drugs of traditional systems of medicine, modern medicines, pharmaceuticals, food supplements, flock medicines, pharmaceutical intermediates and chemical entities (Ncube *et al*., 2008). *Azadirachtaindica* A. Juss (Neem) is well known in India and its neighbouring countries for more than 2000 years as one of the most versatile medicinal plants having a wide spectrum of biological activity.

Shankarnarayana *et al*.(1979) stated that *Mangiferaindica* is another beneficial herb containing different chemicals, especially the polyphenolics, flavonoids, triterpenoids. Mangiferin which confers its bioactivities.

This study attempted to assess the phytochemical properties of *Azadirachtaindica* and *Mangiferaindica (MI)* stem bark for possible use in the treatment of diseases in poultry.

Materials and Methods

Site of Experiment

The research was carried out at three different locations; proximate analysis was carried out at Chemistry laboratory, College of Biochemistry, Federal University of Agriculture, Abeokuta, phytochemical screening was carried out at Gaagee laboratory in Ibadan, Oyo state.

Sources and Collection of Plant Materials

The plants materials; *Mangiferaindica (MI)* and *Azadirachtaindica* bark were sourced from school premises of Federal University of Agriculture Abeokuta (FUNAAB). Fresh bark pieces were collected from both *Mangiferaindica* tree and *Azadirachtaindica* tree at school farm of Federal University of Agriculture Abeokuta (FUNAAB). The samples were air dried under the shade at room temperature for two weeks. The dried samples were chopped into smaller pieces in preparation for extraction.

Extraction of Plant Materials

The extraction was done mechanically by crushing and soaking the crushed stem bark in 70% ethanol for 3 days in a sealed container at a room temperature. 1kg of the stem bark were used against 2kg of 70% ethanol. The mixture were turned twice daily to ensure proper mixing, on the fourth day the extract were separated from the shaft with a strainer (cheesecloth). The solvent was removed at a temperature of 40°C in a water bath and the extracts were stored in a freezer at -20°C.

Phytochemical Screening of *Mangiferaindica (MI) and Azadirachtaindica (AI)* extracts

Phytochemical test of the ethanolic extract was carried out using standard procedures as described by (Harborne, 1973) and enunciated by Sofowora (1993) to determine Saponin, terpenoid, alkaloid, phenol, carotenoid, phytate and oxalate content.

Statistical Analysis

Data obtained from the analysis were subjected to studentized T-test using SAS (2005).

Results

The phytochemical screening of the stem bark extracts of *Azadirachtaindica* and *Mangiferaindica*

Table 1 shows the result obtained fromphyto chemical screening of ethanol bark extract of *Azadirachtaindica* (A.I) and *Mangiferaindica* (M.I). All the values of phytochemicals were significantly ($p<0.05$) different between the two extracts. *Mangiferaindica* (M.I) bark extract had significantly ($p<0.05$) higher tannin (1510.00mg/kg), oxalate (139.20mg/kg), phytate (15.55mg/kg), trypsin inhibitor (730mg/kg), flavonoids (78.50g/kg) and saponins (17.71%) than extract of *Azadirachtaindica* (A.I). However, terpenoids (43.85mg/kg), total phenol (34.00mg/kg), total carotenoids (89.59g/kg), Total Carotene Carotenes (69.88g/kg), xanthophyl (19.71g/kg), alkaloids (19.50%) and antioxidant (DPPH scanvenger) (68.65%) were significantly ($p<0.05$) higher in extract of *Azadirachtaindica* (A.I) than *Mangiferaindica* (M.I).

Table 1. **Phytochemical screening of *Azadirachtaindica* (*AI*) and *Mangiferaindica* (*M.I*) ethanolic stem bark extract**

	Herbs Bark Extracts		
Parameter	*Azadirachtaindica*	*Mangiferaindica*	SEM
Tannin (mg/kg)	1495.50□	1510.00^{a}	0.29
Oxalate (mg/kg)	128.68□	139.20^{a}	0.14
Phytate (mg/kg)	13.90□	15.55^{a}	0.28
Terpenoids(mg/kg)	43.85^{a}	13.54□	1.01
Trypsin inhibitor (mg/kg)	494.71□	730.00^{a}	0.21
Total phenol (mg/kg)	34.00^{a}	30.60□	0.29
Total Carotenoids (g/kg)	89.59^{a}	54.17□	0.14
Total Carotene Carotenes (g/kg)	69.88^{a}	42.26□	2.10
Xanthophyll (g/kg)	19.71^{a}	11.92□	0.28
Flavonoids (g/kg)	13.68□	78.50^{a}	1.29
Alkaloids (%)	19.50^{a}	5.61□	1.43
Saponins (%)	8.02□	17.71^{a}	1.03
Antioxidant (DPPH Scanvenger) (%)	68.65^{a}	58.48□	4.21

^{ab} Means with different superscript differs significantly ($p<0.05$)

Discussion

The phytochemical screening of the stem bark extracts of *Azadirachtaindica* and *Mangiferaindica* revealed the presence of tannin, oxalate, phytate, terpenoids, trypsin-inhibitor, total phenol, total carotenoids, total carotene carotenes, xanthophyll, flavonoids, alkaloids, saponin and antioxidant. These phytochemicals exhibit various pharmacological and biochemical actions when ingested by animals. Plants used in the treatment of diseases are said to contain bioactive principles with biological activity some of which are responsible for the characteristic odour, pungencies and colour of plant, while others give the particular plant its culinary, medicinal or poisonous virtue (Evans, 2002).

Saponins are known bioactive substances that can reduce the uptake of cholesterol and glucose at the gut through intra-lumenal physiochemical interaction (Price *et al*., 1987). Saponins as a class of natural products are also involved in complexation with cholesterol to form pores in cell membrane bilayers (Francis *et al*., 2002) as such may be used as anticholesterol agents or cholesterol lowering agent. Alkaloids are beneficial chemicals to plants serving as repellant to predators and parasites. This probably endows these group of agents its antimicrobial activity. However, when ingested by animals, they affect glucagon, thyroid stimulating hormones and inhibit certain enzymatic activities (Okaka *et al*., 1992). Flavonoids were also determined in the two extracts and they in general serve as flavouring ingredients in plants. Besides their role as flavouring agents they are also expressed in plants in response to microbial infection suggesting their antimicrobial activity (Kujumgiere *et al.,* 1999).

Flavoniods have also been implicated as antioxidants both in physiological and disease states. For instance tea flavonoids have been reported to reduce the oxidation of low-density lipoprotein, lower the blood level of cholesterol and triglycerides (Erdman, 2007). Tannins in this study were indicated to be present but in low concentration in both plant parts. This bioactive compound is known to have potential anti-viral activity (Cheng *et al*., 2003) as well as potential prophylactic and therapeutic effect against cancer cells, but via different mechanisms (Narayanan *et al*., 1999).

Phytic acid and Oxalate are present in low concentration in all the samples studied and this also makes them safe for consumption. Oxalate should be consumed in small quantity because oxalic acid binds with other mineral such as calcium to form oxalate salt which has been postulated to be the cause of kidney stone according to (Bridget, 2010). However, in comparison to report by Harry-Asobara*et al*.(2014) concentrations revealed as regards the presence of Alkaloid (1.22%), Flavonoid (0.36 0%), Saponin (0.32 %), Phenols (0.18 %), Phytate (0.15 %) and Tannin (0.26%) in dry ash extraction method of *Azadiracthaindica* stem bark contradicts the percentage concentration of recent studied. Also the results reported by Adetuyi*et al.*(2013) on *Mangiferaindica* stem bark was contradictory with the recent results, his studies revealed the presence of active secondary metabolites including tannins, saponins, flavonoids and alkaloids. However, carotenoids, xanthophyll, terpenoids, oxalate and phytate were reported to be absent. Also he reported percentage composition of tannins, Saponins, flavonoids and nonflavonoids to be (0.35mg/g, 9.78mg/g, 12.9mg/g and 8.60mg/g) which were low in concentration compared to Tannins, Saponins, Flavonoids and Alkaloids (1495.50mg/kg, 8.02%, 13.68g/kg and 19.50%, respectively) of recent study.

The broad distribution of phytochemicals in the extracts studied support, as well as provide a basic rationale for its use as an antimicrobial, antiviral, anticholesteremic, antioxidants and some other health related uses in livestocks especially in poultry.

References

Adetuyi, F.O., Dada, I.B.O., Ibrahim, T.A. 2013. Phytochemical Analysis and Antioxidant Activities of Hot and Cold Water Extracts of Mango (*Mangiferaindica* L.) Leaf and Stem Bark. *Journal of Basic Medical Sciences. Vol. 1.*

Bridget C. 2010. Oxalates and Diets.Available on www.livestrong

Cheng, H.Y., Lin, C.C., Lin, T.C., 2003. Anti-herpes simplex virus type 2 activity of casuarinin from the bark of Terminaliaarjuna Linn. *Antiviral Research* 55, 447–455.

Erdman, J. W., 2007. Flavonoid and Heart Health. 2005. Proceedings of the ILSI North .
America Flavonoid workshop, May 31 – June 1.*Journal Nutrition*, 137(3): 718s-737s.

Evans, W.C. 2002. Trease and Evans Pharmacognosy, 15th edition.*W.B. Sauders Company Limited, London*. pp 137-139,230-240.

Francis, C., George, G., Zohar, K., Harinder, P. S., Makhar, L. M., Klaus, B. 2002. The biological action of saponins in animal system: a review. *British Journal Nutrition* 88(6):587-605l.

Harborne, J.B. 1973. Phytochemical Methods; A guide to modern techniques of plant analysis.2nd Edition, *London New York. pp*. 49-188.

Harry-Asobara, Joy, L., and Samson, E. O., 2014. Comparative study of the phytochemical properties of *Jatrophacurcas* and *Azadirachtaindica* plant extracts. *Journal of Poisonous and Medicinal Plants Research* Vol. 2(2), pp. 20-024.

Kujumgiev, A, Tseveikoval, T.S., Serkedjivay, D.E., Bankora, V., Christo, R., Popov, S. 1999.Antibacterial, antifungal and antiviral activity of propolis geographic origin. *Journal of Ethnopharmacol.* 44: 35-40.

Narayanan, B.A., Geoffrey, O., Willingham, M. C., Nixon, D. W. 1999. Expression and its possible role in GI arrest and apoptosis in allergic acid treated cancer cells. Cancer Letters 136(2): 215 - 21.

Ncube, N.S., Afolayan, A.J. and Okoh, A.L., 2008. Assessment techniques of antimicrobial properties of natural compounds of plant origin: current methods and future trends. *African Journal Biotechnology*. 7 (12): 1797-1806.

Okaka, J.C., Enoch, N.J., Okaka, N.C. 1992. Human nutrition: An integrated approach. ESUT Publication Enugu pp 57-58.

Parekh, J. Karathia, N. and Chanda, S., 2006. Screening of some traditionally used medicinal plants for potential antibacterial activity. *Indian Journal Pharmaceutical Science.* 68(6): 832-834.

Price, K.R., Johnson, L. I., Feriwick, H. 1987. Chemical and biological significance of saponin in food science. Nutrition. 26:127-135.

SAS Institute. 2005. SAS/STAT User's Guide, Version 9.1. Cary, NC: SAS Institute.

Shankarnarayanan ,D., Gopalakrishman, C. , Kameswaran, L., Arumugum, S. 1979. The effect of mangostin, mangostin 23:3-6.

Sofowora, A. 1993.Medicinal plants and traditional medicine in Africa. *Spectrum Books Ltd., Ibadan, Nigeria*, 289p.

Development of Organic Fish Feeds: Case Study of Poultry Droppings and Pig Feces as Replacement for Soybean Meal in Practical Diets for Nile tilapia, *Oreochromis niloticus* (L.)

[1]George, F. O. A., [1]Nwaezeigwe, F. O., [1]Abdul, W. O. and [2]Jegede, A. V.

[1]Department of Aquaculture and Fisheries Management, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria

[2]Department of Animal Nutrition, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria

Corresponding author:
georgefoa@funaab.edu.ng

Keywords:
Poultry droppings, Tilapia, soybean meal, protein

Abstract

There have been persistent increases in the cost fish feeds and organic fish feeds are practically non-existent in Nigeria. This study was conducted to investigate the effects of replacement of soybean meal (SBM) with dried pig feces (DPF) and poultry droppings (PD) on growth performance, nutrient utilization and carcass composition of Oreochromis niloticus fingerlings. O. niloticus weighing 5.29 ± 0.02g and standard length 5.35 ± 0.07cm were fed seven iso-nitrogenous diets containing 40% crude protein in which the SBM protein was replaced with DPF and PD meals each at 0% (control diet, D7), 15% (Diets DPF1and PD4), 30% (Diets DPF2 and PD5) and 45% (Diets DPF3 and PD6) levels for 12 weeks in plastic aquaria measuring 52x33x33 cm^3(Length x Breadth x Height). Each treatment was in triplicate. At the end of the feeding trial, data obtained were analyzed statistically using one-way analysis of variance; and means were separated using Duncan's multiple range test, DMRT. Water quality parameters measured during the study period were within the range for tilapia production, except for dissolved oxygen. Weight gain of 11.0 ± 0.27g was highest in fish fed PD5, while PD4 had the lowest (6.99 ± 0.27 g);and was significantly different (p<0.05) from other diets. Feed conversion ratio of 1.79 in fish fed PD5 was not significantly different (p>0.05) from 1.81 and 1.83 recorded for fish fed D7 and PD6 respectively. Apparent net protein utilization was highest (62.57%) in fish fed PD5 and lowest (35.85%) with a significant differences (p<0.05) in fish fed diet PD4. Apparent protein digestibility was highest in fish fed PD5 (91.86%) and lowest in fish fed PD4 (78.98%). Percentage survival was similar (100%) in fish fed DPF3 and PD6 (93.33%) but was significantly higher (p<0.05) than values obtained in fish fed D7, DPF1, DPF2, PD4 and PD5 with an equal value of 90% respectively. This study revealed that poultry droppings could replace 30% of soybean meal in practical diets of O. niloticus without any adverse effects on growth and with concomitant reduction in aquaculture feed costs.

Introduction

The rapid increasing cost of fish feed has prompted research to focus on reducing the cost of the most expensive ingredients by using alternative protein sources. Most research has been conducted for replacing fish meal with either plant protein sources or other un-conventional animal protein sources (Faturoti *et al*., 1998) such as poultry offal (Fasakin, 2008), fermented shrimp head waste meal (Nwanna, 2003), maggot meal (Faturoti *et al.,* 1995; Fasakin *et al*., 2004) and water hyacinth meal (Sotolu*,* 2008). On the contrary fewer works have been reported on the replacement of soybean meal which is the costliest and the most utilized plant protein source in most fish feed in developing countries (Lovell, 1988, Alexis, 1990). To reduce the production costs of growing fish, the usefulness of locally available agricultural wastes which may serve as substitutes for the conventional feedstuffs should be examined; such agricultural wastes could be pig feces and poultry droppings.

Nigeria is considered to be the largest producer of pig in Africa. Available data showed that there were about seven million pigs in the country, reared in total confinement production systems. The wastes produced in these confinement systems present both an odor and an organic matter pollution problem; however, these wastes may possess untapped feeding value (Kornegay *et al.,* 1977). Also, poultry droppings abound in Nigeria because chickens are capable of excreting about 20% undigested feed in addition to about 10% wastes generated during normal feeding of poultry birds, thus making available up to 10-30% total protein in dried chicken wastes representing 1100-1400 kcal kg^{-1} energy and soluble synthesized vitamins in poultry manure (Tuleun, 1992; Musa *et al*.,2011). Animal wastes often become a nuisance to livestock farmers – as farmers expend energy, time and money to dispose of them so as to control diseases and have a clean environment, free from organic pollution. The use of these wastes as feed ingredients offer potential for salvaging some of the nutrients and for reducing the pollution problem (Kornegay *et al.,* 1977).

Experimental Procedure

The experiment was carried out at Federal University of Agriculture, Abeokuta (FUNAAB). The culture media were plastic aquaria with dimensions of 52cmx33cmx33cm (length, breadth and height) respectively. The water source was from a dug-out well. The poultry droppings were obtained from caged adult broilers from a poultry farm located at Alanco, Osiele, while the pig feces was collected from the piggery unit of the Federal University of Agriculture, Abeokuta. The fresh poultry droppings and pig feces were sun-dried for five days at temperatures ranging between 33^0C and 38^0C. The proximate composition of the animal wastes was determined thereafter following AOAC (2005).*Oreochromis niloticus* fingerlings*weighing* 5.29 ± 0.02 g and standard length 5.35 ± 0.07 cm were sourced from Choice Farm Isolo, Lagos State; and transported in oxygenated nylon bags to the project site in the early hours of the day. On arrival, they were acclimated for 72hours and later fed with 2mm commercial diet (Coppens feed, CP 45%) for a week before being randomly assigned to the experimental diets. The acclimated fish were weighed individually with an electronic digital counting balance (GOLDEN-METTLER U.S.A, Model: HC-D, Max: 2000g, d: 0.1g, e: 1g).Twenty-one plastic aquaria were thoroughly washed, filled with 30 liters of water and 10 *Oreochromis niloticus* fingerlings were randomly allotted to each aquarium. At the beginning of the feeding trial, composite samples of eleven whole fish were analyzed for proximate composition and a random sample of three fish per treatment at the end of the 84days (12weeks) experimental period. Each treatment had three replicates. The fish were fed at 3% body weight daily for six days and weight gain was measured on the seventh day on weekly basis; and the quantity of feed fed adjusted accordingly. The quantity of feed fed to each group of fish was recorded. The water was partially changed on daily basis, while fecal matter and left- over feed were siphoned every morning and afternoon 30 minutes before feeding, using a hose. Bicycle pump was used in aerating the water in the experimental units twice daily.

Experimental diets

Seven iso-nitrogenous diets (40% CP) were prepared. The feed ingredients comprised fish meal (72% CP), soybean meal (44% CP), poultry droppings (36.8% CP), pig feces (21.02% CP), maize (10%), palm oil, vitamin C, vitamin premix, methionine, lysine, salt and Oyster shell. Balance of mineral was achieved by using oyster shell at 0.5%. Salt (NaCl) was added as mineral source and for palatability at 0.5%. Vitamin premix was added at 1.0% inclusion to fortify the diets. The soybean meal was substituted with poultry droppings and pig feces at 0%, 15%, 30% and 45% levels of inclusion.

Feed preparation

The sun-dried pig feces, poultry droppings, maize and soybean meal were grounded (separately) into powdery form. For specific formulation, the calculated weight of each ingredient was measured into plastic bowl and thoroughly dry-mixed. Thereafter cold water (25^{0}C) was added at the rate of 30cl per 5000g of the feed to enable pelleting. Pelleting of the feed was done to maximize utilization of the feed by the fish as the fish may select only the desirable components of such ingredients, reduce water pollution emanating from un-eaten components of the feed and to reduce cost that may come from feed wastage. The pelleted feeds were sun-dried for six hours with ambient temperature between 33^{0}C- 38^{0}C. The dried feeds were allowed to cool and packed in air-tight polythene bags and labeled. The feeds were subjected to proximate analysis following the Association of Analytical Chemists Method (AOAC, 2005).

Water quality analyses

Physicochemical parameters such as; water temperature (^{0}C) was measured using mercury-in-glass thermometer, water pH was measured using Hanna COMBO pH-meter model CE-HI98129 after standardization with two buffers of known pH at 25^{0}C on every occasion and dissolved oxygen (mg/l) was measured using the Winkler's method.

At the end of the experiment, data representing growth indices and nutrient utilization were calculated as follows:

a) Mean weight gain calculated after Obasa and Akinyemi (2009) and expressed as

$$MWG = \frac{W_f - W_i}{N}$$

Where Wf = final body weight
Wi = initial body weight
N = number of fish.

b) Food conversion Ratio (FCR) calculated after Wee and Shu, (1989) and expressed as

$$FCR = \frac{Quantity\ of\ feedfed\ (g)}{Weightgain\ (g)}$$

c) Protein efficiency Ratio (PER) calculated after Millikin, (1982) and expressed as

$$PER = \frac{Liveweightgain\ (g)}{Proteinfed\ (g)}$$

d) Specific Growth Rate calculated after Obasa and Akinyemi (2009) and expressed as

$$SGR = \frac{(\text{In}Wf - \ln Wi)}{T} \times 100$$

Where:
Wf = final body weight
Wi = initial body weight
T = duration of experiment in days
ln = Natural Logarithm

e) Apparent Protein Utilization (APU) calculated after Millikin, (1982) and expressed as

$$APU = \frac{Proteingain}{Proteinfed} \times 100$$

f) Survival (%) calculated after Obasa and Akinyemi (2009) and expressed as

$$S = \frac{F_2}{F_1} \times 100$$

Where:
$F2$ = number of fish at the end of the experiment
F_1 = number of fish at the beginning of the experiment

g) Gross Feed Conversion Efficiency (GFCE) calculated after Stickney, (1979) and expressed as

$$GFCE = \frac{1}{FCR} \times 100$$

Results

Table 1. **Gross Composition and proximate analyses of the experimental diets (g/100g)**

Ingredients	**D7**	**DPF1**	**DPF2**	**DPF3**	**PD4**	**PD5**	**PD6**
Fish meal	31.90	33. 10	34.40	35.80	32.30	32.60	33.00
Soybean Meal	31.90	28.20	24.10	19.70	27.50	22.90	18.20
Poultry droppings	0.00	0.00	0.00	0.00	4.80	9.80	14.90
Pig feces	0.00	5.00	10.30	16.10	0.00	0.00	0.00
Maize	29.70	27.20	24.70	21.90	28.90	28.20	27.40
Palm oil	3.00	3.00	3.00	3.00	3.00	3.00	3.00
[1]Vitamin Premix	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Methionine	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Lysine	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Oyster shell	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin C	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
%Moisture	10.52	9.22	9.40	9.82	12.28	12.37	8.98
Lipid (%)	5.34	5.37	5.42	5.47	5.37	5.40	5.43
Ash (%)	13.12	15.29	17.66	18.23	14.82	16.34	17.81
Crude fiber (%)	2.51	3.21	3.95	4.76	3.08	3.68	4.29
Crude protein (%)	39.88	39.51	39.81	39.43	39.10	39.63	39.30
NFE (%)	28.71	27.40	23.76	22.29	25.35	22.58	24.33

[1]Vitamin premix (Radar) supplies per 100 g diet: Palmitate (A) 1000 IU; cholecaciferol (D) 1000 IU; a- tocopherol acetate (E) 1.1 mg; Menadione (K) 0.2 mg; Thiamine (BI) 0.63 mg; Riboflavin (B2) 0.5 mg; pantothenic acid, 0.9 mg; Pyridoxine (B6) 0.15 mg; Cyanocobalamine (B12), 0.001 mg: Nicotinic acid 3.0 mg; Folic acid 0.1 mg; Choline 31.3 mg; Ascorbic acid (C), 2.5 mg; Fe, 0.05 mg; Cu 0.25 mg, Mn 6.0 mg; Co, 0.5 mg; Zn 5.0 mg; I, 0.2 mg; S, 0.02 mg.

Key: DPF = Pig feces- based diet, PD = poultry droppings- based diet and D7 = control diet, 1 liter of Palm oil at 25^{0}C is equal to 0.89kg, NFE = Nitrogen Free Extract

Haematology and Serum Indices of African cat Fish Fed *Telfairia occidentalis* Based Diets

Olaniyi, C.O

Ladoke Akintola University of Technology, Ogbomoso, Nigeria

Corresponding author:
oludayo.olaniyi@gmail.com

Keywords:
Replacement,
serum indices,
heamatology, health

Abstract

The effect of feeding Telfairiaoccidentalis based diets was investigated on the blood of African catfish (Clarias gariepinus). 150 African catfish were randomly allotted to five experimental diets (CP 40%) in which ugu leaf replaced soybean at 0%, 10%, 20%, 30% and 40% respectively and fed at 3% body weight daily for the period of 9 weeks. At the end of the feeding period, the blood samples were collected from the caudal peduncle of the fish samples in replicates and analyzed for both haematological parameters such as packed cell volume (PCV), haemoglobin (HB), red blood cell (RBC), white blood cell (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) and serum parameters such as Aspartate aminotransferase (AST), Alanine aminotransferase (ALT) Alkaline phosphatase (ALP), Urea, Creatine (CRE), Total protein, Albumin(ALB), and Globulin(GLO). The highest PCV (40.1%) was recorded in fish fed 0% and the lowest PCV (11.5%) was recorded in fish fed 40%; while the highest RBC (3.14ul) was also recorded in the same treatment, fish fed 0% and lowest RBC (0.96ul) was recorded in fish fed 40%. The highest HB content (14.2g/dl) was recorded in fish fed 0% and the lowest HB (7.2g/dl) was obtained in fish fed 40%, the highest WBC count (152.5ul) was recorded in fish fed 0% and the lowest was recorded in fish fed 40% ugu leaf meal while the highest lymphocyte count (62.5) was recorded in fish fed 30%. But the highest MCV (132.3fl) value was recorded in fish fed 10%. The highest MCH (50.3) value was recorded in fish fed 40%. The serum indices increase significantly as the replacement level of Telfairia occidentaIis increases. In contrast, TP and Glo has its highest value in T_1 (control) 4.805 and 3.13 respectively. In ALP, Urea and ALB, the highest value was observed in T_3 (20%). However, in T_1 and T_4 of ALP there is no significant difference (p>0.05) in the diets, likewise in T_2 and T_5 of ALP, there is no significant difference (p>0.05). The chemical compositions of the Telfairia occidentalis used are as follows; crude protein (35.70%), crude fiber (23.52%), ether extract (2.38%), ash (12.60%), dry matter (92.10%).were recorded and there was significant difference (p<0.05). This trial indicates that Telfairia occidentalis meal can replace soybean at 20% in the diets of African catfish without any deleterious effect on the physiology and or health status of the fish.

Introduction

Aquaculture is a fast growing sector under agriculture in Africa and especially in Nigeria. This is cultivation of different species of aquatics animals including fish for various purposes such as feeding, decoration, ornamental and advanced research. Amongst the following, fish is majorly cultivated in Nigeria and has become very important because they are good sources of protein, vitamins, oils etc.

African catfish, *(Clarias gariepinus)* is the most extensively cultured fish species in Nigeria. However, limitation of conventional feed stuffs (fish meal, soya bean) availability due to increasing demand for human consumption and by other animal feed industries has greatly increased the cost of fish feed thereby reducing the profitability of fish production business (Balogun 1998). This has encouraged the need to look for cheaper alternative sources for the development of low cost feed that can replace the conventional ones without reducing the nutrients of the diets. In particular ,using less expensive and readily available plant protein source Researchers have mostly focused on the underutilized plant protein sources in feed diet. Prominent among these, are Lima, bean (Adeparusi and Ajayi 2004), Pigeon pea (Adeparusi, 1994), Jackbean (Fagbenro *et al.,* 2007; Jimoh *et al.,* 2010) sunflower and sesame (Fagbenro *et al.*,2010a; b and c).

Telfairia occidentalis is a tropical vine grown in West Africa as a leaf edible seeds. The common name for the plant includes fluted gourd, fluted pumpkin and ugwu. *Telfairia occidentalis*i s a member of cucurbitaceae family and is indigenous to southern Nigeria. The fluted gourd grows in many nations of West Africa, but is mainly cultivated in Nigeria, used primarily in soups and herbal medicine. The leaf is a rich source of protein, fats and oil, vitamins and minerals and it is also rich source of folic acid, calcium, zinc, potassium, cobalt, copper, iron, vitamins A, C and K (Ajibade *et al.*, 2006). *Telfairia occidentalis* leaf contains active ingredients such as bioflavonoid, an active chemical, a plant growth promoter, which promote growth in birds (Fasuyi and Nonyerem, 2007). The leafy vegetable posseses anti-microbial and anti-viral properties (Nwozo *et al*., 2004; Olorunfemi *et al.*, 2005). Aqueous extract increase hematological parameters (Alada, 2000). This study therefore investigate the effect of *Telfairia occidentalis on the haematology and blood serum of African cat fish.*

Materials and Method

Experimental Site

The experiment was conducted at the Fishery unit of the Ladoke Akintola University of Technology Teaching and Research farm, Ogbomoso, Oyo state, Nigeria.

Processing of Ugwu Leaf *(Telfairia occidentalis)*

Ugwu leaves were harvested from Crops type collection unit of Teaching and Research farm Lautech, Ogbomoso, Oyo state. The leaves were rinsed with clean water, chopped into smaller pieces and air-dried for 11 days to a constant weight, then grounded to a meal using Experimental Diets.

Feed ingredients were purchased from a reputable store in Ogbomoso, Oyo State. The ingredients were; Maize, Groundnut cake (GNC), Fish meal, Soybean meal, Bone meal, Oyster shell, Vitamin mineral premix, Salt, Lysine, Methionine, Honey and Ugwu (test ingredient) was added. The ingredients were weighed according to their calculated weight, mixed thoroughly and then pelletized. The pelletized feeds were sun-dried to a constant weight, then stored in an air-tight container.

A total number of five diets were formulated for the experiment, diet 1 serves as control, diets 2, 3, 4 and 5 were the experimental diets containing varying levels of ugwu leaf meal *(Telfairia occidentalis)* in 10%, 20%, 30% and 40% respectively.

Experimental Fish

A total number of one hundred and fifty fingerlings of African catfish *(Clarias gariepinus)* were| procured from a reputable farm in Ogbomoso Oyo State. They were acclimatized for two [weeks during which they are fed with floating feed.

Experimental Procedure

After two weeks of acclimatization, the fishes were divided to six groups and allotted to six treatments. Fifteen fingerlings of average weight of 171.528g+/-0.2 were randomly distributed into 70 litres plastic tanks, each treatment was replicated twice and the fingerlings were fed experimental diets (3% l body weight) two times daily (morning - 08:00hrs and evening - 17:00hrs) for the period of 63days. Fish were weighed every two weeks using an electronic digital weighing scale.

Table 1. **Gross Composition of the Experiment Diets**

Ingredients	Diet 1 fO%)	Diet 2 00%)	Diet 3 (20%)	Diet 4 (30%)	Diet 5 (40%)
Maize	27.00	26.50	26.00	26.00	25.50
GNC	22.00	22.50	23.50	23.00	23.50
Fish meal	33.00	33.00	33.00	33.00	33.00
Soybean meal	14.00	12.6	11.20	9.80	8.40
Ugwu leaf	-	1.40	2.80	4.20	5.60
Oyster shell	1.35	1.35	1.35	1.35	1.35
Bone meal	1.50	1.50	1.50	1.50	1.50
Salt	0.20	0.20	0.20	0.20	0.20
Premix	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Honey	-	0.15	0.15	0.15	0.15

Data Collection

Determination of Haematology and serum indices
At the end of feeding trial, the blood samples were obtained by cutting through the caudal peduncle of the fish with a sharp blade. Blood samples were collected into EDTA Bottles for haematology [(packed cell volume (PCV), haemoglobin (HB), red blood cell (RBC), white blood cell (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC)], also the blood sample were collected into the centrifugation tubes for serum biochemistry The sample was later centrifuged to obtain sera. Sera samples were tested for alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activities by the method of Reitman and Frankel (1957), serum alkaline phosphatase activity by the method of Rec (1972), and serum total protein and albumin assessed by Biuret and BCG methods respectively.

Chemical Analysis
The proximate composition of the test ingredient, fish carcass and experimental diets were determined using the method of AOAC (1995).

Statistical Analysis
All data collected were subjected to one way analysis of variance (ANOVA) using completely randomized design (SAS, 2000). Package and Means were separated using Duncan Multiple Range Test of the same package.

Results

The proximate composition of the *Telfairiaoccidentalis* leaf meal is as shown in Table 2.the Crude protein content 35.70%, crude fiber 23.52%, ether extract2.38%, ash 12.60%, dry matter content 92.10%.

The experimental diets are as shown in table 3 and it was observed that there were no significant difference in the CP, CF, EE and DM for all the treatments. However, there were significant differences in ash in which treatment 2 recorded the highest percentage of ash while treatment 4 recorded the lowest percentage of ash.

The proximate composition of the experimental diets fed to *Clarias gariepinus* is as shown in table 3. In dry matter, there is no significant differences ($p>0.05$) observe in the value of all diets. Diet 3 (20%) has the highest crude protein value of (40.20%) followed by diet 2 (10%) of 40.15, there is no significant different ($p>0.05$) between the two diets. T_1, T_4, T_5, has the same value (40.05%), there is no significant difference among them. The crude fibre value were significantly different ($p<0.05$) among the diets However no significant different ($p<0.05$) among the diets. However no significant different ($p<0.0$) observed in diet T_3 (3.60%) and T_5 (3.60%), T_1 has the highest value in crude fibre (3.70%), while T_2 has the least value (3.40%). in Ether extract, there is no significant different ($p>0.05$) among the diets, however, no significant different ($p>0.05$) was observed in T_3, $T_{5,}$ the two diets have the same value (9.90%). T_2 has the highest value (11.88%), while T4 has the least value (6.93%).

The haematology studies of the fish fed *Telfairiaoccidentalis* leaf meal is as shown in table 3. Packed cell volume (PCV), Hemoglobin (HB), Red blood cell (RBC), White blood cell (WBC), Mean cell volume (MCV), Mean corpuscular haemoglobin (MCH), Mean corpuscular haemoglobin concentration (MCHC), Platelet (PLT), Lymphocyte were significant ($p<0.05$).

PCV ranged from 11.5% in fish fed 40% to 40.1% in fish fed 0%. However, fish fed 0% recorded the highest PCV (40.1%) while fish fed 40% recorded the least PCV (11.5%). Haemoglobin ranged from 7.2g/L in fish fed 40% to 14.2g/L in fish fed 0%. Fish fed 0% recorded the highest HB content (14.2g/L) respectively and the least HB content (7.2g/L) were recorded in fish fed 40%. HB contents (12.6g/L, 13.3g/L, 12.7g/L) were also recorded in fish fed 10%, 20% and 30% respectively. RBC ranged from 0.96 in fish fed 40% to 3.14 in fish fed 0%. Fish fed 0% recorded the highest RBC count (3.14×10 $12/L$), while fish fed 40% recorded the least RBC count (0.96×10 $12/L$). The highest WBC (152.5×10 $9/L$) was observed in fish fed 0% while the lowest WBC (56.8×10 $9/L$) were recorded in fish fed 40% ugu leaf meal Fish fed 10% ugu leaf meal have the highest MCV (132.3fL), while fish fed 40% has the least MCV (111.2fL).The highest value of MCH (50.3pg) was found in fish fed 40% while the least value (45.2pg and 45.1pg) were found in fish fed 0% and 30% respectively. The highest MCHC (56.6g/L) was recorded in fish fed 40% ugu leaf meal while the least MCHC (35.4g/L,36.7g/L, 36.5g/L,) were recorded in fish fed 0%, 10% and 30% respectively. The highest platelet count (122.0×10 $9/L$) was recorded in fish fed 30% and the least platelet count (21.0×10 $9/L$) were recorded in fish fed 40%. Fish fed 30% ugu leaf meal recorded the highest lymphocyte count (62.5%) while the fish fed 10% ugu leaf meal recorded the least lymphocyte count (50.5%).

The serum indices of *Clarias gariepinus* fed *Telfairia occidentalis* is shown in table 5. it was observed that all parameters were significantly different ($p<0.05$) in all the diets. ALT were not significant ($p>0.05$) among $T_{1,}$ T_2, T_3 (47.365, 38.95, 47.11) respectively, the highest value was observed in T_5 (87.37). In ALT, there is no significant different ($p>0.05$) observed in T_1, T_2, T_3 and T_4

(17.53, 19.415, 21.05, 21.21), highest value was observed in T_5. In Urea, all the treatments are significantly different ($p<0.05$), the highest value was observed in T_3(4.95) while T_5has the least value (2.06). In Creatine, no significant different was observed in T_2, T_3, T_4, (26.465, 21.905, and 23.525) respectively, Highest value was observed in T? (40.445), while T_1has the least value (11.795). In Total protein, there is significant different among the treatments. However, there is no significant different between T_3 and T_5(3.965 and 4.225) respectively likewise, there is no significant different between T_2 and T_4(3.54 and 3.35) respectively. Highest value was observed in T_1. In ALB, there is no Significant Uirrerent among T_1, T_2,T_4. (1.65, 1.56 and 1.53) respectively. Highest value was observed in T_3. In Globulin, there is no significant different among T_2, T_3. T_4, and T_5 (2.07, 2.04, 1.82 and 2.35) respectively. Highest value was observed in T_1.

Table 2. **Proximate composition of *Telfairia occidentalis* fed to C*lorias gariepinus***

Parameters	Percentage Composition
Dry Matter	92.10%
Crude Protein	35.70%
Crude Fiber	23.52%
Ether Extracts	2.38%
Total Ash	12.60%

Table 3. **Proximate composition of experimental diets fed *Clarias gariepinus***

Diets						
Parameters	T_1 (10%)	T_2(20%)	T_3(30%)	T_4(40%)	T_5(50%)	SEM
%Ash	8.91^{c}	11.88"	9.90^{b}	6.93^{d}	9.90^{b}	0.21
%CP	40.05^{b}	40.15^{3}	40.20^{a}	40.05^{b}	40.05^{b}	0.54
%CF	3.70^{a}	3.40°	3.60^{ab}	3.50^{b}	3.60^{ab}	0.28
%EE	6.50	6.50	6.60	6.50	6.80	0.05
%DM	92.10	92.06	91.78	92.14	91.59	0.13

a,b,c,d: Means on the same row with different superscripts are significantly different ($p<0.05$)
SEM: Standard Error of Mean, CP: Crude Protein, CF: Crude Fibre, EE: Ether extract, DM: Dry matter.

Table 4. **Haematology of African Cat Fish (*Clarias gariepinus*) Fed Varying Levels of Ugwu Leaf (*Telfairia Occidentalis*) Meal**

Parameter	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	T5 (40%)	SEM
PCV (%)	40.2^{a}	34.5^{b}	35.5^{b}	34.7^{b}	11.5^{c}	1.19
HB (g/dl)	14.2^{a}	12.6^{b}	13.3^{ab}	12.7^{b}	7.2^{c}	0.35
RBC (x10^{6}ul)	3.14^{a}	2.60^{c}	2.76^{b}	2.81^{b}	0.96^{d}	0.09
WBC (ul)	152.5^{a}	137.4^{c}	138.5^{c}	144.0^{b}	56.8^{d}	4.07
MCV (fl)	127.9^{b}	132.3^{a}	128.9^{b}	123.6^{c}	111.2^{d}	0.87
MCH (pg)	45.2^{c}	48.4^{b}	48.1^{b}	45.1^{c}	50.3^{a}	0.30
MCHC(gm/100ml)	35.4^{c}	36.7^{bc}	37.4^{b}	36.5^{b}	56.6^{a}	0.96
PLATELETS	91.0^{c}	86.0^{d}	103.0^{b}	122.0^{a}	21.0^{e}	9.13
LYMPHOCYTES	57.8^{b}	50.5^{d}	53.5^{c}	62.5^{a}	58.6^{b}	0.52

Treatments Parameters	T,(10%)	T_2(20%)	T_3(30%)	T_4(40%)	T_5(50%)	SEM
MCHC(gm/100ml)	35.4^{c}	36.7^{bc}	37.4^{b}	36.5^{b}	56.6^{a}	0.96
PLATELETS	91.0^{c}	86.0^{d}	103.0^{b}	122.0^{a}	21.0^{e}	9.13
LYMPHOCYTES	57.8^{b}	50.5^{d}	53.5^{c}	62.5^{a}	58.6^{b}	0.52

a,b,c,d; means the superscript on the same row are significantly different (P<0.05).
WBC – White Blood Cell, HGB – Haemoglobin, RCB – Red Blood Cell, PCV – Packed Cell Volume, MCV – Mean Corpuscular Volume, MCH – Mean Corpuscular Haemoglobin, MCHC – Mean Corpuscular Haemoglobin Concentration, SEM – Standard Error Mean, T – Treatment.

Table 5. **Serum indices of *Clarias gariepinus* fed varying level of Ugu leaf *(Telfairia occidentalis)* meal**

AST	47.365^{bc}	38.95^{bc}	47.1 1^{bc}	57.37^{b}	87.37^{a}	4.94
ALT	17.53"	19.415"	21.05"	21.21^{b}	30.36^{3}	1.33
ALP	6.9^{b}	18.85^{ab}	27.66^{a}	7.82^{b}	11.04^{ab}	2.91
UREA	1.095^{C}	3.015"	4.95^{a}	3.71^{ab}	2.06^{bc}	0.41
CRE	11.795"	26.465^{ab}	21.905^{ab}	23.525^{ab}	40.445"	3.50
TP	4.805^{a}	3.54^{b}	3.965^{ab}	3.35^{b}	4.225^{ab}	0.17
ALB	1.65 °	1.56^{C}	2.01*	1.53^{c}	1.88^{b}	0.52
GLO	3.13^{a}	2.07^{b}	2.04^{b}	1.82	2.35^{b}	0.15

a, b, c, d means the superscript on the same row are significantly different(P<0.05).
SEM - Standard Error Mean, AST Aspartate aminotransferase, ALT Alanine aminotransferase, ALP - Alkaline Phosphatase, CRE - Creatine , TP - Total protein, ALB -Albumin , GLO - Globulin

Discussion

From the result of this study, it was recorded that fish fed 10%, 20%, 30% ugu leaf meal falls within the normal range (27.58 – 35.50%) of PCV, according to Eronduet *et al*., (1993) but its lower compared to 37% of PCV recorded by Adedeji *et al*., (2000).

The haemoglobin ranged (7.2-14.2g/dl) is higher than the value of 9.60g/100ml recorded by Omitoyin and 10.62g/100ml reported by Osigwe *et al*., (2005) who fed *Clarias gariepinus* with jack bean meal based diets but in agreement with findings of Adeyemo (2007).

Fish fed 10%, 20%, 30% ugu leaf meal falls within the normal range (2.3-2.9 x10^6 u) of RBC describe for catfish by Gabriel *et al*.,(2004). The reduced erythrocyte count in fish fed 40% ugu leaf meal (0.96u) may preclude the possibility of haemolyticanaemia (RBC Destruction) as stated by Kelly (1974) due totoxic factors, infectious, nutritional deficiency and metabolic disease.

There is a marked increase in WBC count (56.8-152.5ul) across the treatment compare with normal value (6.6 x 10^3ul) recommended by Adedeji *et al*., (2000). Increase in total WBC (leukocytosis) may be attributed to increase in production of leucocytes in the haematopoietic tissue in the kidney and perhaps the spleen.

The mean corpuscular volume (MCV) range (111.2 to 132.3fl) recorded in this experiment was higher than 79.20 to 105.32 fl reported for *Heteroclarias* (Anyanwu *et al.,* 2011). The increase in MCV may be attributed to the swelling of the erythrocytes resulting in macrocytic anaemia (RBC are larger than normal).

Fish fed 0%, 10%, 20%, 30% ugu leaf meal falls within the normal range (37%) of MCHC, recommended by Adedeji *et al*., (2000). The MCHC, which is the ratio of blood haemoglobin concentration as opposed to the haematocrit, is not influenced by the blood but can be interpreted incorrectly when new cells with a different haemoglobin concentration are released into blood circulation (Soivio and Nikimmaa, 1981).

Serum indices test are routinely used to assess health status and aid in the diagnosis of diseases in man and animal. In this study, an attempt was made to investigate biochemical blood parameters in *C. gariepinus* following the replacement of soybean with ugwu leaf *(Telfairiab occidentalis)* meal. One of the important functions of plasma/serum protein is the maintenance of osmotic balance between the circulating blood and tissue fluids. (Harper *et al,* 1979).

Many soluble serum enzymes have been considered as relevant stress indicator. Therefore, activities of serum ALT and AST have been commonly used in the detection of tissue damage caused by environmental pollution.

In the present study, fish fed varying level of ugu leaf showed a rapid increase in ALT and AST, increase of these enzyme activities in serum is a sensitive indication of even minor cellular damage (Palanivelu *et al,*2005) and indicate stress-based tissue impairment. Increase in ALT and AST indicate tissue damage in liver, kidney or gill (Osigwe *et al.,* 2011).

Conclusion

It could be concluded based on the result of this study that *Telfairiaoccidentalis* can be used to replace soybean up to 20% with no detrimental effect in term of physiological and/or health wise in African catfish.

Recommendation

Based on the result obtained from this experiment, it is thereby recommended that 20% inclusion level leaf of ugu leaf *(Telfairiaoccidentalis}*meal should be used as a substitution for soybean in the diet of Africa catfish.

References

Adedeji, O.B., Taiwo, V.O. and Agbede, S.A. (2000). Comparative Haematology of five Nigeria fresh water fish species: Nigeria veterinary journal Ib. 21: 75-84.

Adeparusi, E.O and Ajayi, A. D. (2004). Haematological characteristics of Nile Tilapia *(Oreochromisniloticus)* fed differently processed lima bean *(Phaseoluslunatus* L.) diets.

Journal of Research in Science and Management, Vol. 2 (1): 73-80.

Adeyemo, O.K.(2007). Haematological profile of *Clariasgariepinus* (Burchell 1822) exposed to lead. *Turkish Journal of Fisheries and Aquatic Sciences*. 7:163-169.

Ajibade S.R, Balogun M.O, Afolabi O.O and Kupolati MD, (2006). Sex differences in the biochemical contents of *Telfairiaoccidentalis*. Hook f. *Journal of Food Agriculture Environ.,*4: 155-156.

Akoroda, M.O (1990). Ethnobotany of *Telfairiaoccidentalis* (Curcurbitacae) among igbos of Nigeria. Economic Botany 29-39. Jstor. Alada ARA. 2000. The haematological effects of *Telfairiaoccidentalis* diet preparation. *African Journal of Biomed.Res*., 3(3): 185-186

Alada ARA. (2000). The haematological effects of *Telfairiaoccidentalis* diet preparation. *African Journal of Biomed. Res*., 3(3): 185-186.

Anyanwu DC, Udedibie ABI, Osuigwe DI, Ogwo VO, (2011). Haematological responses of hybid of *Heterobranchusbidorsalis x Clariasgariepinus* fed dietary levels of *Carica papaya* leaf meal World Rural Observation. 3(1):9-12.

A.O.A.C. (1995).Official method of analysis, 16th edition, Association of Official Analytical and Applied Chemist, Washington D.C United State of America.

Balogun, A.M., \(1988). Feeding fish with alternative food formulation and resource: prospects, problems and implication: In: G.M. Babatunde (Ed.); Proceeding of the National Workshop in Alternative Food Formulation for Livestock Feed in Nigeria, Ilorin 21-25 presidency, Nigeria: 669-697.

Fagbenro, O.A., Adeparusi, E.O. and Jimoh W.A. (2007). Evaluation and nutrients quality of detoxified jackbean seeds cooked in distilled water or trona solution, as a substitute for soybean meal in Nile tilapia, *Oreochromisniloticus* diets. *Journal of Applied Aquaculture,* 19 (2): 83-100.

Fagbenro, O.A., Adeparusi, E.O. and Jimoh W.A. (2010a). Apparent nutrient digestibility of sunflower and sesame seed meal in *Clariasgariepinus* (Burchell,1822) fingerlings, *Conference Proceeding of the 25th Annual Conference of Fisheries Society of Nigeria* (FISON), FSN-NU 0001, ISSN: 1117-3149, ASCON, Badagry 25th-29th October 2010.

Fagbenro, O.A., Adeparusi, E.O. and Jimoh W.A. (2010b).Haematological profile of blood of African catfish *(Clariasgariepinus,* Burchell, 1822) fed sunflower and sesame meal based diet. Conference Proceeding of the 25th *Annual Conference of Fisheries Society of Nigeria* (FISON), FSN-NU 0001, ISSN: 1117-3149, ASCON, Badagry 25th-29th October 2010.

Fagbenro, O.A., Adeparusi, E.O. and Jimoh W.A. (2010c). Nutritional evaluation of raw sunflower and sesame seed meal in *Clariasgariepinus:* an assessment by growth performance and nutrient utilization. *African Journal of Agricultural Research, vol. 5(22)* 3096-3101.

Fasuyi A.O, Nonyerem A.D. (2007). Biochemical, nutritional and haematological implications of *Telfairiaoccidentalis* leaf meal as protein supplement in broiler starter diets. *African Journal Biotechnology* 6: 1055-1063.

Harper H.A, Rodwell V.W, Mayes P.A. *Review of Physiological Chemistry,* 17th Ed. Lange Medical Publications Los Allos California. 1979.

Nwozo, S.O., OA. Adaramoye and E.O. Ajaiyeoba, (2004). Antidiabetic and hypolipidaemic studies of *Telfairiaoccidentalis*on allox an induced diabetic rabbits. Nig. J. Nat. Prod. Med., 8: 45-47.

Olorunfemi AE, Arnold Cl, Emmanuel O, Nkaima N, Akem A. 2005. Hypoglycaemia activity of *Telfairiaoccidentalism* rats. *J. Pharm. Biores, 2:* 36-42.

Osuigwe D.I, Obiekezie A.I and Onuoha G.C (2005). Some haematological changes in hybrid catfish (*Heterobranchuslongifilis*x *Clariasgariepinus*) fed different dietary levels of raw and boiled jackbean (*Canavaliaensiformis*) seed meal. African Journal of Biotechnology.4(9):1017-1021.

Palanivelu V, VijayavelK, Ezhilarasibalasubrumanian S. and Balasubraminian M. (2005). influence if insecticidal derivative (Cartap hydrochloride) from the marine polychaete on certain enzyme systems of the freshwater fish *Orechromismossambicus. J. Environ. Biol,* 26:191-196.

Soivio A. and Nikinmaa M. (1981).The swelling of erythrocytes in relation to the oxygen affinity of the blood of rainbow trout, *Salmogaidneri* (Richardson). In: Stress and Fish (Ed. A. D. Pickering), Academic Press, London pp. 103 – 119Pp.

Connaître les plantes utiles pour l'Agriculture Biologique d'après la littérature: Construction et exploration d'une base de connaissances pour la santé végétale et animale

Knowing the Useful Plants for Organic agriculture according to literature: Building and Exploring a Knowledge Base for Plant and Animal Health

*Pierre Martin, Samira Sarter, Marianne Huchard, Appolinaire Tagne, Zakaria Ilboudo, Pascal Marnotte and Pierre Silvie

Corresponding author:
Pierre Martin, as above

Keywords:
Plant-based product, organic agriculture, knowledge management

Abstract

Organic Farming excludes the use of synthetic chemicals to protect plants in the field or during grain storage and questions the use of antibiotics for livestock breeding or aquaculture. One way to limit major constraints of chemicals (pests and diseases) is to use active plants parts or plants-based products, as it has been described in the literature for plant and animal health. Our current work consists in building a knowledge database from existing literature and implementing exploration methods to support the extraction of knowledge by the potential users (smallholders, advisors, extensionists, researchers, producers, etc.). In early May 2018, the knowledge base gathered data from 227 documents, dated from 1957 to 2017. Ninety-four percent of the 33,400 uses recorded concerned sub-Saharan African countries.

Introduction

L'agriculture biologique exclut, par définition, l'usage de produits chimiques de synthèse, pour la protection des plantes au champ ou lors du stockage des grains. Cette agriculture questionne également l'emploi des antibiotiques pour l'élevage des animaux terrestres et aquatiques, dont l'utilisation massive et inappropriée induit le développement de bactéries résistantes. Ces dernières compromettent l'efficacité thérapeutique des antibiotiques et représentent une menace pour la santé humaine, animale et environnementale (O'Neill, 2016).

Parmi les contraintes de production, les maladies et les ravageurs des cultures occupent une place prépondérante. Les pertes de grain dues aux maladies peuvent atteindre 11% de la production totale mondiale (Oerke *et al*., 1994). En condition tropicale, les pertes occasionnées par les insectes sur le maïs sont estimées à plus de 30% des récoltes (Guèye *et al.*, 2010). Les coléoptères de la famille des Bruchidae peuvent causer des dégâts estimés à 800 g/kg dans les stocks de niébé (*Vigna unguiculata*) après 6 mois de stockage (Ouédraogo *et al*., 1996).

Une voie prospectée consiste à utiliser des plantes, selon différentes formes. Les exemples d'utilisation en santé végétale et animale sont nombreux. Le traitement des semences de maïs ou de riz à l'aide des fongicides formulés à base d'huiles essentielles de : citronnelle, (*Cymbopogon citratus*), de thym (*Thymus vulgaris)*, ou de basilic (*Ocimum gratissimum)*, réduisent l'inoculum initial pouvant causer la pourriture des épis de maïs et des tiges au champ (Tagne *et al.*, 2013), ou des panicules vides « bakanae disease » du riz (Nguefack *et al.*, 2008). La protection post récolte des grains de maïs contre le charançon *Sitophilus zeamays* (Coleoptera: Curculionidae) peut être faite à partir d'huiles essentielles

(Ngamo *et al*., 2004). Des formulations biopesticides à base d'huiles essentielles et de support poudreux (poudre de manioc, de gomme arabique et d'amidon) ont été utilisées efficacement contre le ravageur principal du niébé *Callosobruchus maculatus* (Ilboudo *et al*., 2015).

Explorer la biodiversité végétale locale pour la phytothérapie permet également de valoriser et de préserver les connaissances et les savoir-faire traditionnels dans les pays du sud. Le travail présenté dans ce document a été réalisé dans le cadre du projet Knomana, financé par le méta-programme Glofoods INRA-Cirad. Il consiste à remplir une base de connaissances à partir de la littérature existante et à disposer de méthodes d'exploration permettant aux différents utilisateurs cibles (producteurs, conseillers, chercheurs, etc.) de trouver les réponses à leurs questions, celles-ci pouvant être diverses à l'exemple des plantes d'intérêt pour lutter contre un insecte nuisible aux cultures ou un vecteur de maladies animales pouvant se transmettre à l'homme (zoonose), aux modes de préparation ou aux effets négatifs de certains usages.

Matériel et Méthodes

Le recensement des usages expérimentaux et/ou appliqués dans les élevages et sur les cultures, au champ ou dans les stocks a conduit à la construction d'une base de connaissances « PPAf » (Plantes Pesticides d'Afrique). Initiée en 2015, cette base rassemble les données collectées dans les articles publiés par des chercheurs, en particulier ceux du réseau informel également appelé PPAf (Silvie *et al*., 2016). La saisie des données a été effectuée par des chercheurs, des cadres techniques et des étudiants localisés en France et en Afrique.

En parallèle à la saisie, le développement de méthodes de *visualisation et d'interaction avec la base de connaissances a été initié. L'objectif de ces méthodes est d'assister l'utilisateur à formuler sa requête, sans connaissance requise des méthodes informatiques mises en œuvre.* Les données présentes dans la base de connaissances étant très nombreuses et les types de requête non connus au préalable, la méthode informatique choisie repose sur des techniques de classification en cours d'adaptation à PPAf, en particulier l'Analyse Formelle de Concepts et ses variantes *pour le traitement des données numériques et relationnelles* : les Pattern Structures (Kaytoue et al., 2015), les approches Graph-FCA (Ferré and Cellier, 2016) et l'Analyse Relationnelle de Concepts (Rouane-Hacene et al., 2013). Les extractions, présentées dans ce résumé, sont préliminaires aux analyses plus complexes qui seront effectuées par la suite.

Résultats

Début mai 2018, la base de connaissances rassemblait des données extraites de 227 articles. Ces derniers proviennent de 132 sources d'origines diverses (revue scientifique, acte de conférence, bulletin d'académie, etc.), rédigés en langue anglaise ou française, et datés de 1957 à 2017. De ces articles, 33 400 usages ont été recensés, qu'ils soient expérimentaux ou appliqués, en protection des cultures et en santé animale. La recherche ayant porté principalement sur les pays d'Afrique sub-Saharienne, 94% des usages concernent cette zone géographique. Quelques cas d'études sont proposés dans les tableaux suivants.

Protection des plantes au champ ou dans les denrées stockées

L'interrogation de la base de connaissances par type de culture permet de dresser le tableau des usages, expérimentaux ou réels, dans le cas de cultures comme les légumes, généralement fortement traitées chimiquement (e.g., la tomate et le choux). Le nombre de plantes utilisées varie selon les cultures : 17

pour le choux, 16 pour le haricot, et 26 pour la tomate (Tableau 1). Dans le cas de la tomate, selon le lieu et la méthode de préparation/application, les plantes permettent de protéger la culture de champignons (*Aspergillus niger, Athelia rolfsii, Fusarium graminearum, Fusarium oxysporum, Fusarium poae, Phytophthora infestans*), de bactéries (*Escherichia coli, Staphylococcus aureus*) ou d'insectes (*Helicoverpa armigera, Tetranychus evansi, Tuta absoluta*).

Dans le cas d'un insecte exotique envahissant pour l'Afrique, il est possible de rechercher le nom des plantes utilisées sur d'autres continents, également présentes en Afrique. Par exemple, pour *Spodoptera frugiperda* récemment signalée, PPAf propose, entre autres, *Acanthospermum hispidum*, *Azadirachta indica*, *Calotropis procera*, *Carica papaya*, *Citrus limon*, *Dysphania ambrosioides*, *Melia azedarach*, *Momordica charantia*, *Ricinus communis*, *Senna obtusifolia*, *Solanum lycopersicum*, *Zanthoxylum gilletii*, et *Zea mays*. Ces résultats permettent d'identifier des espèces ou des genres botaniques pouvant faire l'objet de travaux de recherche complémentaires sur leur efficacité.

Tableau 1. **Exemple de plantes pour la protection de cultures contenues dans PPAf**

Culture protégée	Espèce expérimentée ou appliquée
Choux *(Brassica napus, Brassica oleracea, Brassica sp.)*	*Allium sativum*, *Aloe spp.*, *Azadirachta indica*, *Capsicum annuum*, *Capsicum frutescens*, *Capsicum spp.*, *Carica papaya*, *Chenopodium opulifolium*, *Derris elliptica*, *Eucalyptus spp.*, *Lippia javanica*, *Nicotiana tabacum*, *Ocimum gratissimum*, *Senna siamea*, *Solanum delagoense*, *Tagetes minuta*, *Tephrosia vogelii*
Haricot *Phaseolus vulgaris*	*Allium sativum*, *Aloe spp.*, *Azadirachta indica*, *Callistemon viminalis*, *Capsicum annuum*, *Capsicum frutescens*, *Capsicum spp.*, *Chenopodium opulifolium*, *Dryopteris filix-mas*, *Dysphania ambrosioides*, *Eucalyptus spp.*, *Nicotiana tabacum*, *Ocimum gratissimum*, *Senna siamea*, *Tephrosia vogelii*, *Urtica dioica*
Tomate (*Solanum lycopersicum*)	*Ageratum conyzoides*, *Ageratum houstonianum*, *Azadirachta indica*, *Bidens pilosa*, *Callistemon citrinus*, *Calotropis procera*, *Clausena anisata*, *Commelina benghalensis*, *Cymbopogon citratus*, *Deinbollia saligna*, *Emilia coccinea*, *Entandrophragma angolense*, *Erigeron floribundus*, *Eucalyptus saligna*, *Eucalyptus tereticornis*, *Euphorbia hirta*, *Garcinia smeathmanii*, *Lippia javanica*, *Lippia multiflora*, *Musa sp.*, *Ocimum basilicum*, *Ocimum gratissimum*, *Oxalis barrelieri*, *Podocarpus milanjianus*, *Solanum delagoense*, *Tephrosia vogelii*

Dans le cas de la protection des denrées stockées, le tableau 2 présente quelques espèces végétales sur les 49 recensées, expérimentées ou appliquées en Afrique contre le bruche du niébé (*Callosobruchus maculatus*). La base de connaissances permet de retrouver les noms vernaculaires et les références bibliographiques correspondantes.

Tableau 2. **Exemples de plantes, d'après PPAf, expérimentées ou appliquées contre *Callosobruchus maculatus* dans les stocks de niébé**

Famille	Espèce
Annonaceae	*Annona muricata*, *Annona senegalensis*, *Monodora myristica*, *Xylopia aethiopica*
Euphorbiaceae	*Euphorbia lateriflora*, *Spirostachys africana*
Fabaceae	*Chamaecrista nigricans*, *Tephrosia densiflora* , *Tephrosia vo gelii*
Lamiaceae	*Hyptis spicigera*, *Hyptis suaveolens*, *Ocimum americanum*, *Ocimum basilicum*, *Ocimum canum*, *Tetradenia multiflora*
Moringaceae	*Moringa oleifera*
Verbenaceae	*Lantana camara*, *Lippia javanica*, *Lippia multiflora*, *Lippia rugosa*

Santé animale
Concernant la santé animale, l'analyse partielle permet de recenser 373 espèces végétales utilisées de manière expérimentale ou appliquée, pour protéger 7 familles animales, dont 2 espèces aquatiques, i.e. le tilapia et la crevette. Le tableau 3 présente des exemples de plantes pour la protection des bœufs (*Bos taurus*) et des chèvres (*Capra aegagrus*) contre différents bio-agresseurs.

Tableau 3. **Exemple de plantes expérimentées ou appliquées en santé animale, d'après PPAf**

Espèce animale	Espèce de plante de protection	Organisme cible
Bœuf *(Bos taurus)*	*Lantana camara*	*Amblyomma variegatum*, *Corynebacteriaceae*, *Hansenula* sp., *Rhipicephalus microplus*, *Saccharomyces* sp., *Sporobolomyces* sp., *Torulopsis candida*
	Ocimum gratissimum	*Rhipicephalus microplus*
	Tephrosi a vogelii	*Amblyomma variegatum*, *Rhipicephalus microplus*
Chèvre *(Capra aegagrus)*	*Chromolaena odorata*	*Rhipicephalus lunulatus*
	Dysphania ambrosioides	*Rhipicephalus lunulatus*
	Eucalyptus saligna	*Rhipicephalus lunulatus*

Discussion

Le croisement des résultats présentés ci-dessus montre que certaines plantes sont utilisées pour protéger autant des cultures agricoles que des élevages animaux. Dans le cas de *Lantana camara* par exemple, elle est employée pour des modèles biologiques distincts : le bruche du niébé en santé végétale, des bactéries, des acariens et des champignons pathogènes en santé animale. Les usages recensés pour cette plante proviennent de pays différents (Burkina Faso, Bénin, Kenya, etc.). Leur regroupement au sein de la base PPAf permet ainsi de mettre en évidence son aptitude multi-usages, et pose la question de sa composition chimique pouvant varier selon son lieu de développement. De plus, cette plante étant invasive, sa mobilisation dans un cadre d'agriculture biologique permettrait de valoriser au mieux cette ressource locale non cultivée.

Conclusion

Les premières analyses permettent d'envisager des résultats importants concernant le multi-usage des plantes cultivées et non-cultivées. Les travaux actuels portent sur la consolidation de la base de connaissances avec un enrichissement par des travaux réalisés sur d'autres continents. L'accès à une analyse plus approfondie sera possible dès lors que les méthodes de navigation et d'interrogation de la base de connaissances seront implémentées.

Références

Ferré S., Cellier P. 2016. Graph-FCA in Practice. Graph-Based Representation and Reasoning. Lecture Notes in Computer Science 9717, Springer 2016. p. 107-121.

Guèye M.T., Seck D., Wathelet J.P., Lognay G. 2010. Lutte contre les ravageurs des stocks de céréales et de légumineuses au Sénégal et en Afrique occidentale : synthèse bibliographique.

Ilboudo Z., Dabiré-Binso C.L., Sankara F., Nébié R.C.H., Sanon A. 2015. Optimizing the use of essential oils to protect stored cowpeas from *Callosobruchus maculatus* (Coleoptera: Bruchinae) damage. *African Entomology* 23 (1): 94-100.

Kaytoue M., Codocedo V., Buzmakov A., Baixeries J., Kuznetsov S.O., Napoli A. 2015. Pattern Structures and Concept Lattices for Data Mining and Knowledge Processing. ECML/PKDD 3: 227-231.

Ngamo T.L.S., Goudoum A., Mapongmetsem P.M., Kouninki H., Hance T. 2004. Persistance of the insecticidal activity of five essential oils on the maize weevil *Sitophilus zeamays* (Motsch.) (Coleoptera: Curculionidae). *Common Agric. Appl. Biol. Science* 69 (3): 145-147.

Nguefack J., Leth V., Lekagne Dongmo J.B., Torp J., Amvam Zollo P.H., Nyasse S. 2008. Use of three essential oils as seeds treatment against seed-borne fungi of rice (*Oryza sativa*). *American-Eurasian Journal Agriculture and Environment Science* 4 (5): 554-560.

Oerke E. C. Dehne H.W. Scönbeck F. Weber A. 1994. Crop Production and Crop Protection. Estimated losses in major food and cash crops. Elsevier 808p.

Ouédraogo A.P., Sou S., Sanon A., Monge J.P., Huignard J., Tran M.D., Credland P.F. 1996. Influence of temperature and humidity on populations of *Callosobruchus maculatus* (Coleoptera Bruchidae) and its parasitoids *Dinarmus basalis* (Pteromalidae) in two zones of Burkina Faso. *Bulletin of Entomological Research* 86: 695-702.

O'Neill J. 2016. Tackling drug-resistant infections globally: final report and recommendations. Review on antimicrobial resistance. Wellcome Trust and UK Government, 80 p.

Rouane-Hacene M., Huchard M., Napoli A., Valtchev P. 2013. Relational concept analysis: mining concept lattices from multi-relational data. Ann. Math. Artif. Intell. 67(1): 81-108.

Silvie P., Martin P., Marnotte P., Yarou B., Zida P., Foko D., Ilboudo Z., Tofel H., Tendonkeng F., Sow G., Adda C. 2016. Using knowledge management to better identify research gaps and priorities on pesticide plants in West and Central Africa. *Natural products and Biocontrol* Meeting, Perpignan (France), 1 p.

Tagne A., Amvam Zollo P.H., Fontem D.A., Mathur S.B., Neergaard E. 2013. Fungicides and Essential Oils for Controlling Maize Seed-Borne Fusarium moniliforme and its Transmission into Seedlings. *World Journal of Agricultural Sciences* 9 (3): 290-297.

Organic Fertilizers improve the Growth, Seed Quality and Yield of newly Released Soybean (*Glycine max* (L.) Merrill Varieties in the Tropics

Tobechi Onyenali,
Victor Olowe*,
Thomas Fabunmi
and Soretire Adeniyi

Federal University of Agriculture Abeokuta (FUNAAB)

Corresponding author:
owebaba@yahoo.com

Keywords:
growth, oil content, protein content, seed yield, yield attributes

Abstract

Soybean (Glycine max (L.) Merrill) yield in tropical Africa remains below 1t/ha partly because most growers rarely use beneficial organic soil amendments on degraded tropical soils. Therefore, filed trials were conducted during the late cropping seasons (July – Nov.) of 2015 and 2016 on the organic research plots of the Institute of Food Security, Environmental Resources and Agricultural Research, Nigeria (7° 23′ N, 3° 39′ E, altitude 139 m above sea level). The trials evaluated the agronomic response of five recently released soybean varieties (TGx 1448-2E, TGx 1440-1E, TGx 1740-2F, TGx 1987-62F and TGx 1835-10E) to the application of three commercial organic fertilizers (Aleshinloye Grade B, Organo-Farm and Gateway) and a control. The trials were laid out in randomized complete block design (RCBD) in a 5 × 4 factorial arrangement and replicated three times. Data were collected on growth parameters, yield and yield attributes, and seed quality. Significant (P<0.05; F-Test) varietal difference was recorded for aboveground plant weight, grain filling period, height at physiological maturity, number and weight of pods per plant, number of branches and seed yield, and quality in both years. Application of organic fertilizers significantly (P<0.05; F-Test) increased aboveground plant weight, number of branches, pods, weight of seeds per plant, seed yield and quality in both years relative to the control treatment, except oil content and seed yield in 2016. The three organic fertilizers appear appropriate for soybean cultivation since soybeans grown on treated plots produced seed yield above 1/ton in both contrasting years of experimentation.

Introduction

Soybean (*Glycine max* (L.) Merrill) is mainly grown for its seed that contains 18 – 25% oil and 30 – 50% protein required for human and animal nutrition (Manna, 2014). At present in tropical Africa, the average seed yield of soybean is below 1 t/ha as against the world average of 2.7t/ha (FAO, 2016). General low yields of food crops in the tropics have been attributed to low soil fertility status, weed infestation, rising cost of agrochemicals, low purchasing power of resource-constrained farmers, lack of improved crop varieties, lack of access to necessary inputs, poor management practices among others (Affholder *et al.* 2013; Zerihun and Haile, 2017). The use of low input technology such as organic fertilizers will go a long way in ameliorating some of the challenges farmers face in the tropics. According to Chen (2006), all the required nutrients by plant must be present in the soil in balanced quantities and forms for the plant's optimal growth. Organic soil amendments have been reported to improve the physical and chemical, and biological properties of the soil through the improvement of soil aeration, soil carbon exchange capacity (CEC), water holding capacity, slow mineralization of organic materials (Yan *et al.* 2007; Zhong *et al.* 2010; Gautam and Pathak, 2014). Unfortunately, fewer efforts have been made thus far to explore the potential of the use of only organic fertilizers to boost the productivity of soybeans in the tropics. Some of the documented efforts are from Indonesia (Abidin and Sutrisno 2015, Kuntyastuti *et al.* 2018), Pakistan (Javaid and Mahmood 2010), Egypt (Mekki and

Ahmed 2005), Nigeria (Olowe *et al.* 2014), India (Aher *et al.* 2015). However, most of these studies were limited to grain yield and yield attributes, not addressing seed quality as affected by the applied organic fertilizers. Therefore, our study was carried out to evaluate the effect of organic fertilizer application, on growth, yield, yield attributes and quality of soybeans in the tropics.

Materials and Methods

The field experiments were carried out on the organic research plots of the Institute of Food Security, Environmental Resources and Agricultural Research, Nigeria (7° 23′ N, 3° 39′ E, altitude 139 m above sea level) during the late cropping seasons of 2015 and 2016 on a sandy loam soil. During the period of experimentation, a total rainfall of 435.8 and 519.1 mm was recorded in 2015 and 2016, respectively. Based on the results obtained from soil analysis, the soils of the experimental sites were loamy sand in texture and contained 0.11 and 0.12% total nitrogen, 1.17 and 1.19% total organic carbon, available P 16.42 and 48.69 mg/kg, 0.28 and 0.91 mol/kg exchangeable potassium with pH of 6.1 and 6.2 in 2015 and 2016, respectively. The experimental design was randomized complete design in a 5 × 4 factorial arrangement and replicated three times. The factors were varieties: TGx 1448-2E (late maturing), TGx 1440-1E (Late maturing), TGx 1740-2F (Early maturing), TGx 1987-62F (Early maturing) and TGx 1835-10E (Early maturing) and organic fertilizers: Alehinloye Grade B (0.58 and 0.56% N; abattoir waste based), Organo farm (1.58 and 1.67% N; brewery waste based) and Gateway (0.50 and 0.50% N; animal dung and wood ash based) in 2015 and 2016, respectively. Sowing was done on the experimental plots that consisted of six rows measuring 4 m x 3 m (12m^2) at 60 cm x 5 cm giving a total plant population of 333,000 plants per ha. Sowing was done on July 15, 2015 and July 13, 2016. Organic fertilizers were applied at three weeks after sowing (WAS) immediately after the first weeding. The second hoe weeding was done at 6WAS. Thereafter, five plants were randomly selected and tagged at 5WAS from the net plot for plant height and yield attribute measurement on plot basis. Data were collected on plant height at physiological maturity (R7), grain filling period (GFP), and above ground plant weight. At harvest, data on yield attributes (number of branches per plant, number and weight of seeds and pods per plant were collected on five randomly selected plants from each plot and total plot yield was determined. The oil and protein content of seeds were determined using Soxhelt extraction and Kjeldahl block digestion and steam distillation, respectively (Egan *et al.* 1981). All data collected were subjected to analysis of variance (ANOVA) to test the main and interaction effects and where the effects were statistically significant ($P < 0.05$, F-test), treatment means were separated using the least significant difference (LSD) method.

Results

The five test varieties were significantly different ($P<0.05$; F - test) from each other for above ground plant weight, grain filling period, number of branches per plant and height at physiological maturity in 2015 and 2016. Similarly, application of Aleshinloye Grade B and Organo farm organic fertilizers significantly ($P<0.05$) increased aboveground plant weight and number of branches per plant relative to the control. However, the organic fertilizer application had no effect on grain filing period and height at physiological maturity. The Variety × Fertilizer application effect on the measured growth parameters was not significant on the varieties in both years (Table 1). Pod number and weight per plant was significantly ($P<0.05$; F – test) affected by varietal effect and organic fertilizer application in both years, except the effect of organic fertilizer on pod weight in 2016. Application of Aleshinloye significantly ($P<0.05$) enhanced seed weight of soybeans compared to other organic fertilizers and control. Variety and organic fertilizers had no effect on seed number per plant. Variety × Fertilizer Application effect was not significant on any of the measured yield attributes in both years (Table 2). The main and interaction effects significantly (*P<0.05; F* – test) affected seed yield and quality in both years, except fertilizer

Table 1. **Effect of organic fertilizer application on aboveground plant weight (ABGPWT), Grain filling Period (GFP), height at physiological maturity (HTR7) and number of branches per plant (NBR) of soybean varieties, 2015 and 2016**

Treatment	2015				2016			
	ABGPWT (g)	GFP	HTR7 (cm)	NBR	ABGPWT (g)	GFP	HTR7 (cm)	NBR
Variety (V)								
TGx 144-2E	24.9	15.1	57.6	4.6	34.5	16.3	69.5	4.3
TGx 1440-2E	27.4	17.8	56.9	5.8	35.7	14.9	75.2	5.0
TGx 1740-2F	26.9	16.8	58.9	5.5	26.5	13.1	76.5	4.5
TGx 1987-62F	18.3	14.5	50.1	3.5	21.9	13.8	66.9	3.5
TGx 1835-10E	9.0	12.3	44.7	2.6	18.3	16.9	58.3	2.6
LSD (5%)	6.71	0.62	5.78	1.24	11.36	2.07	7.61	1.32
Organic fertilizer (F)								
Control	14.1	15.3	67.9	2.9	16.6	15.6	67.9	2.6
Aleshiloye B	28.7	15.6	71.1	5.4	35.6	15.5	71.1	4.1
Organo Farm	23.9	14.8	69.9	5.2	33.9	14.5	69.9	4.9
Gateway	18.5	15.5	68.1	4.0	23.4	14.4	68.0	4.3
LSD (5%)	6.00	ns	ns	1.11	10.16	ns	ns	1.18
V × F	ns	ns	ns	ns	ns	ns	ns	ns

ns – not significant

Table 2. **Effect of organic fertilizer application on some yield attributes of soybeans, 2015 and 2016**

Treatment	2015				2016			
	PODN	PODW (g)	NSD	WTSD (g)	PODN	PODW (g)	NSD	WTSD (g)
Variety (V)								
TGx 144-2E	53.1	19.0	83.1	9.9	59.2	23.8	92.9	11.4
TGx 1440-2E	65.7	25.0	85.0	13.2	55.2	24.5	83.4	10.9
TGx 1740-2F	59.6	19.8	97.4	10.8	49.9	17.5	83.3	9.9
TGx 1987-62F	36.4	13.2	76.4	9.4	33.1	11.5	76.9	8.2
TGx 1835-10E	20.4	8.1	44.0	8.6	20.3	8.9	43.9	9.3
LSD (5%)	17.43	8.19	ns	ns	15.99	8.76	ns	ns
Organic fertilizer (F)								
Control	33.8	10.4	61.8	6.5	31.2	12.6	59.2	7.3
Aleshiloye B	61.4	21.6	90.8	16.2	58.3	20.3	89.9	14.4
Organo Farm	47.9	21.7	92.9	10.6	44.1	21.3	89.8	9.3
Gateway	45.1	14.4	63.8	8.3	40.1	14.7	65.4	8.8
LSD (5%)	15.59	7.33	ns	4.03	14.30	ns	ns	4.30
V × F	ns	ns	ns	ns	ns	ns	ns	ns

ns – not significant, PODN – number of pods per plant, PODW - weight of pods per plant, NSD – number of seeds per plant, WTSD – weight of seeds per plant application and V × F effect on seed yield in 2016. Soybean plants that were grown on plots treated with Gateway fertilizer recorded the highest values for protein and oil content (significant at $P < 0.05$) relative to soybean plants grown on other treated plots and control plots (Table 3).

Table 3. **Effect of organic fertilizer application on seed yield and quality of soybean varieties, 2015 and 2016**

Treatment	2015			2016		
	Seed yield (kg/ha)	Protein content (%)	Oil content (%)	Seed yield (kg/ha)	Protein content (%)	Oil content (%)
Variety (V)						
TGx 144-2E	1518.2	36.1	16.4	1833.3	35.5	16.9
TGx 1440-2E	1824.8	36.1	17.4	1805.6	36.4	17.4
TGx 1740-2F	1792.9	37.0	17.1	1715.3	36.1	17.3
TGx 1987-62F	1015.3	36.8	17.4	1638.9	37.3	17.4
TGx 1835-10E	547.3	37.2	17.4	1131.9	35.3	16.9
LSD (5%)	314.89	0.24	0.03	365.08	0.22	0.32
Organic fertilizer (F)						
Control	997.9	35.1	16.5	1444.5	35.9	16.9
Aleshiloye B	1595.7	36.9	17.6	1577.8	36.2	17.3
Organo Farm	1446.6	37.2	17.0	1794.4	36.6	17.1
Gateway	1318.7	37.4	17.6	1683.3	37.8	17.4
LSD (5%)	281.65	0.22	0.02	ns	0.19	0.28
V × F	**	**	**	ns	**	**

ns – not significant, ** significant at 1% probability level

Discussion

The huge potential of organic soybean production had in the forest savanna transition zone of the humid tropics has been established (Olowe and Adebimpe; Olowe *et al.* 2014). Varying responses to organic fertilizer application were observed in the five tested soybean varieties. TGx 1440-1E, a late maturing variety, was the most vigorous variety and it produced significantly (P<005) higher above ground plant weight, pod number and weight than the two early maturing varieties (TGx 1987-62F and TGx 1835-10E) in both years. However, it was on par with TGx 1448-2E (check and late maturing) and TGx 1740-2F, an early maturing variety, for aboveground plant weight, height at physiological maturity and number of branches per plant. Although, It was observed that neither plant height at physiological maturity or length on grain filling period directly resulted in greater plot seed yield even in the more favourable 2016 growing season. This agrees with the report of Board (2002). The two late varieties recorded longer grain filling period than the early maturing varieties and consequently significantly (P<0.05) higher grain yields than TGx 1987-62F and TGx 1835-10E in both years, except TGx 1835-10E in 2016. The yield performance of the tested varieties compared very well with their potential (1.1 – 2.7 t/ha) in the traditional growing regions especially during the wetter 2016 (Asafo-Adeji and Adekunle, 2001). The varieties also contained comparable amounts of oil and protein. Application of the three commercial organic fertilizers, especially Aleshinloye Grade B and Organo Farm resulted in significantly (P<0.05; F-test) higher above ground plant weight and number of branches in both years relative to the control. Enhanced growth could be attributed to provision of macro and micro nutrients required for vegetative growth by the manure. Significant growth response to applied manure and compost had been reported by Yagoub *et al.* (2012) and Sutrisno (2017). On average, organic fertilizer application also significantly (P<0.05; F-test) increased pod number and weight, and weight of seeds per plant in both years, except pod weight in 2016. Enhanced development of soybeans on the treated plots could be due supply and availability of nutrients necessary for partitioning of assimilates to the various structural components of the plants. Similar results have been reported by Myint *et al.* (2009) and Devi *et al.* (2013). Application of Gateway organic fertilizer (animal dung and wood ash based) that contained comparatively high levels of micronutrients (Zn, Cu, Fe and Mn) resulted in significantly (*P<.05*) higher protein and oil content than the control and on par with the other two fertilizers. On average, the three fertilizers enhanced seed quality of soybeans relative to the control. It was concluded that application of organic fertilizers to soybeans is worthwhile venture that can boost its production in the tropics.

References

Affholder, F. Poeydebat, C. Corbeels, M. Scopel E. and Tittonell, P. (2013). The yield gap of major food crops in family agriculture in the tropics: Assessment and analysis through field surveys and modeling. Field Crop Research 143: 106-118.

Aher, S.B. Lakaria B.L. Kaleshananda, S. Singh, A.B. RAmana S, Ramesh K and Thakur J.K. (2015). Effect of organic farming practices on soil and performance of soybean (Glycine max under semi-arid tropical conditions in Central India. *Journal of Applied and Natural Sciences* 7: 67-71.

Almaz, M.G., Halim, R.A and Martini, M.Y. 2017. Effect of combined application of poultry manure and inorganic fertilizer on yield and yield components of maize intercropped with soybean. *Tropical Agricultural Science* 40:173-184.

Asafo-Adeji B. and Adekunle A.A (2001). Characteristics of some released IITA soybean varieties and promising advanced breeding lines. IITA Publication. 10p.

Board, J.E. (2002). A regression model to predict soybean cultivar yield performance at late planting dates. *Agronomy Journal* 94: 483-492.

Chen, J. (2006). The combined use of chemical and organic fertilizer and or biofertilizer for crop growth and soil fertility. *Taipei Food Fert. Technology Bulletin* 17: 1-9.

Devi, K.N Singh T.B Athokpam, H.S. Singh, N.B and Samurailatpam D. (2013). Influence of inorganic, biological and organic manures on odulation and yield of soybean (Glycine max (L.) Merrill) and soil properties. *Australian Journal of Crop Science* 7:1407-1415.

Egan, H. Kick R.S. Sawyer R. (1981). Soxhlet extraction method. In Person's Chemical Analysis of Food. 8th edn, pp507-547. London: Churchill Livingstone Publishers.

FAO (2016). Soybeans, yield (hectogram per hectare) for all countries. www.factfish.com/statistic /soybean%2C%20yield.

Falodun, E.J., Ehigiator, J.O., Ogedegbe, S.A. 2015. Growth and yield response of soybeans (*Glycine max* (L.) Merrill) to organic and inorganic fertilizer in Edo Rain forest of Nigeria. *American Journal of Plant Sciences* 6: 3293-3297.

Gautam, S.S and Pathak N. (2014). Effect of organic fertilizers on soybean yield in Bundelkhand. *Technofame* 3: 84-87.

Javaid, A. and Mahmood N. (2010). Growth, nodulation and yield response of soybean to biofertilizers and organic manures. *P. J. Bot*. 42: 863-871.

Khaim, S., Chowdhury, M.A., and Saha, B.K. 2013. Organic and Inorganic fertilization on the yield and quality of soybean. *J. Bangladesh Agric. University* 11: 23-28.

Kuntyyastuti, H and Sutrisno, H.K. 2017. Effect of manure, phosphate solubilizing bacteria, and chemical fertilizer application on the growth and yield of soybean. *Nusantara Biosciences* 9:126-132.

Mannan, M.A. (2014). Foliar and soil fertilization effect on seed yield and protein content of soybean. *Bangladesh Agron. J.* 17: 67-72.

Mekki, B.B and Ahmed, A.G. (2005). Growth, yield and seed quality of soybean (*Glycine max* L.) as affected by organic, biofertilizer and yeast application. *Research Journal of Agriculture and Biological Sciences* 1: 320-324.

Myint, T.Z. Sooksathan I. Kaveeta R and Juntakool S. (2009). Effects of different organic amendment and chemical fertilizer on plant growth and grain yield of soybean on Pakchong soil series. *Kasetsart J.* (Nat. Sci.) 43:432-441.

Olowe, V.I.O and Adebimpe, O.A. (2009). Intercropping sunflower with soybeans enhances total crop productivity. Biological Agriculture and Horticulture 26: 365-377.

Olowe, V.I., Adejuyigbe, C, Oshundiya, F, Ajibde, O, Adeboye, O and Bakare, J. (2014). Agronomic performance of soybeans (*Glycine max* (L.) Merrill) in an organic crop rotation system. In Rahmann, G and Aksoy, U (eds). Proceedings of the 4th ISOFAR Scientific Conference tagged "Building Organic Bridges" held on 13 – 15 Oct. 2014 in Istanbul, Turkey 835 – 837.

Prihastuti, Abidin Z and Sutrisno D.I. (2015). Evaluation of organic fertilizer application on soybean in the village ubaru, District Sumenep, Madura Island. International Journal of research in Agriculture and Forestry 2: 27-34.

Yagoub, S.O, Ali Ahmed, W.M and Mariod, A.A (2012). Effect of urea, NPK and compost on growth and yield of soybean (Glycine max L.) in semi-arid region of Sudan. International Scholarly Research Network. Doi:10.5402/2012/678124. 6p.

Yan D, Wang D. and Yang L. (2007). Long term effect of chemical fertilizer, straw and manure on liable organic matter fractions in a paddy soil. Biol Fert. Soils 44:93-101.

Zerihun, A and Haile D. (2017). The effect of organic and inorganic fertilizers on the yield of two contrasting soybean varieties and residual nutrient effects on a subsequent finger millet crop. Agronomy 7: 1-15.

Zong W, Gu T. Wang W, Zang B. Lin X Huang Q and Shen W. (2010). The effect of mineral fertilizer and organic manure on soil microbial community and diversity. Plant Soil 326: 511-522.

Assessment of the Effect of Plant-based Bio-nematicides on Growth and Yield of Tomato Planted on Nematode Infested Soil

Timothy Ipoola Olabiyi[1],
Maryam Adeniran Adeleke[1]
and Jonathan Jeremiah Atungwu[2]

[1]Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

[2]Department of Crop Protection, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria

Corresponding author:
tiolabiyi@lautech.edu.ng

Abstract

The concern for the environment, high cost of chemical nematicides in the time of need, coupled with the hazards posed on the target and non target organisms have motivated researchers to exploit alternative ways of controlling nematode infections on economic food crops. Effects of selected bio-active plant-based bio-nematicides were assessed on the growth and yield of tomato planted on nematode infested soil at organic garden, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The treatments were leaves of neem, castor, wild sunflower, siam weed, nitta, lantana and Ak plants formulated with black soap. Plots where black soap and no bio-nematicides were applied served as different experimental controls. Each treatment was replicated four times and fitted into randomized complete block design. Nematodes found in the soil included Meloidogyne incognita, Pratylenchus brachyus, Helicotylenchus and Xiphinema species. The results showed that the root damage and soil population of plant parasitic nematodes were significantly reduced in the plots where bio-nematicides were applied when compared with the controls. The growth and yield of tomato increased significantly when compared with the controls. Application of bio-nematicides with black soap formulation for the management of plant parasitic nematodes in tomato is hereby recommended.

Keywords:
bio-nematicides,
tomato, nematode,
management

Introduction

Tomatoes (*Lycopersicon lycopersicum*) is an important cash crop in the forest, traditional and savannah zones of Nigeria. Tomato contain important chemical compound that play important roles in the prevention of cancer, heart disease, cataracts and many other healthissues (Beecher, 1998). Tomato is a savory, typically red edible fruit and is most widely grown fruit in the world and has great nutritional value. Tomato is an excellence source of vitamin A, C, B6, pantothenic acid and vitamin B2. It is also very good source of molybdenum, potassium, manganese, chromium, copper, niacin, magnesium, iron and phosphorus. In addition, tomatoes are good source of protein, dietary fiber. Tomato has been shown to be excellence source of antioxidants especially lycopene which prevent a growing list of cancer including prostrate, breast, lung and pancreatic cancer.

Nematodes are major pest of tomato globally (De Lannoy, 2001; Amer-Zareen *et al.,* 2003). Various control strategies are employed to manage the nematode. Some of these have been the use of synthetic chemicals, biological agents and planting of resistant varieties. Indiscriminate use of chemical methods has led to phytotoxicity, environmental pollution and nematodes resistance (Adegbite and Adesiyan, 2005). As an alternative, organic soil amendment has been found to be cheaper, less harmful to man and effective in the management of plant-parasitic nematodes. Organic amendments have consistently been shown to have beneficial effects on soil nutrient, soil physical conditions, soil biological activity and thereby improving the health of plants and reducing the populations of plant parasitic nematodes. A number of organic items of plant origin, including oil-seed cakes, chopped plant parts and seed dressing with plant extracts have been used as nematode control agents.

The objective of this study is to assess the effectiveness of plant-based bio-nematicides in the control of nematode pests of tomato.

Materials and Methods

The experiment was carried out at Organic Garden, Teaching and Research Farm Ladoke Akintola University of Technology, Ogbomoso, Oyo States, Nigeria during 2016 and 2017 cropping seasons. In each year, the land was ploughed, and raised plant beds were made as experimental plot on a piece of land measuring 8 m × 54 m. The land was divided into 4 blocks, each block comprised of 12 treatments which were replicated 4 times giving a total of 36 plots in a Randomized Complete Block Design. Alley ways measuring 0.5 m were in between the plot and 1 m in between blocks. Prior to planting, the initial population of the nemtodes at the experimental site was determined using the Baermann's technique (Whitehead and Hemming, 1965).

Tomato seedlings were transplanted at a spacing of 6 × 30 cm. Application rate of 3L of each bio-nematicides into 15L of water was used. Chopped root (5 g) of nematode infected *Celosia agentea* was incorporated into base of the root of tomato plants at 2 weeks after planting (WAP). Bio-nematicides were applied at 3 WAP as soil drench within the tomato rhizosphere.

Data were collected on plant height, number of leaf per plant, number of branches per plant, fruit weight and number of fruit; soil and root nematode populations. Data collected in 2014 and 2015 were pooled together; subjected to analysis of variance and means of significantly different treatments were separated using Duncan's Multiple Range Test at 5% probability level.

Results

It was evident that the bio-nematicides enhanced plant height, number of branches, number of fruits, fruit weight and number of leaves per plant (Table 1). The tomato that was not treated with the bio-nematicides recorded significantly ($P<0.05$) lower plant height, number of branches, number of fruits,

Table 1. **Effect of bio-nematicides on growth and yield of tomato in nematode soil**

Treatment	Height	Branch	Leaf/plant	Fruit/plant	Fruit weight
Neem	53.4a	9d	57e	9b	151.4a
Castor	51.5a	11c	110b	14a	141.5cd
Wild sunflower	57.0a	29a	134a	13a	145.7bc
Siam weed	41.7c	10c	65d	10b	148.0b
Nitta	51.7a	14b	103b	9b	151.3a
Lantana	49.2b	8d	58e	9b	142.8bc
Ak	44.2bc	9d	79c	9b	135.0c
Black soap	19.0d	5e	36f	3c	39.3d
Water	12.6e	2f	32f	3c	27.1e

Means with same letters along the same column are not significantly different ($P < 0.05$)

fruit weight and number of leaves per tomato plant. The bio-nematicides reduces the nematode population both in the soil and roots of tomato plant (Table 2). The tomato treated with bio-nematicides that were formulated with black soap had significantly (P<0.05) lower nematode population in the soil and root, compared to those tomatoes treated with black soap and distilled water (Table 2).

Table 2. **Effect of bio-nematicides on nematode populations in soil (250 ml) and tomato root (10 g)**

Treatment	Initial soil nematode population	Final soil nematode population	Nematode population in the root	Root gall index
Neem	3045a	178b	7a	1.5a
Castor	3067a	187a	8a	2.0a
Wild sunflower	3060a	169b	7a	2.0a
Siam weed	3045a	182a	6a	2.0a
Nitta	3040a	184a	5a	1.5a
Lantana	3068a	171b	8a	1.5a
Ak	3063a	180a	7a	2.0a
Black soap	3092a	2758c	21b	4.5b
Water	3012a	3833d	33c	4.8b

Means with same letters along the same column are not significantly different (P < 0.05)

Discussion

The results showed that all the treatments significantly suppressed the development of nematode and increased the yield and growth of tomato compared to the controls. The bio-nematicidal potential of neem found in this study was supported by Yasmin *et al.* (2003) findings, who reported that fresh extracts of seeds, leaves and barks of neem inhibited the hatching of *M. incognita.* The neem constituents namely; nimbin, salanin, thionemone, azadirachtin and various flavoids, have been reported to have nematicidal action (Akhtar and Malik, 2000).

The results showed that the use of bio-nematicide significantly suppressed the development of nematode population both in the soil and root systems of tomato plant. Khan *et al.,* (2004) used Datura, Ak, Neem leaves and sawdust of Shisham alone and in combination against nematodes in pots on tomato and found significant increase in plant height and shoot weight and reduction in root galls. Wani (2006) reported that soil amendments with oil cakes of castor and neem and leaves of castor, *Persian lilac* (bakain) and neem, caused significant reduction in root galling and improved plant growth of okra and lentil.

Conclusion

This study concluded that the use of plant-based bio-nematicides formulated with black soap be adopted for nematode management. Since the management procedure is a non-chemical approach, it therefore recommended for organic tomato production.

References

Adegbite A.A. & Adesiyan S.O. (2005). Root extracts to control root-knot nematode on edible soybean. World Journal of Agric Science 1 (1): 18-21.

Akhtar M. & Malik I. (2000): Control of plant parasitic nematodes with "Nimin" and some plant oils by bare-root dip treatment. *Nematol. Medit.,* 21; 89-92.

Amer-Zareen, Zaki, J.M. & Javed N. (2003). Nematicidal activity of ginger and its effect on the efficacy *Pasteuria penetrans* for the control of root-knot nematodes. *Asian Journal of plant Science* 2(11): 858-860.

Beecher G.R. (1998). Nutrient content of tomatoes and tomato products. *Proc. of the society for experimental biology and med.* 218: 98-100.

De Lannoy G. (2001). Vegetables. In: Crop production in Tropical Africa. Romain H. Raemaekers (ed.) DGIC, Brussels. pp. 467-75.

Khan H.U., Mukhtar T., Ahmad R. & Khan S.M. (2004). Use of amendments for the control of root-knot disease of tomato caused by *M. incognita* (Kofoid and White) Chitwood. Pakistan Journal of Phytopathology, 16(1): 33-36.

Wani A. H. (2006). Management of root-knot nematode, *Meloidogyne incognita*on okra and lentil by soil amendment with oil cakes and leaves of different plants.Nematologia Mediterarranea, 34(1): 83-87.

Whitehead A.G. & Hemming J.R. (1965). A comparison of some quantitative methods of extracting small vermiform nematodes from soil. Annuals of Applied Biol., 55: 25-38.

Yasmin L., Rashid M.H., UddinNazim M., Hussain M.E & Ahmed M.U. (2003). Use oofneem extract in controlling root-knot nematode of sweet-gourd. *Pakistan Journal of Plant Pathology* 2(3):161-168.

Potency of Arati-Obd+ Organic Fertilizer on Plant-Parasitic and Free-Living Nematodes in Peppermint (*Mentha Piperita* L.) Field

*Atungwu, J. J.[1], Adeoye, O. O.[1], Olabiyi, T. I.[2], Oladeji, O. A[1]. and Eche, C. O.[3]

[1]Department of Crop Protection, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

[2]Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, Ogbomosho, Oyo State, Nigeria

[3]Department of Crop and Environmental Protection, University of Agriculture, Makurdi, Benue State, Nigeria

*Corresponding author: jojerat1@yahoo.com

Keywords:
Aromatic plants, medicinal plants, organic farming, pests, phyto-nematodes

Abstract

Peppermint (Mentha piperita L.*) is one of the most economical aromatic and medicinal crops useful in pharmaceutical and agro-allied industries globally. In view of the potential threat Plant-Parasitic Nematodes (PPN) pose to the crop, a study was conducted to appraise the effects of Arati-OBD^{+} organic fertilizer in the control of associated phytonematodes in a field in Abeokuta. Responses of Free-Living Nematodes (FLN) to the organic fertilizer were also recorded. The fertilizer was applied at 0 tha^{-1}, 5 tha^{-1} or 10 tha^{-1}, laid out in Randomized Complete Block Design with three replications. Five core soil samples were collected randomly from the rhizosphere at depth of 0-30 cm, once every month for the period of three months per plot. Soil samples per plot were bulked to form a composite sample from which 250 g sub-samples were obtained and assayed for nematode presence, type and numbers of each found. Results indicated that 11 genera of PPN were found in the organic peppermint tested. They included Helicotylenchus, Rotylenchus, Rotylenchulus, Meloidogyne, Longidorus, Aphelenchus, Radopholus, Tylenchulus, Ditylenchus, Hoplolaimus, Pratylenchus and some free-living nematodes. These nematodes varied significantly ($P \leq 0.05$) across treatments. Application of Arati-OBD^{+} at 5 tha^{-1} and 10 tha^{-1} significantly ($P \leq 0.05$) suppressed PPN compared with untreated (control) plots. Ditylenchus, Tylenchulus, Meloidogyne, Radopholus and Aphelenchus decreased by up to 100% (total control), Helicotylenchus by 73 - 50% and Rotylenchus by 60 - 33% in the treated plots while the FLN increased by as much as 18 - 47% in the soil following application 5 – 10 tha^{-1}.*

Introduction

Peppermint is one of the most economically important aromatic and medicinal crops in the pharmaceutical and agro-allied industries world-wide (Eccles, 1994). It is a perennial herbaceous plant with rhizome and of the family *Lamiaceae* (Begay, 2005). The leaves and shoots are commonly used as spice and medicine, which contain therapeutic properties such as antibacterial, antifungal and antiseptic (Mimica-Dukic, 2008) and also used in preparation of herbal concoction (Beemnet, 2010). Peppermint is also used as flavouring agent by food, gum, toothpaste and tea industries (Chessa, 2013). Beside this, it contains essential oil useful in pharmaceutical, nutraceutical and cosmeceutical industries (Verma, 2010) and the oil can cure headache, diarrhea and menstrual cramps (Chessa, 2013).

Phytonematodes are one of the most important groups of pathogenic organisms found around the rhizosphere, which reduce the growth and yield of medicinal and aromatic plants (Pandey *et al*., 2010). Diversity of diseases such as nematode diseases have been reported on peppermint as a result of severe damage posed to this crop every year (Pandey, 2005). Emerging organic farmers in developing countries must put in place sound nematode control program to make it attractive and profitable (Atungwu *et al*., 2013).

The use of mineral fertilizer is the fastest way to meet plant nutrients (Mando, 2005), but crop yield can be affected by its excessive application and lead to soil acidification, loss of soil biological activity, nutrient imbalance and loss of soil physical properties (Adediran, 2004). Plants grown on less organic matter soil are prone to severe nematode damage compared with plants grown on high organic matter soil (Al-Rehiayani, 2001). Use of synthetic nematicides and fertilizers has been in existence but they result to environmental and health hazards. Currently, information on management of phytonematodes and their diseases in relation to medicinal and aromatic plants is limited (Pandey, 2009). The present study was therefore, designed to determine the effect of Arati-OBD$^+$ organic fertilizer on plant-parasitic and free living nematodes population in peppermint field.

Materials and Methods

Five core soil samples were collected randomly on an established peppermint plot between October and December, 2014 at Organic Agriculture Skills Demonstration Plot, Federal University of Agriculture, and Abeokuta in Ogun State. Arati-OBD$^+$ organic fertilizer was applied at 0 tha^{-1}, 5 tha^{-1} or 10 tha^{-1} and replicated three times was applied on experimental plot laid out in Randomized Completely Block Design (RCBD).

Nematode extraction from soil

Composite soil sample was gently mixed and 250 g sub-soil was taken for nematode assay using Whitehead and Hemming nematode extraction technique (Whitehead and Hemming, 1965). Double-ply nematode extractor tissue paper was sandwiched between two plastic sieves of 15 cm inside diameter, placed in a 25 cm inside diameter bowl and arranged on the laboratory bench. Two hundred and fifty millimeter (250 ml) of water was gently poured to the extraction bowl and the set up was left undisturbed for 24 hours, and thereafter poured into a 500 ml Nalgene bottle and topped up. It was left undisturbed for 5 hrs and the supernatant was siphoned out with the aid of 3 mm inside diameter siphoning tube and quantified.

Nematode assay and identification

All nematodes in the composite sample were counted and identified with the aid of stereo and compound microscope respectively using the simplified nematode pictorial key of Mai and Lyon (1975). One ml of nematode suspension was pipette to Doncaster ringed nematode-counting dish placed under stereo microscope. Nematodes were identified and counted. Unfamiliar nematodes were picked with a finely pointed broom stick to a slide and placed under compound microscope for identity confirmation.

Data collection and analysis

Soil sample collected each month were assayed for nematode presence, types and number of nematodes. Data collected on the number of nematodes were transformed to reduction percentage (Puntener, 1981).

Results

Nematode genera found in the rhizosphere of peppermint in Abeokuta, Ogun State is presented in Table 1. Eleven genera of PPN belonging to two orders were found associated with peppermint in Abeokuta, Nigeria between October and December, 2014. Ten of the eleven genera belong to the order *Tylenchida*, while only one genus belongs to the order *Dorylaimida*. The genus belongs to different families like *Aphelenchidae*, *Tylenchulidae*, *Meloidogynedae*, *Tylenchidae*, *Pratylenchidae*, *Hoplolaimidae*, *Nacobbidae*, *Heteroderidae and Longidoridae*.

Reduction percentage of PPN and FLN on peppermint with respect to Arati-OBD$^+$ organic fertilizer application is presented in Table 2. All PPN found on peppermint field were greatly suppressed ($P<0.05$) by 100 – 33% in October, November and December irrespective of the application rate compared with PPN in control plot (0%) which were not reduced. The reduction rate of FLN on the field was low compared with reduction rate of PPN. Also, gradual disappearance of some PPN from peppermint field was noticed in November and December.

Table 1. **Genera, order and family of plant parasitic nematodes in the rhizosphere of peppermint in Abeokuta between October and December, 2014**

Genera	Family	Order
Aphelenchus	*Aphelenchidae*	*Tylenchida*
Radopholus	*Pratylenchidae*	*Tylenchida*
Tylenchulus	*Tylenchulidae*	*Tylenchida*
Meloidogyne	*Meloidogynedae*	*Tylenchida*
Ditylenchus	*Tylenchidae*	*Tylenchida*
Pratylenchus	*Pratylenchidae*	*Tylenchida*
Helicotylenchus	*Hoplolaimidae*	*Tylenchida*
Rotylenchus	*Hoplolaimidae*	*Tylenchida*
Rotylenchulus	*Nacobbidae*	*Tylenchida*
Hoplolaimus	*Hoplolaimidae*	*Tylenchida*
Longidorus	*Longidoridae*	*Dorylaimida*

Table 2. **Reduction percentage of PPN and FLN population on peppermint at Abeokuta between October and December, 2014**

TRT	APH (%)	RAD (%)	TYL (%)	MEL (%)	DIT (%)	PRA (%)	HEL (%)	ROT (%)	RLUS (%)	HOP (%)	LON (%)	FLN (%)
							October					
0 tha^{-1}	0	0	0	0	0	0	0	0	0	AB	AB	0
5 tha^{-1}	0	100	75	100	100	100	73	100	100	AB	AB	47
10 tha^{-1}	100	0	75	100	100	100	63	0	100	AB	AB	29
							November					
0 tha^{-1}	AB	0	0	0	0	AB	0	0	0	0	0	0
5 tha^{-1}	AB	100	0	0	100	AB	50	60	0	100	100	18
10 tha^{-1}	AB	100	100	100	0	AB	50	60	100	0	0	1
							December					
0 tha^{-1}	AB	AB	AB	AB	0	AB	AB	0	0	AB	AB	0
5 tha^{-1}	AB	AB	AB	AB	100	AB	AB	33	33	AB	AB	12
10 tha^{-1}	AB	AB	AB	AB	100	AB	AB	33	33	AB	AB	12

KEY: TRT - Treatment, APH - *Aphelenchus,* RAD - *Radopholus,* THY - *Tylenchulus,* MEL - *Meloidogyne,*DIT - *Ditylenchus,* PRA - *Pratylenchus,* ROT - *Rotylenchus,* RLUS - *Rotylenchulus,* HEL - *Helicotylenchus,* HOP - *Hoplolaimus,* LON - *Longidorus,* FLN - Free Living Nematode, % - Percentage, tha^{-1} - tons/hectare, AB - Absent.

Discussion

In this study, Arati-OBD$^+$ organic fertilizer at both 5 t ha^{-1} and 10 t ha^{-1} application rate were found effective in suppressing the population of plant-parasitic nematodes and drastically increased their free-living counterparts in peppermint field and this corroborate findings of Renco *et al.,* (2011) who reported that several organic fertilizers have been proved to effectively suppress the population of PPN and also stimulated the population of FLN. The present study demonstrated that Arati-OBD$^+$, a novel organic fertilizer been advocated for used by the emerging organic growers in Nigeria had proven to cause a great reduction in PPN population, which thereby resulted in increase of the FLN population on peppermint field.

References

Adediran, J. A., Taiwa, L. B., Akande, M. O., Sobulo, R. A. and Idowu, O. 2004. Application of organic and inorganic fertilizer for sustainable maize and cowpea yield in Nigeria. *Journal of Plant Nutrition*, 27: 1163 – 1181.

Al-Rehiayani, S. M. 2001: Organic and inorganic fertilizers in relation to the control of the root-knot nematode, *Meloidogyne javanica* in infecting tomato. *Egypt Journal of Agronematology*. 5: 1 – 9.

Atungwu, J. J., Ozuzu, L. and Tijjani, I. 2013. Categorisation of ten sweet potatoes (*Ipomoea batatas* L.) varieties for resistance to *Meloidogyne* spp. in organic field. *Archives of Phytopathology and Plant Protection,* 46: 253 – 260.

Beemnet, M., Omarsherif, M., Tsion, T. and Solomon, A. 2010. Production, processing and utilization of aromatic plants. *Ethiopian Institute of Agricultural Research* (EIAR), Addis Ababa, Ethiopia. 31pp.

Begay, R. 2005. Processing of medicinal plants. *Antshararat Razavi*. 170.

Chessa, M., Sias, A., Piana A., Mangano, G. S., Petretto, G. L. and Masia, M. D. 2013. Chemical composition and antibacterial activity of the essential oil from *Mentha requienii* Bentham. *National Production Research,* 27: 93 – 99.

Eccles, R. 1994. Menthol and related cooling compound. *Journal of Pharmacology*. 46 (8): 618 -630.

Mai, W. F. and Lyon, H. H. 1975. *Pictorial key to Genera of Plant-parasitic Nematodes*. Fourth Edition (Revised). Cornell University Press, Ithaca, New York. 219pp.

Mando, A., Quattara, B., Sedago, M., Stroosnijder, L., Quattara, K., Brussaard, L. and Vanlauwe, B. 2005. Long term effect of tillage and manure application on soil organic fraction and crop performance under sudano-sahelian conditions. *Soil and Tillage Research*, 80: 95 – 101.

Mimica-Dukic N., Bozin B. and Sokovic M. 2008. Mentha L. species (Lamiaceae) as promising sources of bioactive secondary metabolites. *Current Pharmaceutical Desgin*, 14 (29): 3141 – 3150.

Pandey, R. 2009. Nematode disease of medicinal and aromatic plants: Indian scenario and ecofriendly management. *In*: Proceedings National Seminar on Environment Degradation and Biodiversity: Problem and Prospects" 9-20pp.

Pandey, R. 2005. Field application of bio-organics in the management of *Meloidogyne incognita* in *Mentha arvensis*. *Nematologia Medit.* 33 (1): 51-54.

Pandey, R., Mishra, A. K., Tiwari, S., Kalra, A. and Singh, H. N. 2010. Phytonematodes: A severe menance for successful cultivation of menthol in Indo-Gangetic plains. *Medicinal Plants*. 2 (3): 175 – 180.

Puntener, W. 1981. *Manual for Field Trials in Plant Protection*. Agricultural Division, Ciba Geigy Limited, Basle, Switzerland. 205pp.

Renco, M., Sasanelli, N. and Kovacik, P. 2011. The effect of soil compost treatments on potato cyst nematodes *Globodera pallida*. *Helminthologia*. 3: 184 -194.

Verma, R. S., Rahman, L., Verma, R. K., Chauhan, A., Yadav, A. K., and Singh, A. 2010. Essential oil composition of menthol mint (*Mentha arvensis*) and peppermint (*Mentha piperita*) cultivars at different stages of plant growth from Kumanon region of West Himalaya. *Open Access Journal of Medicinal and Aromatic Plants*. 1:13 – 18.

Whitehead, A.G. and Hemming J. R. 1965. A comparison of some qualitative methods of extracting small vermiform nematodes from soil. *Annals of Applied Biology*. 55: 25 - 38.

Assessment of Traditional Agricultural Practices in Nigeria for Possible Conversion to Organic Farming Systems

Olanrewaju[1], P. O., Meludu[1], N. T., Yekinni[1], O. T. and AdeOluwa[2], O. O.

[1]Department of Agricultural Extension and Rural Development, University of Ibadan

[2]Department of Agronomy, University of Ibadan

Correspondent author:
roctunde@yahoo.co.uk

Keywords:
Traditional agricultural practices, compliance with standard, organic agriculture

Abstract

Low external input agriculture does not automatically confer on traditional farmers the status of organic farming. This study assessed traditional agricultural practices for compliance with organic practices in Nigeria. Information was obtained from 177 crop farmers in 6 states of 3 agricultural zones in Nigeria, while frequency counts, percentages, mean, and PPMC were used to analyse the data. The result showed that majority were male (69.0%), the mean in years for age (47.7years), formal education (10.5%), farming experience (26.5years), and farm size (5.8ha) with average monthly income of N30,485.76 and most (52.0%) had access to extension service fortnightly. Wood ash, multiple cropping, neem extract and trapping were ranked high as pest management practices while cover crops, uncured poultry manure, crop rotation and mulching were ranked high as soil fertility management practices in use by the respondents. However, most of the practices are used as supplements to synthetic inputs, thus compliance with organic practices is low. The correlation test showed a positive and significant relationship (r=0.114, p=0.044) between traditional practices in use and the level of possible compliance with organic practices. The study concluded that, possible compliance of traditional agricultural practices with organic practices is low. The study therefore recommend that, leveraging on some of the farmers' practices that align with organic principles and engaging extension service for increased awareness of the standard and benefits of organic agriculture would enhance more rapid conversion to organic farming in Nigeria.

Introduction

Many farmers in Africa practice low external input farming. This claim has made many to think farmers in Africa, practice organic agriculture by default (Walaga, 2005, IFOAM- Organics International, 2013, and Olaito, 2014). The opinion holds because, about 70 percent of the farming population in Africa could not access some of the synthetic inputs such as chemical fertilisers and agrochemicals. Though, these low external inputs can be seen as potentials to leverage on, for promotion of organic agriculture in Africa, conscious recognition of and compliance with organic standards would be required to make efforts truly organic.

In order to remain in business, many farmers in Africa have developed sustainable technologies and practices to produce food for the increasing population in Africa and Nigeria in particular, although some of the technologies and practices are clearly not sustainable and do require improvement. Farmers adopt a wide range of indigenous agricultural practices based on generations of experiences, informal experiments and intimate understanding of their environment. The application of indigenous farming practices for example has reflected in the following: soil preparation and planting materials, controlling pests and diseases, maintaining soil fertility, controlling weeds, harvesting and storage. (Abioye *et al.,* 2011). Many of these indigenous knowledge and approaches to environmental conservation include technologies and practices such as; shifting cultivation, mixed cropping or intercropping, minimum tillage and agro-forestry and ethnoveterinary. Some of the advantages of these technologies and practices are reduction in susceptibility of the crops to pests and diseases, and better use of the environment (Yekinni, 2002).

Charles Walaga (2005) opined that, the subsidies withdrawal on agrochemicals by most African governments and the misuse of the Green Revolution in Africa, have increased the promotion of viable alternatives for improving food security and sovereignty. In Africa, some of the practices and agro ecological strategies in use, and promoted include; integrated pest management, desertification control, soil fertility management, agricultural biodiversity conservation, agroforestry, rural community development, urban agriculture, participatory ecological land-use management which are incline with some organic agriculture principles and farming techniques.

Organic agriculture (OA) is based upon traditional agricultural practices, farmers' innovations and the results of scientific research (AdeOluwa, 2010; Singh and Grover, 2011, and IFOAM, 2011). Organic farming practices are embedded in local cultures, ethical values and beliefs. It gives them renewed possibilities for maintaining and developing their local sustainable farming systems. Organic agriculture as a production system, distinguished practices by being deliberate in planning, organising, and compliance with standards from seed selection to marketing. Currently, there is Organic Agriculture Standard to enhance; compliance to principles of organic agriculture, adoption of organic practices by farmers, access to local and international market, and stimulate engagement of policy makers in Nigeria.

Majority of the smallholder farmers in Nigeria still use indigenous practices, for them to benefits from the inherent health, economic, and environmental potentials of OA, there is a need to assess their practices for compliance with organic practices.

Therefore the objectives of this study was to; i) identify the traditional practices in use for crop production in Nigeria, and ii) determine the extent of compliance of the agricultural practices with organic principles and standard in Nigeria. Hypothesis of the study; there is no significant relationship between traditional practices and compliance with organic principle and standard in Nigeria.

Methodology

This study was conducted in Nigeria. Nigeria has six agricultural zones; Southeast, Northeast, Northwest, Southwest, Southsouth, and North central zones (Agricultural Transformation Agenda, 2011). The study population was crop farmers in three agricultural zone in Nigeria. A multistage sampling procedure was used to select respondents for the study. The primary data were collected using quantitative methods. Quantitative data were collected with validated structured questionnaires. From three agricultural zones, six states (Ebonyi, Anambra, Benue, Niger, Ekiti and Oyo) were randomly selected for this study. From the six states, 15 Local government Areas (LGAs), and two communities were randomly selected from each of the 15 LGAs. And twenty percent of the farming households were selected as respondents for this study using simple random sampling technique. Variable measured in the study were socio-economic characteristics, traditional practices in use, and extent of compliance with organic practices.

Results and Discussion

Table 1 reveals that the farmers had a mean age of 47.7 years. This shows that most of the farmers were still in the active years. These findings are consistent with that of Meludu (2014), who reported a mean age of 49 years for farmers in Oyo State. Distribution of farmers by sex shows that majority (69.0%) of them were male, while female (31.9%), the average number of years spent for formal education is 10.5 years. This finding is in line with Adeniyi, and Yekinni (2015), who reported that the average formal education of farmers was 9.6 years. This result implies that there is considerable level of literacy among the farmers, which is an important factor that may likely influence application of new ideas and agricultural practice. The average year of farming experience is 26.5 years, implying that these farmers

Table 1. **Distribution of crop farmers by socio-economic characteristics n=117**

Variables	Percentage	Parameter
Age		
21 – 33	8.70	Mean = 47.78
34 – 46	39.0	S.D = 11.32
47 -59	33.9	
60 -72	17.7	
73 – 85	0.7	
Sex		
Male	69.0	
Female	31.0	Mode = Male
Years of formal Education		
Primary education	30.96	Mean = 10.57
Secondary education	40.32	S.D = 6.12
Tertiary education	21.30	
No formal education	7.42	
Years of farming experience		
1 – 10	17.7	
11 – 20	27.4	Mean = 26.46
21 – 30	21.6	S.D = 4.33
31 – 40	18.1	
41 – 50	11.0	
51 – 60	4.2	
Land Acquisition		
Inheritance	61	
Lease	12	
Rent	22	
Purchase	5	
Access to extensive service		
None	32.7	
Once in a year	4.0	
Twice in a year	4.0	
Quarterly	7.3	
Fortnightly	52.0	
Monthly income		
1,000 - 20,000	50.24	
20,001 - 40,000	27.12	30,485.76 ± 31,834.27
40,001 - 60,000	11.86	
60,001 - 80,000	4.00	
80,001 - 100,000	2.26	
>100,000	4.52	

Source: Field Survey, 2017

are well knowledgeable on farming activities, the predominant mode of land acquisition in the study area is through inheritance (61.0%). The average farm size was 5.8 hectares. This implies that crop farmers in the study area are predominantly smallholder, which has a lot of influence on the type of agricultural practices they use. The Table also shows that above half (52.0%) of the respondents have access to extension service fortnightly and the average monthly income of N30,485.76.

Table 2 presents the traditional agricultural practices used for pest and soil fertility management. The Table shows that, wood ash rank first, followed by multiple cropping, trapping and neem extract as third and fourth frequently use traditional practices for pest management. The least on the list for pest management practices was marigold. This is an indication that some farmers in the study area still make use of traditional practices to manage both insect and rodent pests. Eze and Echezona (2012), reported that majority of the farmers in African and Asia use some indigenous practices like neem extracts, wild tobacco, wood ash, and chilli to control and repel pest. Moyin-Jesu (2010) also reported that wood ash has insecticide properties. Table 2 also shows that majority of the crop farmers' ranked cover crop first among the traditional practices still in use for soil fertility management, uncured poultry manure and crop rotation were ranked second and third respectively. Cow manure was the least traditional practices used by respondents for soil fertility management.

Table 2. **Distribution of crop farmers' use of traditional practices n = 177**

Pest management		
Wood ash	1.00	1st
Multiple cropping	0.99	2nd
Trap setting	0.86	3rd
Neem extract	0.58	4th
Neem + kerosene	0.39	5th
Lemon grass extract	0.32	6th
Tobacco	0.24	7th
Pawpaw	0.24	7th
Alligator pepper and lemon grass extract	0.21	9th
Local black soap	0.21	9th
Dried pawpaw leaf	0.21	9th
Marigold flower	0.14	12th
Soil fertility		
Cover crop	1.27	1st
Uncured poultry manure	1.10	2nd
Crop rotation	1.03	3rd
Use of wet mulching materials	0.79	4th
Compost	0.78	5th
Poultry manure (cured)	0.77	6th
Pig manure	0.72	7th
Sheep and goat	0.58	8th
Abattoir manure	0.45	9th
Cow manure	0.41	10th

Source: Field Survey, 2017

Extent of closeness of traditional practice with organic standard

The distribution of the results as represented in Table 3 shows compliance of respondents practices under three headings; general organic practices, soil fertility management and pest management. The Table shows that only 12.4% of the respondents complied with no use of mineral fertilizer, also only 11.3% complied with no use of herbicides, while 37.3% complied to use of cured manure before application. Use of battery powder is not allowed in organic practices 58.8% complied with it, while only 21.5% complied with no use of fire for land clearing.

For soil fertility management 52.5% complied with use of crop rotation, but only 39.5% indicated compliance to planned rotation strategy. Bad odour of compost material before application is not a good practice in organic farming, 48.6% complied with it. Adding some synthetic fertilizers to compost is fraud in organic farming 50.3% complied with this. Pest management practices; only 18.6% practiced the use of neem for pest management. The use of same knapsack sprayer for both plant extracts and synthetic pesticide is not allow in organic farming, only 16.4% complied with it, while not adding chemical and kerosene to plant extracts had 55.9% and 67.8% compliance respectively.

This findings show that majority of the respondents practices are not in compliance with organic practices and standard, therefore, extent of compliance with organic practices is low. This implies that, educating farmers on the organic standard and practices is highly needed across the zones for conversion to organic agriculture.

Table 3. **Distribution of crop farmers by extent of compliance to organic principles**

Variables	Complied %	Not Complied %
General practices		
No use of mineral fertilizer	12.4	87.6
No use of herbicides to control weed	11.3	88.8
Cure of manure before application	37.3	62.8
No use battery powder as seed dresser	58.8	41.3
No use of fire for land clearing	21.5	78.5
Soil fertility management		
Use of crop rotation	52.5	47.5
Use crop rotation plan	39.5	60.5
No bad odour of compost before application	48.6	51.4
No addition some synthetic fertilizer to compost Pest management	50.3	49.7
Use of neem extracts	18.6	81.4
No use of same knapsack sprayer for plant extract and synthetic pesticide	16.4	83.6
No addition of some chemical pesticides to plant extracts	55.9	44.1
No addition of kerosene to plant extracts	67.8	32.1

Source: Field Survey, 2017

Table 4 shows that crop farmers (51.4%) had low level of compliance with organic practices. This implies that higher proportion of the agriculture practices of the respondents are not in compliance with organic practices, thus they have low compliance with organic standard. This is in line with the findings of Babalola (2012), Issa, (2015), and Oyekale (2016), that Nigeria farmers still have low compliance to agricultural safety precautions.

Table 4. **Distribution of respondents by level of compliance with organic standards n=177**

Level	Percentage	Parameter
Crop farmers		
Low	51.4	Min =18.00, Max =61.00, Mean = 39.60
High	48.6	

Source: Field Survey, 2017

Relationship between respondents' use of traditional agricultural practices and the level of compliance with organic standard

Table 5 shows that there is positive and significant relationship (r=0.114, p=0.044) between the respondents traditional agricultural practices and level of compliance with organic practices. This findings may be explained by the fact, that some of the respondents are smallholder farmers and have limited access to synthetic input and with relatively low income to purchase synthetic inputs. These could inform the use of available traditional practices to make up for their agricultural production and some of these traditional practices in use are not too far in principle from some organic practices, for instance; crop rotation, use of manure, use of plant extract and multiple cropping. This suggest that some of the practices could be leverage on to promote conversion to organic agriculture practices.

Table 5. **Correlation for test of relationship between use of traditional practices and compliance with organic standard**

Variable	r value	p value	Decision
Traditional practices	0.114	0.044	Significant

Source: Field Survey, 2017

Conclusion

Many Nigeria farmers use traditional agricultural practices a long side synthetic inputs for their production such as; crop rotation, use of manure, use of plant extract and multiple cropping, but without compliance to safety precaution. The level of compliance with organic practices is low with half of the farmers in this category. Therefore, for rapid adoption of organic practices the need to leverage on the traditional practices that are close to organic principle is imperative as well as engaging agricultural extension service for awareness, advocacy and to promote organic agriculture as adaptable practices for health, economic and environmental benefits.

Acknowledgement

I hereby appreciate the sponsorship of this PhD project by Ecological Organic Agriculture (EOA) initiative in Nigeria through the Swiss Agency for Development and Cooperation (SDC) through Bio-Vision Africa Trust; through Association of Organic Agriculture Practitioners of Nigeria (NOAN) and University of Ibadan (Pillar Implementing Partner).

References

Abioye, A. Y, and Egberongbe, S. Halima (2011). Documenting and Disseminating Agricultural Indigenous Knowledge for Sustainable Food Security: The Efforts of Agricultural Research

Libraries in Nigeria. IFLA Conference, San Juan, Puerto Rico. Accessed on 27 November 2015 from http://conference.ifla.org/ifla77. Pg 4-5.

Adeniyi, R. T. and Yekinni, O. T (2015). Arable crop farmers' characteristics affecting the utilisation of information and communication technology for agricultural marketing information in Oyo State, Nigeria. Nigerian Journal of Rural Sociology Vol. 15, No. 2, March 2015, 23.

AdeOluwa, O. O. (2010). Organic agriculture and fair trade in West Africa. Food and Agriculture Organization of the United Nations. Office of Knowledge Exchange, Research and Extension, FAO, Vialedelle Terme di Caracalla, 00153 Rome, Italy. Pg 62-67.

Eze, S. C. and B. C Echezona (2012). Agricultural pest control programmes, food security and safety, African journal of food, Agriculture, nutrition and Development. Scholarly, peer Reviewed vol. 12 No. 5 August 2012, ISSN 16845374 .

International Federation of Organic Movement (IFOAM) (2011). Network building for lobbying in Africa. Compiled by Souleymane Bassoum, René Tokannou and Nguji Mutura. IFOAM, Bonn. Pg 105-110.

International Federation of Organic Movement (2013). Productivity and profitability of Organic Farming Systems in East Africa. IFOAM Head Bonn, Germany www.ifoam.org

Meludu, N. T and Adesina J.B (2014). Bridging the Gap between Old and New Technology: Consideration of Indigenous Knowledge in Maize Pest Management Practices in Nigeria. Building Organic Bridges Vol. 3. Proceedings of the ISOFAR Scientific Conference at the Organic World Congress 2014. Pg 851-857.

Moyin-Jesu, E. I. (2010). Comparative evaluation of modified neem leaf, wood ash andneem leaf extracts for seed treatment and pest control in maize (*Zea mays* L.) Emir. J. Food Agric. 2010. 22 (1): 37-45 http://ffa.uaeu.ac.ae/ejfa.shtml.

Olaito, P. (2014). Organic Agriculture in Nigeria. *Global Agricultural Information Network, Promoting Sustainable practices.(Vol.* 5:23-30).

Oyekale, A. S. 2017. Cocoa Farmers' safety perception and compliance with precautions in the use of pesticides in Centre and Western Cameroon. Applied Ecology and Environmental Research 15(3):205-219. http://www.aloki.hu ISSN 1589 1623 (Print) ISSN 1785 0037 (Online) DOI: http://dx.doi.org/10.15666/aeer/1503_205219 2017, ALÖKI Kft., Budapest, Hungary.

Yekinni, O. T. (2002). Socio-Cultural Factors Influencing the Land Management Practices of Farmers in Itesiwaju Local Government Area of Oyo State. Project published in the Department of Agricultural Extension and Rural Development, University of Ibadan. Pg 34-47.

Gender Dimension to Involvement in Organic Agriculture in Southwest Nigeria

Yekinni, O. T., Bamidele, T. O. and Ladigbolu, T. A.

Department of Agricultural Extension and Rural Development, University of Ibadan, Ibadan, Nigeria

Corresponding author:
taofeeqyekinni@gmail.com

Abstract

Female involvement in agriculture generally is low. Given the fact that women are known to be closer to nature, it is expected that an environmentally friendly agricultural practice should be of interest to them. The study investigated the gender dimension to involvement in organic agriculture in Southwest Nigeria. Multistage random sampling technique was used to 160 respondents for the study in Ekiti, Osun and Oyo states. Results revealed that more (51.9%) of the women and fewer (48.1%) of men had high level of organic information needs. Women were at par with men on the basis of involvement in organic agriculture practices; despite the fact that all categories of respondents had low level of knowledge of the concept.

Keywords:
Organic agriculture knowledge, involvement in organic agriculture, environmental friendly agriculture

Introduction

Gender refers to the socially determined and culturally specific difference between male and female; not their biologically determined differences. The term is often misunderstood as promotion of women. It focuses on the relationship between men and women, their roles, access to and control over resources, division of labour and needs. Men and women perform different roles in crop production and take decisions regarding ownership of farm inputs and enterprises. These roles are varied from place to place depending on the culture, tribe, religion and location (FAO, 2004).

There have been various discussions with respect to the degree of contributions of men and women to agricultural production activities and ownership of farm enterprises. The need to highlight the roles of women arises because the arguments have often posited that farming activities are prerogatives of men while women were noted, at best, providing supporting roles. As a result of this position, most agricultural development policies and innovation packages were directed at men.

Gender relationships are fundamental to understanding the way farm work is organised. The way assets such as land, labour, seeds and machinery are managed, as well as the decision on farm enterprises. The revolutionary potential of sustainable approaches to farming to reshape our food systems and the way humans interact with those systems will not be realised unless there is a concerted effort by committed sustainable farmers and consumers to work towards gender equality (Farnworth and Hutchings, 2009).

The gender-environment-development approach to the assessment of women in organic agriculture is meaningful for the understanding of women's connection with sustainable agriculture. Several works and interactions between scholars, practitioners and policy makers resulted in the conceptualisation of the approach to connect women with environment (Bock and Shortall, 2006). According to Zweifel

(2001), women are viewed as victims of environmental degradation, partly responsible for the destruction of the environment, protectors of the environment, being in harmony with nature and managers of natural resources.

According to Altenbuchner, Vogel and Larcher (2017), gender gap is entrenched in organic agriculture practices, as women have higher workload and uneven distribution of knowledge. Women's exclusion from participation and lack of empowerment lead to widening of gender gaps in organic agriculture. Equitable involvement of practitioners of both sexes will lead opportunities for empowerment.

Specific objectives are as listed;

1. Identify areas of information needs for organic agriculture practitioners
2. Determine extent of involvement in organic agriculture practices
3. Evaluate the practitioners' knowledge about organic agriculture

The hypothesis of the study, stated in null form, is that;

$H_0$1 There is no significant difference in involvement in organic agriculture among the male and female respondents

Methodology

The study was carried out in South west Nigeria, being the region that is foremost in organic agriculture promotion activities in the country. The population of the study comprise of all the organic agriculture practitioners (farmers, producers and marketers) of both sexes who are involved in value chain activities. Multistage sampling procedure was used to select 160 respondents for the study from the randomly selected Osun, Oyo and Ekiti states.

The extent of involvement in the various organic agriculture practices by the respondents was captured as the dependent variable of the study, apart from other independent variables that were assessed.

Results and Discussion

Information needs

Results, as shown in Table 1, reveals that the information items that most of the respondents needed in their enterprises were organic agriculture techniques (weighted score=187.5), skill acquisition (187.0), health information (175.6), food/nutrition (173.1) and education (171.8); whereas the information items in which they do not indicate much need are religion (132.5), non-agricultural marketing (118.1) and politics (87.5).

The summary of information needs along gender line, as given in Table 2, shows that fewer (48.1%) of male and more (51.9%) of female were in the high level of information need. This infers the reality of disparity in access to information items along the gender line (Altenbuchner *et al*, 2017).

Table 1. **Distribution of respondents by their information needs**

Information items	**To a great extent**	**To a lesser extent**	**Not at all**	**Weighted score**
Organic agriculture techniques	90.6	6.3	3.1	187.5
Skill acquisition	88.8	9.4	1.9	187.0
Health information	80.6	14.4	5.0	175.6
Food/Nutrition	77.5	18.1	4.4	173.1
Education	78.1	15.6	6.3	171.8
Community development	76.3	15.6	8.1	168.2
Organic product price	66.3	29.4	4.4	162.0
Other agricultural marketing	60.0	36.3	3.8	156.3
Weather information	60.6	33.1	6.3	154.3
Home management information	49.4	46.9	3.8	145.7
Religion	45.6	41.3	13.1	132.5
Non agricultural marketing	30.6	56.9	12.5	118.1
Politics	23.1	41.3	13.1	87.5

Table 2. **Distribution of respondents by their levels of information needs**

Levels of information needs	Male		Female	
	Frequency	Percent	Frequency	Percent
Low	56	51.9	25	48.1
High	52	48.1	27	51.9
Total	108	100.0	52	100.0

Involvement in organic agriculture practices

Result of use of organic agriculture practices, as given in Table 3, shows that the mostly patronised practices were use of mulching (186.3), avoiding bush burning (185.1), crop rotation (174.5) and mixed cropping (171.9); whereas the least used ones were alley cropping (83.9), use of off-farm waste (68.7) and biological pest control (60.6).

Summarily, more (55.6%) of the male and (59.6%) female respondents were involved in organic agriculture practices in the study area. This means that factor does not affect involvements in organic agriculture among the respondents in the study area. This imply that dissemination and adoption of the sustainable agricultural practice cut across the gender lines without bias. According to IFOAM (2007), conventional farming is men's world, although they are equally involved in organic agriculture. This may explain women being at par with them in the organic agriculture sector.

Table 3. **Distribution of respondents by their involvement in organic agriculture practices**

Organic farming practices	Always	Rarely	Never	Weighed score
Use of mulching to conserve soil moisture	89.4	7.5	3.1	186.3
Avoiding bush burning	89.4	6.3	4.4	185.1
Crop rotation to control pests and diseases on the farm.	81.3	11.9	6.9	174.5
Mixed cropping/intercropping to control pests and diseases	80.0	11.9	8.1	171.9
Green manure	76.9	13.8	9.4	167.6
Use of plant residues on the farm as organic fertilizer	70.0	24.4	5.6	164.4
Planting of legumes/cover crops to increase the fertility of the soil and to reduce soil erosion	71.3	18.8	10.0	161.4
Shifting cultivation to replace lost soil nutrients	69.4	15.6	15.0	154.4
Use of plant extracts to control pests and diseases	65.0	21.9	13.1	151.9
Compost application	61.9	26.3	11.9	150.1
Use of ash to reduce pest infestation on the farm	59.4	21.9	18.8	140.7
Use of only animals/species of organic origin	65.6	9.4	25.0	140.6
Use of natural production techniques throughout	65.6	8.1	26.3	139.3
Planting of legumes/cover crops to suppress weed growth	48.1	41.9	10.0	138.1
Ensuring that all animal feeds are truly organic	63.8	10.0	26.3	137.6
Use of locally adapted breeds	63.8	9.4	26.9	137.0
Avoiding unnecessary mutilation of animals	63.1	10.0	26.9	136.2
Mixed farming (i.e. planting of crops and rearing of animals)	55.6	22.5	21.9	133.7
Minimum or zero tillage	40.6	46.3	13.1	127.5
Avoiding the use of vaccines except when necessary	58.1	10.6	31.3	126.8
Use of natural medication for animals	58.1	9.4	32.5	125.6
Avoiding the use of growth promoters	56.9	10.0	33.1	123.8
Avoiding the use of hormone for tissue improvement	53.1	11.9	35.0	118.1
Bush fallowing to allow the soil regains its lost soil nutrients	42.5	30.6	26.9	115.6
Use of animal manure	31.9	41.3	26.9	105.1
Use of potash to reduce soil acidity	28.8	45.6	25.6	103.2
Alley cropping; planting trees at the sides of the farm	18.8	46.3	35.0	83.9
Use of off-farm waste (e.g. kitchen wastes)	25.6	17.5	56.9	68.7
Biological pest control (e.g. use of predators)	13.1	34.4	52.5	60.6

Table 4. **Distribution of respondents by their levels of involvement in organic agriculture**

Level of involvement in organic agriculture	Male		Female	
	Frequency	Percent	Frequency	Percent
Low	48	44.4	21	40.4
High	60	55.6	31	59.6
Total	108	100.0	52	100.0

Knowledge of organic agriculture

Result of the general view about knowledge of organic, in Table 5, shows that more of the respondents have low level of knowledge of organic agriculture. Bifurcation of the result along gender line, in Table 6, entrenched the general picture, which shows that fewer (44.4%) of the male and (40.4%) female had high level of knowledge of organic agriculture in the study area. The finding is a reflection of extent of involvement and interest in the emerging agricultural practice in Nigeria.

Table 5. **Distribution of respondents by knowledge of organic agriculture**

Knowledge level	Frequency	Percent
Low	91	56.9
High	69	43.1
Total	160	100

Table 6. **Distribution of respondents by their level of knowledge of organic agriculture**

Knowledge level	Male Frequency	Percent	Female Frequency	Percent
Low	60	55.6	31	59.6
High	48	44.4	21	40.4
Total	108	100.0	52	100

Result of the t-test analysis, as given in Table 7, shows that there was no significant difference in involvement in organic agriculture practices among the male and female respondents in the study area. Despite the opinion that women are expected to be more involved in organic agriculture (Altenbuchner, 2017); the fact that men are measuring up with them in the practice can be attributed to the effect of organic agriculture promotion activities in the study area. The development can be seen in a positive way as it would entrench the practice, even among the female practitioners, who may be carrying out the practices on the fringe.

Table 7. **Test of difference in involvement in organic agriculture between male and female respondents**

Variable	t-value	df	p-value
Involvement in organic agriculture practices	- 0.88026	158	0.380

Conclusion and recommendation

The female practitioners are more in need of technical information on organic agriculture as a result of gender disparity in access to production resources, including information. Female's involvement parity with that of male meant that they (female) are substantially involved in organic agriculture practices, as opposed to their extent of involvement in the conventional agricultural practices.

Based on the study outcome, the following are recommended;

1. Organic promotion activities should be made to target women in order to entrench their interests in the practices
2. The female organic agriculture practitioners should be improved in terms of technical knowledge on organic agriculture in order to bridge their information gap
3. There is the need to consciously train all the organic agriculture practitioners, male and female alike in order to improve their levels of knowledge.

References

Altenbuchner, C., Vogel, S. and Larcher, M. (2017). Effects of organic farming on the empowerment of women: A case study on the perception of female farmers in Odisha, India. *Women's Studies International Forum*. Vol 64, pp 28 – 33

Bock, B. B. and Shortall, S. (2006). Rural Gender Relations: Issues and Case Studies (ed.).Centre for Agriculture and Bioscience International (CABI), UK, pp 374

FAO (2004). Building on Gender, Agrobiodiversity and Local Knowledge. Training manual fact sheet. Accessed on 25 May 2018 at URL http://www.fao.org/docrep/007/ y5608e/y5608e01. htm

Farnworth, C. and Hutchings, J. (2009). Organic Agriculture and Women's Empowerment.

International Federation of Organic Agriculture Movements, Bonn.
IFOAM (2007). Organic agriculture and gender equality. Accessed on 29 May 2018 at URL http://infohub.ifoam.bio/sites/default/files/page/files/oa_gender_en.pdf.
Zweifel, H. (2001). Rural women and the environment. *Rural Gender Relations: Issues and Case Studies*. (Ed) B. B. Bock, S. Shortall. CABI p374.

Haematological Indices of ISA Brown Birds Fed diets Containing Guinea Hen Weed (*Petiveriaalliacea*) leaf and Root Meals

*Muhammad[1], S. B., Sobayo[1], R. A., Oso[1]A. O., Sogunle[2], O. M., Ayoola[2], A.A., Basiru[1], Y. T. and Abotinde[1], R.O.

[1]Department of Animal Nutrition,
[2]Department of Animal Production and Health, Federal University of Agriculture, Abeokuta

*Corresponding author:
babatunde.muhammad9@gmail.com

Keywords:
Petiveriaalliacea, ISA brown, Haematology

Abstract

Haematological indices of ISA brown growerbirds fed diets incorporated with Petiveriaalliacea leaf meal (PLM) and Petiveriaalliacearoot meal(PRM) were investigated in a 21-weeks trial. A total of 450 birds were divided into ten treatments groups of forty-five birds with three replicate of fifteen birds. The diets contained PLM and PRM at five levels of inclusion; (0, 1000, 1500, 2000 and 2500 mg/kg). The experiment was arranged in a 2 × 5 factorial layout in a completely randomized design (CRD).Amidst varying inclusion of PLM and PRM, birds fed diets containing 1500 mg/kg of PLM showed decreased (P<0.05) PCV. Birds fed diets containing 1500 and 2500 mg/kg of PLM reduced (P<0.05) RBC in comparison to other inclusion levels of plant parts. When compared to birds fed varying inclusion of PLM and PRM; least (P<0.05) WBC were obtained in birds fed diets containing 1000 and 2000 mg/kg of PRM. In conclusion, addition ofPetiveria leaf and root meal affected haematology indices as values obtained fell within normal range for healthy birds.

Introduction

The use of antibiotic-based growth promoters is presently facing serious criticism and has raised global concern as some reports revealed their ill effects among which are the development of microbial resistance to the products and their potential harmful effects on human health (Rahmatnejad *et al*., 2009). These shortcomings has led to the search for alternatives substances that eliminates these threats. Recently, there is an increasing interest in the utilization of growth promoters from natural origin (Holden *et al*., 1998., Grela and Klebanuik, 2007). Rahmatnejad *et al*.(2009) reported that medicinal plants and herbs are one of the natural feed additives currently used in poultry diets to enhance the performance and immune response of birds.Biovet, (2005) opined that many active ingredients present in the plant are considered as pro-nutrients and recently been tried in animal feeds.

Materials and Method

Petiveriaalliacea was harvested around the Federal University of Agriculture, Abeokuta (FUNAAB). The roots were washed, chopped into bits followed by sun drying for 14 days (≤ 90% DM). *Petiveriaalliacea* leaves were washed, air dried under a shed (29±2^{0}C) until they were crispy to touch, while retaining their greenish colouration. Both the leaves and roots were milled (1mm sieve) using a laboratory mill to obtain a product referred to as *Petiveria* leaf meal (PLM) and *Petiveria* root meal (PRM). The entire test ingredients were stored in an air tight container at room temperature until when needed.

A total of 450 (16 weeks) point of lay ISA brown were obtained from a reputable source in Ogun state for the study. The birds were fed the test diets and managed intensively on dip litter throughout the duration of the experiment. The birds were subjected to ten treatment groups of 45 grower chicks. Each treatments was further divided into three replicate of fifteen birds each in a 2 × 4 factorial arrangements of; 2 plant parts (leaf and root) and 4 inclusion levels of PLM and PRM (0 mg/kg, 1000 mg/kg, 1500 mg/kg and 2000 mg/kg and 2500 mg/kg).

At the 21stweek of the study, blood samples were drawn from the wing (bronchial vein) of the birds into (EDTA) bottles for haematological indices according to method of Jain, (1986) and Davice and Lewis, (1991) respectively. Data obtained were laid out in a 2 × 5 factorial arrangement and significant means were separated using Duncan multiple range tests (Duncan, 1955).

Results

The interactive effects of plant part and levels of inclusion of plant parts on haematological indices of laying *birds* (37 weeks) showed significant ($P<0.05$) effects on PCV, RBC, WBC, heterophil, eosinophil, basophil and monocyte. Amidst varying inclusion of PLM and PRM, birds fed diets containing 1500 mg/kg of PLM showed decreased ($P<0.05$) PCV. Birds fed diets containing 1500 and 2500 mg/kg of PLM reduced ($P<0.05$) RBC when compared to other inclusion levels of plant parts. When compared to birds fed varying inclusion of PLM and PRM; least ($P<0.05$) WBC were obtained in birds fed diets containing 1000 and 2000 mg/kg of PRM.

Table 1. **Gross composition (%) of experimental layers diets (16-37 weeks)**

PLM (mg/kg) PRM (mg/kg)										
Ingredients	0	1000	1500	2000	2500	0	1000	1500	2000	2500
Maize	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00
Wheat offal	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
SBM	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
GNC	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75
FM (72%)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
PKC	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
BM	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Oyster Shell	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
PLM	-	+	++	+++	++++	-	-	-	-	-
PRM	-	-	-	-	-	-	+	++	+++	++++
Total	100	100	100	100	100	100	100	100	100	100
Calculated Proximate composition (%)										
M.E (kcal/kg)	2672.00	2672.00	2672.00	2672.00	2672.00	2672.00	2672.00	2672.00	2672.00	2672.00
C.P	17.07	17.07	17.07	17.07	17.07	17.07	17.07	17.07	17.07	17.07
C.F	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03
E.E	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28
Ash	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54

Vit./ Min. Premix contains: Vits. A, 10 000 000iu; D_3, 2 000 000iu; E, 13 000iu; K_3, 1 500mg; B_{12}, 10mg; riboflavin, 5 000mg; pyridoxine, 1 300mg; thiamine, 1 300mg; D-Pantothenic acid, 8 000mg; nicotinic acid, 28 000mg; folic acid, 500mg; biotin, 40mg; Cu, 7 000mg, Mn, 48 000mg; Zn, 58 000mg; Fe, 58 000mg; Se, 120mg; I, 60mg; Co, 300mg; choline, 275 000mg; methionine, 20 000mg; BHT, 5 000mg. PLM: *Petivera* Leaf Meal. PRM: *Petivera* Root Meal. – = exclusion levels – = exclusion levels. += 1000 mg/kg, ++ =2000 mg/kg, +++ = 2500 mg/kg.

Table 2. **Effects of PLM and PRM inclusion on haematological indices of laying birds (37 weeks)**

Treatment		PCV (%)	Hb (g/dl)	RBC ($\times10^{12}$/l)	WBC ($\times10^{9}$/l)	HET (%)	LYM (%)	BAS (%)	EOS (%)	MON (%)	MCV (fl)	MCH (Pg)	MCHC (g/dl)
Plant parts	Levels of Inclusion												
PLM		32.00	10.50	2.66	13.46	34.00^{b}	64.00	0.60^{b}	0.30	1.00	120.66	39.63	32.85
PRM		34.00	11.08	2.88	12.87	37.60^{a}	60.20	1.00^{a}	0.40	0.80	119.21	38.82	32.57
SEM		0.907	0.278	0.084	0.466	1.074	1.505	0.164	0.083	0.152	2.998	0.966	0.737
	0	35.75^{a}	11.53	2.98	13.12	34.75^{b}	63.25	0.75^{bc}	0.25^{bc}	1.00^{ab}	120.13	38.75	1.49
	1000	34.25^{a}	11.10	2.75	12.55	34.75^{b}	62.25	0.50^{bc}	0.75^{a}	1.50^{a}	124.73	40.43	1.50
	1500	30.00^{b}	10.13	2.50	14.42	40.75^{a}	57.75	0.25^{c}	0.25^{bc}	1.00^{ab}	120.05	40.50	1.54
	2000	32.50^{ab}	10.53	2.80	12.80	36.00^{b}	62.75	1.00^{ab}	0.00^{c}	0.25^{c}	118.60	38.35	1.46
	2500	32.50^{ab}	10.68	2.82	12.92	32.75^{b}	64.50	1.50^{a}	0.50^{ab}	0.75^{bc}	116.18	38.10	1.79
	SEM	1.324	0.429	0.127	0.708	1.553	2.459	0.150	0.072	0.183	4.849	1.556	1.211
PLM	0	36.00	11.50	3.05^{ab}	13.10^{ab}	33.50^{bc}	64.00	1.00^{c}	0.00^{c}	1.50^{b}	117.90	37.70	31.95
	1000	33.00	10.65	2.60^{bc}	13.55^{ab}	33.50^{bc}	64.00	0.50^{d}	0.50^{b}	1.00^{c}	127.10	41.00	32.25
	1500	29.00	9.95	2.40^{c}	13.60^{ab}	39.00^{ab}	59.00	0.00^{e}	0.50^{b}	1.50^{b}	120.85	41.45	34.20
	2000	31.50	10.45	2.80^{abc}	15.10^{a}	34.00^{bc}	65.50	0.00^{e}	0.00^{c}	0.50^{d}	112.95	37.40	33.15
	2500	30.50	9.95	2.45^{c}	11.95^{ab}	30.00^{c}	67.50	1.50^{b}	0.00^{c}	0.50^{d}	124.50	40.60	32.60
PRM	0	35.50	11.55	2.90^{abc}	13.15^{ab}	36.00^{abc}	62.50	0.50^{d}	0.50^{b}	0.50^{d}	122.35	39.80	32.50
	1000	35.50	11.55	2.90^{abc}	11.55^{bc}	36.00^{abc}	60.50	0.50^{d}	1.00^{a}	2.00^{a}	122.35	39.85	32.55
	1500	31.00	10.30	2.60^{bc}	15.25^{a}	42.50^{a}	56.50	0.50^{d}	0.00^{c}	0.50^{d}	119.25	39.55	33.15
	2000	33.50	10.60	2.80^{abc}	10.50^{c}	38.00^{ab}	60.00	2.00^{a}	0.00^{c}	0.00^{e}	124.25	39.30	31.65
	2500	34.50	11.40	3.20^{a}	13.90^{ab}	35.50^{bc}	61.50	1.50^{b}	0.50^{b}	1.00^{c}	107.85	35.60	33.00
SEM		1.905	0.623	0.160	0.760	2.067	3.585	0.046	0.020	0.052	6.925	2.265	1.889
P-values													
Plant parts		0.0926	0.1367	0.0625	0.3854	0.0070	0.0832	0.0349	0.2120	0.2500	0.7469	0.5726	0.8021
Levels of Inclusion		0.0454	0.1951	0.1400	0.4416	0.0052	0.3376	0.0021	<.0001	0.0022	0.8098	0.7127	0.9130
Plant parts x Levels of Inclusion		0.1825	0.4067	0.0379	0.0059	0.0275	0.5962	<.0001	<.0001	<.0001	0.7019	0.7497	0.9965

^{abcde}means on the same row having different superscript were significantly (P<0.05) different. SEM: Standard Error of Mean, Conc: Concentration, PCV: Packed Cell Volume, Hb; haemoglobin, RBC: Red Blood Cell, WBC: White Blood Cell, HET: Heterophil, LYM: Lymphocyte, EOS: Eosinophil, BAS: Basophil, MON: Monocyte, MCV: Mean Corpuscular Volume, MCH: Mean Corpuscular Haemoglobin, MCHC: Mean Corpuscular Haemoglobin Concentration.

Discussion

Haematological characteristics of livestock have been discovered as factors determining the response of livestock to the diet they are fed (Madubuike *et al.,*2006). The RBC at 1500 mg/kg of PLM was lower when compared with other inclusion levels of PLM and PRM. Increase in the count of RBC, Hb and PCV is suggestive of polycythemia and positive erythopoisis (Okpuzor *et al*., 2009). Hence, the values obtained for this parameters were within reported range of (1.58-3.82 x10^{6}/µL RBC and 9.2-28.6 x10^{3}/mm^{3}WBC) as recorded by Mitruka and Rawnsley (1981). Masood*et al.*(2013) opined that a number of natural compounds such as saponin, tannins and flavonoids have been reported for their antioxidant. Elevated WBC counts have been recorded under diseased condition, infection or immune system disorder (Maroufyan *et al.,* 2010). The observed differences obtained in WBC differentials such eosinophil; basophil and monocyte are within the reported range of eosinophil and monocytes of $0 – 0.5$ and $0 – 5 \times 10^{3}$/l respectively for clinically healthy birds (Aiello *et al.,* 1998).

References

Aiello, S.E and Mays M 1998. The Merck-Veterinary Manual, 8th edition. Merck and company.

Biovet, S A Laboratories 2005. The Intensive Production and the Spreading of High Productivity Genetic stocks have conditioned the common use of chemical Substances Known as "Growth Promoters".

Davice, J.U. and Lewis, S.M. (1991).*Practical Haematology*, 8th edition. Longman Ltd., London, U.K.,pp 22-68.

Duncan, D.B. (1955). Multiple Range and Multiple F-test. *Biometrics*. 11:1-42.

Grela, E.R. and Klebanuik, .R., 2007. Chemical composition of garlic preparation and its utilization in piglets diets. *Medcyna Wed*, 63:792-795.

Holden, P.J., Mckean, J. and Franzenbury, O. 1998., *Biotechnical for pigs –garlic (ASLR1559). ISU Swine Research Report, Iowa State University, Ames.*

Jain, N. C. 1986. Schalm Veterinary Haematology 4th Edition Lea and Febiger, Philadephiapp 285.

Madubuike, F.N. and Ekenyem, B.U. (2006).Haematology and serum biochemistry characteristics of broiler chicks fed varying dietary levels of *Ipomoea asarifolia*leaf meal. *International Journal Poultry Science,* 5:9-12.

Maroufyan, E., A. Kasim, S.R. Hashemi, T.C. Loh and M.H. Bejo, 2010. Change in growth performance and liver function enzymes of broiler chickens challenged with infectious bursal disease virus to dietary supplementation of methionine and threonine. *American Journal of Animal and Veterinary Science.* 5: 20-26.

Masood, S., Abbas, R. Z., Igbal, Z. Mansoor, M. K., Sindhu, Z. U. D., Zia, M. A. and Khan, J. A. 2013. Role of Natural Antioxidants for the Control of Coccidiosis in Poultry.*Pakistan Veterinary Journal* 33(4):401-407.

Mitruka BM, Rawnsley HM. 1981. Clinical, biochemical and hematological reference values in normal experimental animals and normal humans. New York: Masson Publishing; 413 p.

Okpuzor, J., Okochi, V. I. Ogbunugafor, H. A. Ogbonnia, S. T., Fagbayi, Obidiegwu, C. 2009. Estimation of Cholesterol Level in Different Brands of Vegetable Oils. *Pakistan Journal of Nutrition* 8: 57-62.

Rahmatnejad, E., Roshanfekr, H., Ashayerizadeh , O., Mamooe, M. and Ashayerizadeh, A., 2009. Evaluating the effect of several non-antibiotic additives on growth performance of broiler chickens. *Journal of Animal Veterinary Advancement*, 8: 1670-1673.

Influence of Composted Poultry Manure on Organic Carbon and Selected Soil Properties under Tomato Cultivation

Wahab A.A.[1]*, Dada O.A.[2], Aina O.[4], Agbanna K[4], and Hamza A.[3]

[1]Kwara State University, Malete, Kwara State

[2]Federal University, Ndufu-Alike Ikwo, Ebonyi State, Nigeria

[3]University of Ibadan, Ibadan, Nigeria

[4]Kogi State University, Ayingba, Kogi State

Corresponding author:
*loukinse@gmail.com

Keywords:
Compost; soil physical properties; soil quality; tomato

Abstract

Soil quality improvement provides an environment for plant nutrient uptake that impacts the development and yield of crop. Thus, this study evaluated the effect of applied poultry composted organic manure (PCOM) on selected soil physical attributes and soil organic carbon content (SOC) under two tomato (UC82B and BESKE) varieties planted in succession. Three rates 0, 10 and 20 t ha^{-1} of compost were applied to two tomato varieties. The experiment was arranged in a 2x3 factorial experiment fitted into a randomized complete block design with three replicates. The soil physical parameters considered were - bulk density, aggregate stability, total porosity and SOC. It was observed that application of PCOM increased SOC, total porosity, aggregate stability and decreased the bulk density in the cropped tomato area. The SOC was highest in 10t ha^{-1} of PCOM. Application of 10 t ha^{-1} compost is adequate to improve carbon content and soil physical properties for a fragile soil.

Introduction

Soil degradation poses a major threat to sustainable agricultural practices and a major environmental threat among others due to excessive soil erosion, nutrient run-off and loss of soil organic matter. Its ineffective management has resulted in soil quality deterioration and consequently impedes crop development. Therefore, soil organic matter (SOM) improvement and stability is one major discussion in sustainable agriculture. According to Arriaga and lowery, (2003) reported that SOM enhances water holding capacity and aggregation of the soil which limits erosion and provides nutrients reservoir that can be released into the soil. This helps provide ease of cultivation, penetration, seedbed preparations, and greater aggregate stability and improve water holding capacity at low suction. For this reason, additional of organic material with high organic matter such as fresh and composted urban waste (Ron *et al*., 2003) shredded and composted plant material derived from municipal landscapes (Walker, 2003) and cotton gin compost and poultry manure (Tejada *et al*., 2006) to soils has become an environmental practice for soil restoration, maintaining SOM, reclaiming degraded soils and supplying plant nutrients (Walker, 2003).Previous studies have consistently found that application of manure can increase soil aggregation (Paglai *et al*., 2004) and total porosity (Schjonning *et al*., 2002). Miller *et al*., (2002) reported that manure amendment significantly ($P<0.05$) increased soil water retention compared to the control across the whole matric potential range between 0 and 1500 kPa. It had also been observed that changes in water retention may depend more on the soil type (Edmeades, 2003) and its initial carbon content than the addition of organic material i.e. soil porosity (Ros *et al*., 2003). The objective of this study was to compare the residual effect of organic manure i.e. composted poultry manureon the following physical properties: hydraulic conductivity, water retention, soil aggregate stability, soil bulk density and total porosity of soil previously planted with tomato.

Materials and Methods

The experiment site was located behind Fadama area in Alabata, Ogun state which lies on latitude $7^0$22' 84"N to 7^0 22' 91"N North of the equator and longitude $3^0$45' 55"E to 3^0 45' 64"EEast of the Greenwich maritime. Land preparation was done by ploughing and harrowing. Compost was applied at the rate of 0, 10 and 20 t/ha which was thoroughly mixed with the soil before tomato varieties was transplanted at three week after planting (UC82B and BESKE). The plots weeds were cleared manually and free of weed throughout the first and second transplanting. The crop residues of the tomato varieties were left to decay on the plot after first planting. Land preparation for the succeeding tomato varieties (UC82B and BESKE were transplanted accordingly) was carried out by hoeing before transplanting. No compost was applied to the succeeding tomato at the spacing of 80 X 30cm with planting population of 56,000 plants per hectare. Weed control took place twice at 3 and 7 weeks after transplanting using Africa hoe. The total plot size was 720m^2 (36plots) and each experimental plot is 4m x 5m laid in 2 x 3 factorial experiment in randomized complete block design replicated three times.

Initial soil samples were collected before and after first and second planting which were analyzed. Soil sample were equally collected at 0 – 20cm and 20 – 40cm depth from each experimental plots. Core samplers are used for the undisturbed sample and shovel were used for the disturbed sample. The Total Organic Matter was determined using Walkey-Black method (1964) to estimate the organic carbon content and its value was multiplied by a standard factor (1.724) in getting the corresponding percent organic matter. Aggregate Stability was estimated using wet sieving techniques as described by Emerson, 1997.Saturated Hydraulic Conductivity was determined using constant head method (Klute and Dirksen 1986).Bulk Density was determined by using the core method (Harte and Horn, 1989). Total Porosity was determined in undisturbed water saturated cores assuming no air was trapped in the pores.

Statistical Analysis

Data generated were subjected to analysis of variance. The analysis of variance was carried out using Genstat statistical package release 7.2 DE (2007) and significant difference was reported at $P \leq 0.05$.

Results and Discussion

Pre-planting soil analysis

Soil reaction of the studied site was slightly acidic (6.04 and 5.59) before planting and after first planting (Table 1). The analyzed results also revealed that the soil of the studied site had very low Av. P, TN, K and OC according to Federal Department of Agricultural Land Resources fertility range (1990) before planting. This was however amended reasonably after the first planting of tomato varieties as shown in the Table 1. Therefore, there was good response to soil amendment form the crop and soil.

Soil Organic Carbon

The soil organic carbon (SOC) concentrations within two depths i.e. 0 – 20cm and 20 – 40cm, were significantly higher than the control in both tomato varieties. The tomato plot amended with 10 t ha^{-1} showed higher SOC at both depths. The increase in SOC due to the application of organic manure is in line with Sharma *et al*., 2002 finds which inferred that application of organic matter encourage higher root biomass accumulation and increased mineralization in fertilized plot than in control plot.

Soil Bulk Density

The soil bulk density (BD) at 0 – 20 cm and 20 – 40 cm revealed that poultry composted manure decreased soil bulk density compare with the control plot in both crop (Table 3). The BD in surface layer 0 – 20cm was significantly lower than that of the subsurface layer (20 – 40cm) (Table 3). This conform with Schjonning *et al*., (2002) findings that there is reduction in the BD of the soil due to application of animal manure; while Rose (1991) also found decreased in BD in plots receiving farmyard manure.

Table 1. **Soil analysis results of the studied sites before planting and after first planting**

Parameters	Value	
	Pre planting soil Analysis	After first planting Analysis
pH (H_2O)	6.04	5.59
Total Nitrogen, TN (g/Kg)	0.09	0.46
Potassium, K^+ (Cmol/Kg)	0.42	1.01
Available Phosphorus, Av. P (mg/Kg)	1.55	1.25
Sodium, Na^+ (Cmol/Kg)	0.23	0.18
Magnesium, Mg^{2+} (Cmol/Kg)	1.47	1.16
Calcium, Ca^{2+} (Cmol/Kg)	2.35	1.87
Total Exchangeable Acidity, TEA (Cmol/Kg)	0.17	0.14
Cation Exchangeable Capacity, CEC (Cmol/Kg)	4.62	3.47
Organic Carbon, OC (%)	1.01	2.17
Base Saturation, BS (%)	96.1	89.1
Bulk density (g/cm^3)	1.63	1.47
Sand (g/Kg)	805	800
Clay (g/Kg)	80	92
Silt (g/Kg)	105	108
Texture	Loamy Sand	Loamy Sand
Porosity (%)	46	48
Permeability (cm/hr)	4.50	5.15

Table 2. **Organic carbon (%) as affected by poultry manure under tomato cultivation**

Tomato varieties	Compost rate (t/ha)	Depth (cm)	
		0 – 20	20 - 40
UC82B	0	1.257	0.883
	10	1.917	1.368
	20	1.765	1.173
	0	1.207	0.870
BESKE	10	2.378	1.082
	20	2.298	1.063

lsd at (p>0.05) for treatment[a] x depth is 0.6440
treatment[a]= tomato varieties x compost rate

Table 3. **Soil bulk density as affected by poultry manure under tomato cultivation**

Tomato varieties	Compost rate (t/ha)	Depth (cm)	
		0 – 20	20 - 40
UC82B	0	1.357	1.593
	10	1.340	1.487
	20	1.312	1.502
	0	1.435	1.457
BESKE	10	1.252	1.410
	20	1.375	1.380

lsd at (p>0.05) for treatment[a] x depth is 0.1244
treatment[a]= tomato varieties x compost rate

Total Porosity

The total porosity (TP) was higher in treated plots compared with the control (Figure 1). The highest TP were recorded in the plots amended with 20 t/ha organic manure for both tomato varieties (49.83-UC82B and 49.75-BESKE respectively). Thus, the trend of the TP for the applied soil amendment rate was 20 t/ha > 10 t/ha > 0 t/ha. This is in agreement with Celik *et al*., (2004) report that total porosity with soil organic amendments depends on the amount added.

Aggregate Stability

The aggregate stability expressed in terms of mean weight diameter (MWD) increased with increased in application rate. Plot amended with 20 t ha^{-1} showed a decrease in the trend in both tomato varieties at both depths (Figure 2). The MWD was highest in plot treated with 10t/ha. The MWD at the sub surface (20-40cm) was higher compare with the surface (0-20cm)(Figure 2). This was due to absence of tillage practice which induces disruption of soil aggregate in deeper soil layer and compaction of soil due to over-burden pressure, which induced close contact of soil particle and consequently better adhesions of soil particle to form stable aggregate (Ghuram and Sur, 2001).

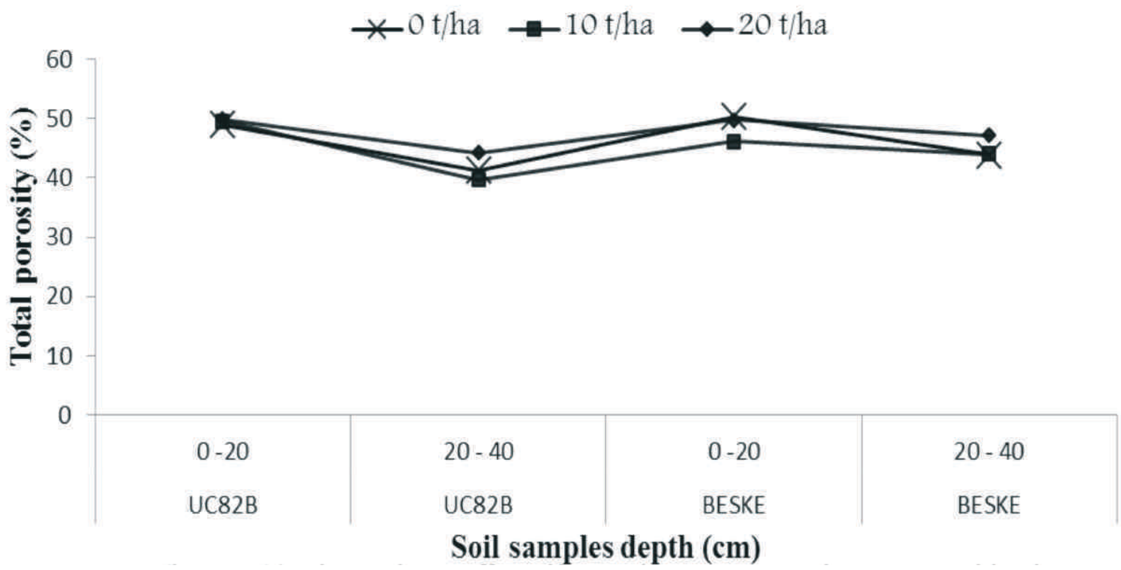


Figure 1. **Total porosity as affected by poultry manure under tomato cultivation**

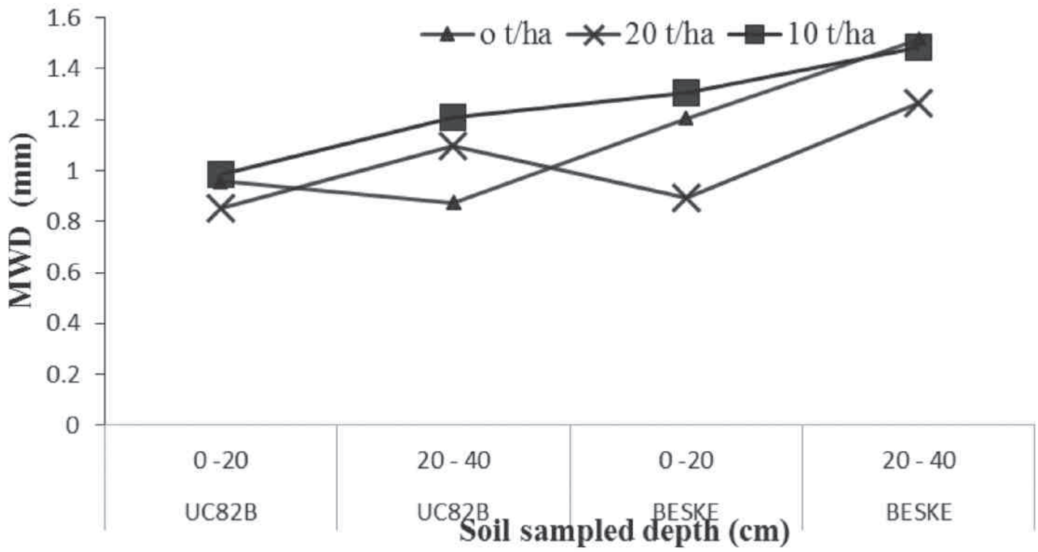


Figure 2. **Mean weight diameter (MWD) as affected by poultry manure under tomato cultivation**

Conclusion

This study showed that application of composted poultry manure to soils increased soil organic carbon and decreased soil bulk density thereby causing an increase in total porosity of the soil. Generally, high soil organic matters promote increased selected soil physical properties. The plot amended with 10 t ha^{-1} composted poultry manure has the highest organic carbon content and shows increased in soil physical properties than either the control or plot amended with 20t/ha. Application of organic manures at 10 t ha^{-1} is adequate to improve carbon content and other soil physical properties for fragile soils characteristics of the area.

References

Arriaga, F.I. and Lowery, B., 2003. Soil physical properties and crop productivity of an eroded soil amended with cattle manure. Soil Science 168 (12),888-899.

Celik, R., Griffin, M. and Kimble, J.R., 2004. Conservation tillage for carbon sequestration: Nutrient Cycling Journal of Agro-ecosystem. 49:243-253.

Edmeades, D.C., 2003. The long-term effects of manures and fertilizers on soil productivity and quality: a review. Nutrient Cycling in Agro-ecosystems 66, 165-180.

Emerson, D., 1997. Aggregate stability and assessment of soil crustability and erodibility. 11. Application to humic loamy soils with varios organic carbon content. Eur . J. soil sci. 48:39-48.

Federal Department of Agricultural Land Resource (FDALR) 1990. Guide on Soil Fertility range and amendment on Nigeria Soil. pp 35 – 42.

GenStat Discovery 3 (2007). VSN International Limited. www.vsni.co.uk

Ghuram J.R. and Sur G.M. 2001. Managing soil carbon. Soil Science J. 304:393 – 408

Hartes, R.I., and Horn, R., 1989. Influence of lime, fertilizer and manure applications on soil organic matter content and soil physical condition: a review. Nutrient Cycling in Agroecosystems 51, 123-137

Klute, A., and Dirksen, C., 1986. Hydraulic conductivity and diffusivity: laboratory methods, In: Klute, A. (Ed.), Methods of Soil Analysis, Part I. Physical and Mineralogical Methods, 2nd ed. American

Society of Agronomy – Soil Science Society of America, Madison, WI, pp. 687-697.
Miller O.C., Lal, R. and Bruce, J.P., 2002. Soil carbon dynamics in cropland and rangeland. Environmental Pollution 116, 353-362.
Pagliai, M., Vignozzi, N., Pellegrini, S., 2004. Soil structure and the effect of management practices. Soil & Tillage Research 79, 131-143.
Ros, W.J., Pachepsky, Y.A., Ritchie, lC., Sobecki, T.M., Bloodworth, H., 2003. Effect of soil organic carbon on soil water retention. Geoderma 116,61-76.
Ron, J.J., Sweetland, N.J., Chang, C., 2003. Hydrological properties ofa clay loam soil after long term cattle manure application. Journal of Environmental Quality 31, 989-996.
Rose, M.A., 1991. Soil organic carbon pools during early adoption of conservation tillage in Northwestern Canada. Soil Sci. Soc. Am. J. 60, 1422-1427.
Schjonning, P., Munkholm, L.J., Moldrup, P., Jacobsen, O.H., 2002. Modelling soil pore characteristics from measurements of air exchange: the long-term effects of fertilization and crop rotation. European Journal of Soil Science 53 (2), 331-339.
Sharma, R.F., CooperB. and, Keay, L.R., 2002. Compost effects on soil physical properties and field nursery production. Compost Science & Utilization 10 (3), 226-237.
Tejada, M., Garcl'a, C., Gonzalez, J.L., Herna'ndez, M.T., 2006. Organic amendment based on fresh and composted beet vinasse: influence on physical, chemical and biological properties and wheat yield. Soil Sci. Soc. Am. J. 70, 900-908.
Walkley, A., Black, I., 1964. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Science 37:29 – 37.

Physico-chemical Composition of Sweet Orange (*Citrus sinensis.* cv Agege 1) with Fruit maturity in an organic production system

*Olubukola Motunrayo Odeyemi, Ibrahim Olayinka Odetola and Abiola Elizabeth Ojetayo

Department of Horticulture, Federal University of Agriculture, Abeokuta. PMB 2240, Ogun State. Nigeria.

*Corresponding author: odeyemiom@funaab.edu.ng

Keywords:
biochemical composition, fruits, maturity, organic, tropics, quality

Abstract

This study investigated changes in the physical, biochemical and proximate composition of sweet orange (cv. Agege 1) with fruit maturity in a 7 year old orchard cultivated under organic production system of the tropical humid climate. The experiment was conducted for two consecutive early seasons between November 2014 and May 2016 at the Federal University of Agriculture, Abeokuta. Nigeria. Sweet orange trees were fertilized with 10t/ha poultry manure/tree twice in a year and fruits were harvested from 90 days after fruit set to 240 days after fruit set to evaluate for quality changes. Fruit and peel weight, juice volume, seed numbers and total soluble solids (TSS) contents of the sweet orange increased significantly ($p<0.05$) with fruit maturity. However, vitamin C content, titratable acidity and firmness decreased with fruit maturity. The peel colour of the fruits remained green with maturity.

Introduction

Sweet orange is an important nutritious fruit crop with a good amount of vitamin C and several phytochemicals. Generally climate has a significant effect on citrus yield, growth, fruit quality and economic returns (Zekri, 2011).Agege 1 is a popular sweet orange variety in South Western, Nigeria because of its adaptability and high fruit yield(Olaniyan and Fagbayide, 2005).

In recent times there is an upsurge in the global demand for organic fruits due to envisaged benefits to health and environment (Aiyelaagbe and Afolabi, 2006). More so, there has been scientifically provenresults that some organically cultivated fruits contain high vitamins and minerals (Odeyemi *et al,* 2014). However, maturity is one of the factors that determine the compositional quality of fruits and vegetables (Lee and Kader, 2000). Due to paucity of information on the quality of sweet orange cultivated under organic practices in Nigeria, this study was carried out to investigate the changes inphysical, biochemical and proximate composition of sweet orange (cv. Agege 1) with fruit maturity under organic production system.

Materials and Methods

Field management and plant materials

Sweet orange fruits were harvested from an organic fruit orchard situated at the Federal University of Agriculture, Abeokuta (7^0, 15'N, $3^0$25'E, 100m) in South western, Nigeria. This area of land lies within the tropical humid region. The location has an average rainfall of 1062.5mm with bi-modal distribution, temperature of 24.7°C -36.4°C and a relative humidity of 88.5%(Aiboni, 2001). The 7 year old sweet orange (cvAgege 1) were grafted on Cleopatra mandarin rootstock and spaced at 9.5cm between rows and 3.5 cm within rows.

Treatments and experimental design

The sweet orange trees were fertilized with 10t/ha poultry manure/tree twice in a year. Foliar application of 5.0ml neem (*Azadirachtaindica*) oil spray per litre of water was used for insect pest control (Lowell, 2008) while weeding was carried out with the use of a hoe thrice in the rainy season and twice in the dry season. Thirty sweet orange trees were randomly selected and fruits were tagged 90 days after set. Subsequently, the fruits were harvested and evaluated every 30 days for quality changes between 90 -240 days after fruit set in the early seasons of November 2014- May 2015 and November 2015- May 2016. The experiments was laid out in a Randomized complete block design replicated thrice.

Assessment of fruit quality

Harvested fruits were properly washed with distilled water to remove dirt and air dried. Physical properties of fruits determined included fruit weight by weighing individual fruits using an electronic balance (model Gallenkamp series, London). Fruit diameter was determined using a veneer caliper in the equatorial region. Fruit firmness of individual fruits was measured using a hand held penetrometer expressed as kg/force. Juice volume was determined by peeling individual orange, halved and then the juice was manually extracted with a juice extractor. The fruit juice was filtered to remove the seeds and pulp. The juice was then determined in measuring cylinder calibrated in milliliters (ml). Color change was evaluated using a colorimeter (CR-400/410, Konica Minolta, Netherlands) to measure colour coordinates in hunters L*a*b* units.

Biochemical composition determined included total soluble sugar (TSS) determined by placing juice from fresh samples on the reading surface of a hand-held Brix Refractometer (Model Atago 1140, Japan). Titratable acidity (TA) was estimated by titrating juice with 0.1 Sodium hydroxide in a beaker using 2-3 drops of phenolphthalein indicator to a pink colour end point. TA was expressed as percentage citric acid. The pH was determined with the use of a pH meter (Jenwaymodel 3310, UK) previously standardized with buffers 4 and 7. Vitamin Cwas estimated using titration method with the indicator dye 2,6-dichloroindophenol to a faint pink end point. Proximate composition was determined according to the standard methods of AOAC (2004).

Data Analysis

Data obtained were subjected to analysis of variance (ANOVA) using Genstat Discovery Statistical package (GenStat 2011). Means were separated using least significant difference at 5% level of probability.

Results

Physical attributes of sweet orange as influenced by fruit maturity in an organic production system.

Results showed that there was a significant increase ($p<0.05$) in the physical attributes of the harvested fruits with increasing fruit maturity from 90 to 240 days after fruit set in the early seasons of 2015 and 2016. The fruit weight, seed number, juice volume, peel weight and the fruit diameter increased with fruit maturity. However fruit firmness decreased as the fruits become more mature while the numbers of segments containing the juice vesicle (sacs) were not significant in both years (Table 1).

Days after fruit set	Fruit weight (g)		Seed number		Juice volume (ml)		Firmness		Number of segments		Peel weight (g)		Fruit diameter (cm)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
90	64.7	58.4	4	3	17.7	10.7	10.7	5.3	10	11	19.8	10.6	4.9	4.6
120	99.4	73.0	8	4	34.5	26.3	18.3	5.8	11	11	22.7	12.6	5.3	5.1
150	187.4	132.8	11	9	42.2	33.6	29.0	14.6	11	11	30.1	21.3	5.7	5.9
180	217.7	196.2	22	17	60.9	38.3	38.3	24.3	11	11	33.3	33.0	5.8	7.2
210	231.7	253.3	27	28	64.1	47.0	66.1	30.8	11	11	34.9	45.4	6.2	7.6
240	239.5	255.0	28	29	65.8	47.3	72.9	52.5	11	11	38.5	46.0	6.5	7.9
Lsd (0.05)	64.3	58.9	7.9	6.2	13.9	11.5	2.9	3.5	ns	ns	12.8	9.6	0.9	0.8

Colour development on sweet orange peel with fruit maturity revealed that the fruits became significantly lighter (L* value) between 90-240 day after fruit set. The peel colour changed from dark green to light green in both years of observation (Table 2).

Table 2. **Colour development on sweet orange (Agege 1) peelwith fruit maturity**

Days after fruit set	**2015**			**2016**		
	L*	a*	b*	L*	a*	b*
90	34.10	-24.20	8.3	37.12	6.9	-27.45
120	35.62	-25.33	9.42	39.11	8.3	-23.64
150	37.51	-20.78	10.8	40.47	9.2	-22.53
180	43.30	-17.90	11.2	42.98	9.7	-18.76
210	44.29	-11.76	12.1	43.91	9.9	-9.5
240	47.70	-5.85	12.7	44.22	10.5	-4.32
Lsd (0.05)	1.23	-	Ns	1.02	ns	-

L*=lightness (0=maximum darkness, 100=maximum lightness) a= (+a* redness/ -a* greenness) b= (+b* yellowness/ -b* blueness)

Biochemical compositions of Sweet orange as influenced by fruit maturity in an organic production system

The pH and TSS of the sweet orange juice increased significantly ($p<0.05$) with fruit maturity both early seasons of 2015 and 2016. Titratable acidity and ascorbic acid on the other hand decreased with fruit maturity in both years (Table 3).

Table 3. **Biochemical composition of sweet orange (cvAgege 1) fruit with maturity in an organic production system**

Days after fruit set	**Total Soluble Sugar (%brix)**		**Vitamin C (mg/100ml)**		**Titratable Acidity (%)**		**pH**	
	2015	2016	2015	2016	2015	2016	2015	2016
90	6.9	7.5	46.32	48.84	0.82	0.77	2.32	2.05
120	7.9	8.3	45.11	45.90	0.79	0.68	2.65	2.10
150	8.6	9.7	38.56	40.62	0.66	0.62	2.77	2.64
180	9.2	10.2	38.97	36.42	0.42	0.57	3.41	2.76
210	10.1	10.5	36.79	32.34	0.45	0.49	4.32	2.97
240	10.4	10.6	37.21	32.97	0.31	0.42	4.50	3.08
Lsd (0.05)	1.04	1.03	5.73	4.44	0.09	0.08	0.33	0.47

Proximate composition of Sweet orange fruits as influenced by fruit maturity in an organic production system

The moisture content of the fruit juice increased significantly (p<0.0.5) with fruit maturity with maximum moisture content at 93.3% in 2016 (Table 4). Water is a major constituent of the mass of the fruit. Other proximate compositions of the fruit juice showed that ash, fat, crude fibre, carbohydrate and crude protein decreased with fruit maturity both early seasons of 2015and 2016.

Table 4. **Proximate composition of Sweet orange with fruit maturity in an organic production system**

Days after fruit set	Moisture Content (%)		Ash (%)		Fat (%)		Crude Fibre (%)		Crude Protein (%)		Carbohydrate (%)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
90	79.7	78.4	0.83	0.79	0.93	0.96	3.10	3.07	1.37	1.03	23.21	18.81
120	80.5	89.9	0.80	0.38	0.91	0.92	3.52	3.41	1.54	0.43	16.74	6.73
150	86.7	91.2	0.45	0.27	0.90	0.88	3.57	3.46	1.01	0.39	9.56	8.59
180	92.5	92.5	0.22	0.19	0.87	0.87	3.68	3.73	0.59	0.38	8.12	7.19
210	92.6	92.7	0.21	0.15	0.86	0.84	3.77	3.81	0.47	0.35	4.76	3.17
240	92.8	93.3	0.17	0.14	0.72	0.77	3.98	4.25	0.38	0.33	2.90	2.14
Lsd (0.05)	5.9	4.7	0.09	0.11	0.05	0.06	0.55	0.43	0.03	0.05	3.66	4.75

Discussion

Agege 1 variety of sweet orange could be classified as a seedy cultivar having more than 15 seeds. The increase in TSS with fruit maturity could be attributed to sugar accumulation in the pulp as high amounts of soluble carbohydrates are translocated to the developing fruits as supported by Iglesias *et al*(2001). TSS is an important maturity index for citrus that contributes to flavor and determines consumers' acceptability. Titratable acidity on the other hand decreased with fruit maturity in both season due to catabolism of the citric acid. It is important that acidity in fruit is reduced. Increasing pH may be due to decrease in the acidity of the fruit with maturity. Carbohydrates decreased because starch disappears with fruit maturity. The peel colour of the sweet orange fruits remained green probably because the orange was cultivated in tropical humid region. According to Ladaniya (2008), changes in the peel colour of sweet orange on the tree are due to the weather condition. A high temperature was experienced during fruiting which reduced the rate of chlorophyll degradation and the fruit remained green even with increasing maturity.

Conclusion

The physical, biochemical and proximate composition of sweet orange (cv. Agege 1) changed with fruit maturity in the organic production system. However, the peel colour of the fruits remained green with maturiy.

References

Aiboni, V.C. (2001). Characteristics and classification of soils of a representative topographic location in the University of Agriculture, Abeokuta. Nigeria. ASSET. Journal series A 1:35-50

Aiyelaagbe, I.O.O. and Afolabi, A. (2006): Growth and dry matter accumulation of Valencia orange

(Citrus sinensis) seedlings in response to organomineral fertilizer. In Organic Agriculture for sustainable food security. Proceedings of the first National conference on Organic Agriculture Project in Tertiary Institutions in Nigeria. Eds Olasantanet al.25-28th October, 2005.

AOAC (2004).Association of official analytical chemists. Official methods of analysis of the association of official analytical chemists, Washington D.C, U.S.A

Genstat, 2011.Procedure Library Release.4th edition. VSN International Limited, Rothamstead Experimental Station, Hamstead, UK.

Iglesias, D.J, Cercos,M., Colmenero-Flores, J.M., Naranjo, M.A., Rios, G., Carrera, E., Ruiz-Rivero, O., Lliso, I., Morillon, R, Tadeo, F.R. and Talon. (2007): Physiology of citrus fruiting. Plant physiol, (19)4:333-362.

Ladaniya, M. (2008).Citrus Fruit; Biology, technology and evaluation. Academic press. USA

Lee, S.K. and Kader, A.A. (2000): Preharvest and postharvest factors influencing vitamin C content of horticultural crops. Postharvest Biology and Technology, 20(3):207-220.

Lowell, J. F. (2008). Producing food without pesticides: Local solution to crop pest control in West Africa.CTA.Wageningen .pp 23.

Odeyemi O.M., Aiyelaagbe I.O.O., Bodunde J.G. and S.O. Babalola. (2014). Influence of variety and production system on postharvest quality of pawpaw (Carica papaya. L) fruits stored in different Media. *Nigerian Journal of Horticultural Science* 19:53-60. ISSN 1118-2733.

Olaniyan, A.A. and Fagbayide, J.A. (2005): Weed population in citrus based cropping systems as affected by crop association. Moor Journal of Agriculture Research. 6(1): 7-15.

Zekri, M. 2011. Factors affecting production and quality of Citrus. Citrus Industry 6-9.

Influence of Compost Supplemented with Jatropha Cake on Growth, Dry Matter Accumulation and Nutrient Uptake of Maize (*Zeamays* L.)

Olowoake Adebayo Abayomi

Department of Crop Production,
Kwara State University,
P.M.B. 1530, Ilorin,
Kwara State, Nigeria

Corresponding author:
aolowoake@yahoo.com

Keywords:
Compost, dry matter yield, Jatropha cake, nutrient uptake

Abstract

The potentials of compost supplemented with jatropha cake as soil amendments were evaluated under screenhouse at Kwara State University. Maize (variety EVDT-W99 STR) was used as test crop. The experiment consisted of two consecutive experiments in which residual effect was observed in the second experiment. The treatments were: control (Zero addition), NPK 15 –15-15 at 60 kg N/ha, 30% Grade B + 70% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 40% Grade B + 60% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 50% Grade B + 50% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 60% Grade B + 40% Jatropha cake at 1.5, 2.0 and 2.5 t /ha . The design was completely randomized design replicated three times. Results obtained showed that 50% Grade B + 50% Jatropha cake greatly influenced growth parameters of maize at first and second cropping. The 50% Grade B + 50% Jatropha cake treatment resulted in the highest nitrogen, phosphorus and potassium uptake value; 13.28, 0.32and 14.60 mg/pot respectively at second planting which differed significantly from all other treatments. The study showed that jatropha cake supplemented with compost at 2.5 t/ha resulted in higher growth parameters and nutrient uptake when compared with NPK at second planting.

Introduction

Declining soil fertility is a serious limitation to crop production in Nigeria. The primary causes are loss of organic matter, acidity, low nutrient contents, nutrients imbalance and soil erosion (Ojo *et al*., 2014). The low nutrient status of most tropical soils necessitates the use of fertilizers (Ogundare *et al*., 2016).The majority of the small holder peasant farmers in Nigeria lacked the financial resources to purchase sufficient fertilizers to replace soil nutrients exported with harvested crop products. As a result, soil fertility has declined and yields of staple food crops are typically low (Olowoake and Adeoye, 2013). One of the ways of increasing the nutrient status is by boosting the soil nutrient content either with the use of organic materials such as poultry manure, animal waste or compost (Dauda *et al*., 2005). Several sources of organic materials and residues abound in Nigeria which can be processed, packaged and made available as branded organic fertilizer at a cheap rate for home gardening, horticulture and farming as a whole (Olowoake *et al*., 2015). There is paucity of information on the use of compost augmented with jatropha cake for the production of maize in Ilorin, Nigeria. This study was carried out to evaluate the influence of compost supplemented with jatropha cake on growth, dry matter yield and nutrient uptake of maize.

Materials and Methods

Pot experiment was conducted in 2016 at Kwara State University Malete, Nigeria (Latitude 80 71'N and Longitude 40 44'E). The university lies in the southern guinea savanna belt of Nigeria. Forty two pots were filled with 5.5 kg of soil. The treatments used were; Control (No fertilizer), NPK 15 –15-15 at 60 kg

N/ha, 30% Grade B + 70% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 40% Grade B + 60% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 50% Grade B + 50% Jatropha cake at 1.5, 2.0 and 2.5t /ha, 60% Grade B + 40% Jatropha cake at 1.5, 2.0 and 2.5 t /ha .Grade B is a commercial fertilizer product of Aleshinloye Fertilizer Plant, Ibadan, Oyo State, Nigeria. The results of the laboratory analyses of Grade B fertilizers and jatropha cake is summarized in Table 1.The treatments were arranged in a completely randomized design (CRD) with three replicates. The soils and compost supplemented with jatropha cake were left to mineralize for two weeks before planting while the mineral fertilizer was applied two weeks after planting. Four maize seeds (variety EVDT-W99 STR) were planted in each pot, but later thinned to two after germination. Pre-cropping chemical analysis of the experimental soil used in the screen-house was carried out before the experiment. Plants were watered daily and weeding was also carried out as required. The plants were observed for six weeks after which they were harvested and analyzed for N, P and K contents based on the procedures described by Okalebo *et al*. (2002).The experiment was repeated without any fertilizer application at the second planting.

Table 1. **Chemical composition of Aleshinloye Grade B and jatropha cake**

Nutrient element	N	P	K	Na	Cu (g/kg)	Mn	Ca	Mg	Fe	Zn
Grade B	11.7	7.6	20.9	29.61	16.98	106.7	23.4	2.4	8195.4	19.9
Jatropha cake	34.1	0.7	2.2	0.08	0.02	0.01	0.3	8.39	2.1	0.08

The data were taken at an interval of two weeks; plant height and number of leaves. At six weeks after planting (6 WAP) maize shoots were harvested from the ground level, oven dried at 70°C to a constant weight; and the weights were recorded as dry matter yield. The dried maize shoots were milled using Willey E. D. 5 milling equipment. Plant samples were analyzed for N, P and K as described by Okalebo *et al*, (2002).The data collected were subjected to analysis of variance (ANOVA) and treatment means were separated by Duncan Multiple Range Test.

Results

Table 2 showed the effect of compost supplemented with Jatropha cake and NPK on growth parameters, dry matter yield and nutrient uptake of maize during the first planting in the screenhouse at 6 WAP.NPK at 60 kgN / ha and 50% Grade B + 50% JC at 2.5 t / ha were significantly ($p< 0.05$) higher than control and other treatments. The highest plant height of 45.3 cm was obtained from plant fertilized with 50% Grade B + 50% JC at 2.5 t / ha. Maize number of leaves in 50% Grade B + 50% JC at 2 .5 t / ha was significantly ($p< 0.05$) higher than number of leaves from NPK and all other fertilizer treatments including control. The dry shoot weight in the compost supplemented with jatropha cake and NPK pots was larger than control by 39-80%. The control treatment produced the smallest dry shoot weight. Dry shoot weight was significantly ($P<0.05$) influenced by the fertilizer treatments in the first trial. Table 3 showed the mean N, P and K uptake of maize during the first planting in the screen house. For the N uptake, the highest value of 13.5 mg N / pot from NPK was significantly ($p <0.05$) higher than the values from all other fertilizer treatments. P uptake values showed that NPK had highest value (3.0 mg P / pot). K uptake had the values of 60.7 mg K / pot from the treatment NPK. However, 30% Grade B + 70% JC at 1.5 t /ha had the lowest value of 14.5 mg K / pot excluding control. Table 4 showed the residual effects of different rates of fertilizer treatments on growth parameters, dry matter yield and nutrient uptake of maize during the second planting in the screenhouse. Height of maize plants treated with 50% Grade B + 50% JC at 2.5 t /ha on maize was significantly ($p<0.05$) different from all other fertilizer treatments including control. The highest height of 39.3 cm was observed under 50% Grade B + 50% JC at 2.5 t /ha. Control (no fertilizer) produced plant that were shorter than 50% Grade B + 50% JC at 2.5 t /ha by 57 %. Effect of fertilizer treatment on maize number of leaves.

Table 2. **Effects of compost supplemented with jatropha cake and NPK on dry matter yield and nutrient uptake of maize during first cropping**

Treatment	Rate (t/ha)	Plant height (cm)	Number of leaves	Dry matter yield (g)	N (mg / pot)	P	K
Control	0.0	33.8c	8.2d	3.5e	3.3d	0.8d	8.4d
30% Grade B + 70% JC	1.5	39.8b	9.8abc	5.7d	5.1c	1.2c	14.5c
30% Grade B + 70% JC	2.0	40.3b	9.3bcd	8.2c	8.5c	2.1b	37.1b
30% Grade B + 70% JC	2.5	37.7b	10.0ab	7.9c	8.7c	2.5b	40.2b
40% Grade B + 60% JC	1.5	39.0b	9.5bcd	7.4c	6.5c	1.2c	23.0c
40% Grade B + 60% JC	2.0	43.8b	9.5bcd	7.7c	7.2c	1.4b	27.8c
40% Grade B + 60% JC	2.5	42.4b	9.5bcd	7.4c	6.1c	1.5b	28.9 c
50% Grade B + 50% JC	1.5	37.6b	8.5d	7.7c	5.1c	1.5b	29.4c
50% Grade B + 50% JC	2.0	39.7b	8.5d	6.9c	4.9c	1.1c	30.9c
50% Grade B + 50% JC	2.5	45.3a	10.5a	10.3b	10.0b	2.9a	54.9b
60% Grade B + 40% JC	1.5	39.2b	9.1bcd	4.9d	6.4c	1.5b	17.8c
60% Grade B + 40% JC	2.0	38.8b	9.1bcd	4.7c	5.7c	1.1c	14.9c
60% Grade B + 40%	2.5	42.3b	9.2bcd	4.9c	6.2c	1.5b	16.0c
NPK	0.06 kgN	45.0a	8.5cd	17.7a	13.5a	3.0a	60.7a

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level

Legend:

Grade B – Un-amended compost JC- Jatropha cake

The effect of 50% Grade B + 50% JC at 2.5 t/ha on shoot dry matter yield of maize was significantly ($p< 0.05$) different from all other fertilizer treatment including control. Table 3 showed the N, P and K uptake of maize during the second planting in the screenhouse. N, P and K uptake differed significantly under different treatments.

Table 3. **Effects of compost supplemented with jatropha cake and NPK on dry matter yield and nutrient uptake of maize during second cropping**

Treatment	Rate (t/ha)	Plant height (cm)	Number of leaves	Dry matter yield (g)	N (mg / pot)	P	K
Control	0.0	16.8e	8.2c	2.5d	2.84f	0.03e	2.34e
30% Grade B + 70% JC	1.5	19.0cd	9.2b	2.9d	8.78c	0.04d	10.44b
30% Grade B + 70% JC	2.0	17.9d	9.3b	2.7d	7.33c	0.05d	7.25c
30% Grade B + 70% JC	2.5	18.8cd	8.8b	4.9c	6.56d	0.08d	7.19c
40% Grade B + 60% JC	1.5	20.9cd	8.8b	2.7d	6.32d	0.14c	5.80d
40% Grade B + 60% JC	2.0	20.7cd	9.2b	2.8d	6.34d	0.14c	7.11c
40% Grade B + 60% JC	2.5	20.8cd	8.7b	2.6d	6.69d	0.22b	5.95d
50% Grade B + 50% JC	1.5	28.6b	9.0b	8.9b	4.52e	0.09d	3.34d
50% Grade B + 50% JC	2.0	32.1b	9.2b	7.9b	4.27e	0.15c	3.48d
50% Grade B + 50% JC	2.5	39.3a	10.3a	11.1a	13.28a	0.32a	14.60a
60% Grade B + 40% JC	1.5	29.3b	9.0b	3.5cd	3.70 e	0.09d	3.46d
60% Grade B + 40% JC	2.0	25.9bc	8.8b	5.4c	3.81e	0.10	3.76d
60% Grade B + 40% JC	2.5	28.7b	9.0b	3.5cd	3.85e	0.09	3.35d
NPK	0.06 kgN	27.3b	8.9b	8.6b	9.28b	0.15c	4.22

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level

Legend:
Grade B – Un-amended compost
JC- Jatropha cake

For Nitrogen uptake, 2.5 t / ha 50% Grade B + 50% JC had the highest (13.28 mg N / pot) which was significantly ($p< 0.05$) different from other treatments. 60% Grade B + 40% had at 1.5, 2.0 and 2.5 t/ ha the least N uptake of 3.70, 3.81 and 3.85mg N / pot respectively excluding the control. In P uptake, 2.5 t / ha 50% Grade B + 50% JC had the highest values (0.32 mg P / pot). Control had the least P uptake of 0.03 mg P / pot. For the K uptake 2.5 t / ha 50% Grade B + 50% JC had the highest (14.60mg K/ pot) which is significantly ($p< 0.05$) different from other fertilizer treatments.

Discussion

Results of this study showed that plant height, number of leaves and dry matter of maize plant differed significantly ($p < 0.05$) among the different rates of fertilizers. This might have been enhanced by the difference in the rates of the compost supplemented with Jatropha cake. Application of 50% Grade B + 50% JC at 2.5 t/ha had significantly ($P <0.05$) higher maize dry matter yield compared to NPK in the second planting of maize. This is in agreement with the findings of Kihanda, (2003), Oghoghodo and Ilegar (1995) and Titiloye (1982) they affirmed that the quantity of organic residues added to the soil might influence the rate of decomposition, which in turn affect the dry matter yield. The uptake of N, P and K by the maize reveals that 50% Grade B + 50% JC at 2.5 t/ha performed better could be as a result of nutrient release pattern of the treatment during the first planting. Observations on some plant growth parameters in second planting showed that residual effects of maize were significantly different from other treatments. The low dry matter yield produced by the control during the second planting of the maize under the screen house conditions showed that the soil where no fertilizer was applied was low in essential nutrients. Therefore, nutrient availability especially N, P and K could affect the photosynthetic activities of the plant and subsequent storage of dry matter produced. The result of residual nutrient uptake effects on maize as a result of applied treatment showed that 50% Grade B + 50% JC at 2.5 t/ha performed better than NPK.

Conclusion

Based on the aforementioned findings, it can be deduced that jatropha cake supplemented with compost at 2.5 t/ha can serve as an alternative to mineral fertilizer.

Acknowledgements

This study was supported by a grant from Tertiary Education Trust Fund (TETFUND).

References

Dauda S.N., Aliyu, L. and Chiezey, UF (2005) Effects of variety, seedling age and poultry manure on growth and yield of garden egg (*Solanumgilo* L.). The Nigerian Academic Forum 9(1):88–95.

Kihanda, F.M. (2003). Effect of Manures Composted with high Quality Organic Residues on Dry Matter Accumulation, Nitrogen Uptake and Maize Grain Yield. E. Afr. Agric. For. J. 69 (1) 63-68.

Oghoghodo, I.A. and Ilegar, P.I. (1995).The use of cassava peels and ricehusks as soil amendments. *Nig. Agric. J.* 28: 96-100.

Ogundare, S. K., Afe, A. I., Kadiri, W. O. J and Etukudo, O. O. (2016).Effects of cow dung manure and single superphosphate on soil phosphorus availability, growth and yield of maize in a Gleysol of Kabba, Nigeria. Nigerian journal of Agriculture, Food and Environment. 12(3):12-15.

Ojo, J. A., Olowoake, A. A.and Obembe, A(2014). Efficacy of organomineral fertilizer and un-amended compost on the growth and yield of watermelon (Citrulluslanatus Thumb) in Ilorin Southern Guinea Savanna zone of Nigeria. Int. J. Recycling and Organic Waste Agriculture. DOI 10.1007/s40093-014-0073-z.

Okalebo, J. R., Gathua., K. W. and Woomer, P. L. (2002).*Laboratory methods of soil and plant analysis: A working manual* (2nd Ed) TSBFCIAT and SACRED Africa, Nairobi, Kenya.

Olowoake, A.A. and Adeoye, G.O. (2013).Influence of differently composted organic residues on the yield of maize and its residual effects on the fertility of an Alfisol in Ibadan, Nigeria. *International Journal of Agriculture, Environment and Biotechnology* 6(1): 79-84.

Olowoake, A.A., Ojo J.A. and Osunlola, O.S. (2015).Growth and yield of okra (*Abelmoschusesculentus* L.) as influenced by NPK, jatrophacake and organomineral fertilizer on an Alfisolin Ilorin, Southern Guinea Savanna of Nigeria. *Journal of Organic Systems*, 10(1): 3-8.

Titiloye, E. O. (1982). *The evaluation of various types of organic wastes as a source of nutrientfor the growth and yield of maize* (*Zea mays L.*) Ph.D. Thesis. University of Ibadan, Nigeria.

Towards Mapping Ecological Organic Agriculture (EOA) Research into use in Nigeria

Victor Olowe[1]*,
Olugbenga Adeoluwa[2],
Julius Orimoloye[2]
and Taofeeq Yekinni[2]

[1]Federal University of Agriculture Abeokuta (FUNAAB)

[2]University of Ibadan, Ibadan, Nigeria

Corresponding author:
owebaba@yahoo.com

Keywords:
Ecological organic agriculture, research, use, thematic area

Abstract

Africa as the second largest continent after Asia is still struggling to feed her teaming population (1.1 billion; 15 percent of world's total population). Organic agriculture has been identified globally as a potential strategy to solve food and related problems affecting Africans because it integrates sustainability, biodiversity and ecosystem services, while producing affordable, nutritious and safe food. Pillar 1 (Research, Training and Extension) of the Ecological Organic Agriculture (EOA) Initiative is poised to oversee the conduct of relevant demand driven, end user oriented and easily adoptable research projects on EOA that will transform the continent's agricultural output. Consequently, an activity was carried out in 2016 to document recent researches relevant to EOA in various disciplines, identify the gaps in EOA researches across disciplines and recommend appropriate areas for further research activities to bridge the knowledge gaps in EOA researches. The activity covered 2013, 2014 and 2015 with emphasis on Nigeria. A total of 203 research articles were reviewed across eleven thematic areas/disciplines: Agronomy (Soil science, crop production and management), plant health (plant pathology, nematology, virology, bacteriology etc.), genetics and breeding, molecular genetics, physiology, food quality, extension, socio-economics, policy issues, organic livestock and organic aquaculture. The spread of research efforts revealed as follows: Agronomy (131=65%), Plant health (43= 21%), Food quality (4=1.9%), Extension (10=4%), Socio-economics (3=1.4%), Policy issues (3=1.4%), Organic livestock (5=2.4%) and Organic aquaculture (4=1.9%). No articles were found on genetics and breeding, molecular genetics and physiology. The implication of this spread is discussed in the paper.

Introduction

One of the daunting challenges facing the human race globally amongst others is how to feed 9 – 11 billion people with safe and nutritious food in the next three to four decades. The continent of Africa is the second largest in the world after Asia and has about 1.1 billion (15 percent of the world's total population). Despite the huge endowment of natural and favorable growth resources, and agricultural potentials such as 25 percent of the world's arable land, yet the continent produces just 15 percent of the global agricultural output (Jayaram *et al.,* 2010). This undesirable situation is further compounded by the fact that Africa accounts for 239 million (25%) out of 850 million people suffering from hunger in the world. In fact, the sub-Saharan Africa (SSA) region remains food-insecure partly because about 75% of the land is degraded with less than 4% under irrigation. Mc Intire (2014) recently documented comprehensively the multi-faceted problems facing Africa's agriculture as follows: (i) raising agricultural productivity to accelerate the delayed shift of labour and national product into industry and services; (ii) slowing high population growth, which leads to greater land pressure and progressively blocks the traditional avenue of rural growth via land expansion; (iii) seizing the opportunity provided by economic growth in the service, industrial and natural resource sectors, which will expand demand and induce technical and land use changes, including both farm consolidation and farm fragmentation; (iv) addressing the chronic problems of food insecurity and malnutrition and their relation to the fiscal and management capacities of African states; (v) mitigating climate change, whose effects are projected to be especially adverse for Africa's agricultural potential; and (vi) developing public policies – investments and incentives – that reverse the historic discrimination against agriculture and stimulate it to reach its potential. In an attempt to overcome some if not all of the highlighted challenges, the African Heads of State unanimously took a decision (EX.CL/Dec. 621 (XVII) in 2011) to mainstream organic agriculture into the agricultural systems of all member states by the year 2020. This lead to the formation of a broad based initiative tagged "Ecological Organic Agriculture" in 2011. Since the pilot phase was carried out in 2012 in six African countries: Ethiopia, Kenya, Uganda, Tanzania, Nigeria and Zambia, it has extended to a total of eight countries now: eight (8) countries - four in Eastern Africa (Ethiopia, Kenya, Uganda, and Tanzania) and four in West Africa (Mali, Nigeria, Benin and Senegal). The EOA Initiative is hinged on six key priority areas (pillars) and Research Training and Extension is the first pillar aimed at coordinating conduct of research projects that will address the needs of EOA practitioners in the continent with a view to improving Africa's smallholder farms and thereby boost food security. Therefore, an activity was conducted in 2016 with an overall objective to document EOA research into use in Nigeria.

Methodology

A desk review of publications and reports related to EOA in the last previous years (2013 – 2015) was done in 2016 to update an earlier exercise carried out in 2013. The team sourced hard copies, accessed electronic copies and reviewed relevant journal articles published by Nigerian scientists in the last three years in local, national and international levels to bring out salient contributions to EOA. Proceedings of national and international conferences/workshops were also sourced and reviewed. Thereafter, the abstracts of relevant articles were complied and impact points of the researches highlighted. The activity focused on the following eleven thematic areas:

a. Agronomy (Soil science, crop production and management)
b. Plant health (plant pathology, nematology, virology, bacteriology etc.)
c. Genetic and Breeding
d. Molecular genetics
e. Physiology
f. Food quality
g. Extension
h. Socio-economics
i. Policy issues
j. Organic livestock
k. Organic aquaculture

A total of 203 articles were reviewed by the team from over forty local and international publications. Thereafter, a list of ten recommendations was compiled to enhance the impact of the initiative in the continent.

Findings

Globally, organic agriculture still remains a "niche' because it occupies just less than 1 percent of the total land area under cultivation. Despite being a niche, organic agriculture is now worth about 100 billion US$ as against 72 billion US$ in 2013 (Rahmann and Aksoy 2014). Unfortunately, Africa still accounts for just 3 percent of organic land (43.1 million hectares in 2013 and 50 million in 2017) and 29 percent of entire producers in the world (Willer and Lernoud 2018). A sustainable strategy to raise the bar is to introduce innovations through demand driven and end user oriented research to current practices of the stakeholders across the value chains.

After the reviewing the 203 articles the spread was as follows: Agronomy (131=65%), Plant health (43= 21%), Food quality (4=1.9%), Extension (10=4%), Socio-economics (3=1.4%), Policy issues (3=1.4%), Organic livestock (5=2.4%) and Organic aquaculture (4=1.9%). No articles were found on Genetics & Breeding, Molecular genetics and Physiology. Apparently, scientists that organic agriculture biased are yet emerge from the academia. The review revealed that majority of the research efforts on the use of organic soil amendments made use of poultry manure. Poultry manure has been identified as an excellent source of nutrients and its composition varies with the type of bird, the feed ration, the proportion of litter to droppings, the manure handling system, and the type of litter. However, the poultry droppings should be properly cured before their application to the crop on the field in order to prevent multiplication of disease pathogens (Leytem *et al.* 2013). Therefore, it is necessary to sample and analyse the manure for specific nutrient content and ascertain its safety before any application to the soil. Unfortunately, most the studies where poultry manure was used, did not specify the type of birds the manure came from neither did they do nutrient analysis of the manure. Majority just applied different rates of the manure to the test crops. This undesirable trend should be corrected by the practitioners. The key to successful soil fertility management using any soil amendment is to match the nutritional requirements of the crop with nutrients available in the manure. It was suggested that scientists should now be weary of working on poultry droppings and be advised to step up by working on other emerging commercial organic fertilizers in the country. The organic fertilizers contain relatively stable concentration of nutrients and should also be analyzed before application.

More botanicals are now being put into use to control pests on organic farms in Nigeria. This accounted for the forty three articles reviewed in this activity. Most of the research works involved the use of neem oil and extracts of traditional plants. The scientists should be encouraged to develop branded products using some of the emerging botanicals in the country. Attempts should also be made to adapt some of these emerging technologies to the local environment. When properly adapted to the local environment, it will be easier for the end users of these technologies (especially farmers) to uptake the technologies. As such, the extension personnel should be advised to step up their activities from simple advocacy programmes to technology dissemination to the end users. Most of the papers on Extension were based on advocacy and base line evaluation of awareness of organic agriculture and nothing on technology adoption rate. More efforts should also be geared towards doing more on socio-economic studies and policy issues. Regular information should be provided for the Government through the Organic Agriculture Division of the Department of Input Service Support, Federal Ministry of Agriculture and Rural Development (FMA&RD). There is also a dearth of information on organic livestock and aquaculture accounting for just 2.4 and 1.9 percent, respectively in this activity. More work should be done to address the wide gaps in knowledge of ecological organic agriculture practices in Nigeria.

The socio-economists should endeavor to do more research activities that can demonstrate the potential of organic agriculture in order to be able to convince the policy makers. They should also step up orgnaising massive advocacy programmes on the merit of organic agriculture over conventional. The vital role of the synergy between private and public sectors is yet to be properly documented in literature.

Conclusions and Recommendations

Arising from the review of the EOA research into use in the eleven thematic areas, the following recommendations were made:

1. More research efforts to be geared towards developing and evaluating branded organic fertilizers.
2. Scientists should be weary of using poultry manure as soil amendment without mentioning the bird and litter type where the manure is from.
3. Scientists should be compelled to state the nutrient content of any organic soil amendment to be used in any study.
4. More concerted research efforts should be geared towards developing resilient varieties for the staple food crops (cassava, maize, sorghum, rice, millet, yam etc) that are suitable for organic production systems.
5. Scientists in the areas of Genetics & Plant breeding, Molecular genetics and Crop Physiology should be encouraged to carry out research activities that can boost food production without breaking the rules and the four cardinal principles of organic agriculture (Care, Ecology, Fairness and Health), knowing that GMOs are not allowed in organic agriculture.
6. Livestock breeders should also be encouraged to develop breeds of livestock that can perform well under organic production systems.
7. Organic feeds for livestock and aquaculture should be developed for prospective stakeholders.
8. Simple training manuals for use by extension personnel must also be developed by subject matter specialists.
9. Position papers that demonstrate success stories on organic farming should be developed for the policy makers in order to assist them in articulating policies that will support organic farming in the country
10. The organic bill being prepared should be adequately followed up to a logical conclusion.

Acknowledgements

The authors hereby acknowledge the financial support for this activity by the Swiss Agency for Development and Cooperation (SDC) through Bio-vision Africa Thrust and through Association for Organic Agriculture Practitioners of Nigeria (NOAN).

References

Jayaram, K., Riese, J. and Sanghvi, S. (2010). Agriculture: Abundant Opportunities. *McKinsey Quarterly*. Summer 2010.

Leytem W.F, Dungam R.S and KLienman, J.J.A. (2013). Sustainable manure management. In: Kebreab E (ed.) Sustainable animal agriculture. CABI Publishing, Boston, pp 83-113.

McIntire, J. C. (2014). Transforming african agriculture. *Glob. J. Emerg. Markets Econ.* 6:145–79.

Rahmann, G and Aksoy, U. (2014). Forward of Proceedings of the 4th ISOFAR Scientific Conference at the Organic World Congress held on 13 – 15 October, 2014 in Istanbul, Turkey.

Willer H and Lernoud J. (2018). *The World of Organic Agriculture. Statistics and Emerging Trends 2017*. FiBL-IFOAM Report. Research Institute of Organic Agriculture (FiBL), Frick and IFOAM-Organics International.

Growth Response, Herbage Yield and Proximate Contents of Peppermint (*Mentha piperita*) as Influenced by Organic Fertilizer Types

Joseph-Adekunle, T.T.
and A.S. Adelola

Department of Horticulture, College of Plant Science and Crop Production, Federal University of Agriculture, Abeokuta, Nigeria

Corresponding author:
oyinlolo@gmail.com

Keywords:
essential oil, growth, Nigeria, organic, peppermint, proximate content

Abstract

Meeting nutrients requirement is one of the important agronomic conditions for successful introduction of new crops because it has a great influence on growth, the quality and quantity of secondary metabolites which directly or otherwise affect our health. A field experiment was conducted in 2016 at Federal University of Agriculture, Abeokuta (Latitude 7º 14ˡ 8.034 NS, Longitude 3º 26ˡ 13.914 EW and altitude 131 masl), Ogun, State Nigeria to assess the effects of two organic fertilizers on performance of peppermint under tropical condition. The treatments were Gateway organic fertilizer (GOF) and Sunshine organic fertilizer (SOF) at the rates of 0 and 6.5t/ha each pre applied two weeks on 2m x 2m beds, laid out in a Randomized Complete Block Desig or 10 days. The effects of the two organic fertilizers on the number of leaves, vine length and proximate contents of Mentha piperita were not significantly different. However n (RCBD) with four replicates. Mint cuttings of 10 cm length were planted and watered twice daily f moisture content was higher with application of 6.5t/ha SOF compared to control and GOF at 6.5t/ha. Application of SOF and GOF at 6.5t/ha produced similar dry matter content which were not significantly different though GOF had higher value. The treatments had significant effect on fat, ash, crude fiber, crude protein, carbohydrate, vitamin C, and alkaloid and glycoside contents. Application of organic fertilizer resulted in superior performance of pepper mint compared to control, Therefore either Gateway or Sunshine organic fertilizer can be considered as the optimum herbage yield and quality of peppermint.

Introduction

Preliminary work on peppermint as a new crop in Nigeria showed a great potential for its adaptability and cultivation under tropical condition due to climate (Joseph-Adekunle and Daramola, 2014). The leaves of peppermint are picked or harvested used extensively either fresh or dried as spice in culinary to add distinctive aroma and flavor to food or as medicinal herbs. The leaves have a pleasant warm, fresh, aromatic, sweet flavour with a cool aftertaste. Mint leaves are used in tea, beverages, jellies, syrups, candies, and ice creams (Budavari *et al.* 1989). The foliar essential oils are important in beverage, cosmetics and allied industries (Aflatuni, 2005).

Organic farming offers safe and healthy food important for human health and offer environmental protection, and its adoption cuts across temperate and tropical areas of the world (Altieri, 1987). There is increasing consumer awareness on *nutraceutical* potentials of plants food bio-safety and increased income in organic production which has led to increased global demand for organically grown herbs. spices and vegetables (Lampkin, 1990). Use of organic fertilizer exerts positive effects on crop growth, soils and absorption of water and steady release nutrients for vegetable crops growth (Aruleba and Fasina, 2004). Adopted cultivation techniques could have a great influence on growth and quantity of secondary metabolites in organic produce. The study aimed to evaluate the effect of organic fertilizers on the growth response and quality of Peppermint.

Materials and Methods

Twelve beds of 2 m x 2m were manually prepared with 0.5 m alley between them. Gateway organic fertilizer® (GOF) and Sunshine organic fertilizer® (SOF) were pre applied two weeks before planting at the rates of 0 and 6.5t/ha each (0 and 2 kg/.bed) and laid out in a Randomized Complete Block Design (RCBD) with four replicates. Mint vines were cut into 10 cm length and the leaves removed and planted spacing of 50 cm x 100 cm and watered twice daily for 10 days. Data collection commenced 14 days after planting and continued weekly for 14 weeks on vegetative growth parameters - number of leaves and vine length. Herbage yield was determined by harvestings the vines by cutting the vines at 5 cm above soil level at 10, 14 and 18 WAP. The fresh harvested herbage was weighed and then oven-dried at 60°C for 48 hour determine dry weight at 18 WAP. Foliar Proximate contentment was determined as described by AOAC 1990 in the laboratory. Oil extraction was by hydro-distillation of 100 g of leaves oven dried leaves. The oil was extracted for 8 hours using a Soxlet apparatus and solvent-petroleum ether following the procedure of Guenther, (1972). Data were subjected to analysis of variance (ANOVA) using GENSTAT discovery package and means were separated using Least significant difference (LSD) at 5% probability level.

Results and Discussion

At 4 and 5 WAP cuttings treated with SOF at 6.5t/ha produced higher number of leaves, however at 8 WAP GOF had significantly highest number of leaves compared to SOF and the control treatment. Similar trend was observed for the vine length within the period of observation. Peppermint had superior fresh and dry herbage yield with the application of GOF while SOF did not differ from control treatment

Table 1. **Effects of Organic Fertilizer types on Number of leaves and vine length of Peppermint Weeks after planting in 2016 at Abeokuta, Nigeria**

	Weeks after planting									
	4	5	6	7	8	4	5	6	7	8
Treatment	Number of Leaves/plant					Vine length (cm)/plant				
Control	107	158	209	282	312	6.25	7	6.68	7.1	7.25
GOF	106	160	244	366	485	4.62	4.43	6.2	6.67	7.3
SOF	162	174	218	242	233	5.62	6.5	6.38	7.12	8.18
se±	33.1	43.7	86.7	133	175.8	0.923	0.893	1.011	1.178	1.51

Table 2. **Effects of organic fertilizer types on Fresh and Dry Herbage Yield of Peppermint Weeks after planting in 2016 at Abeokuta, Nigeria**

	Weeks after planting					
	10	14	18	10	14	18
Treatment	Fresh Weight (g/plant)			Dry Weight (g/plant)		
Control	26	60	22	7	10.1	5.8
Gateway Organic Fertilizer®	176	170	132	58	30.6	44.7
Sunshine Organic Fertilizer®	31	78	35	9	13.4	8.8
LSD (0.05)	141.4	109.6	85.8	Ns	17.32	ns
se±	40.9	22.4	31.7	7.08	24.8	11.84

Applications of the organic fertilizers were not significant on the Carbohydrate, crude fibre, Glycosides and vitamin C contents. The Alkaloid content was significantly higher in control treatment compared to GOF and SOF which had similar values. The ash, protein, dry matter and moisture contents were significantly affected by the treatments. The positive response of Peppermint to the organic fertilizers is in line with assertion of Murray *et al*. 1988 that a high quality of peppermint oil in any region requires the optimum use of fertilizer and water to maintain herbage growth while delaying maturity as long as possible so that the herbage may be harvested with a minimum of flowers (Tables 1-3).

Table 3. **Proximate contents of Peppermint Leaves as influence by Organic fertilizer types 18 WAP in 2016 at Abeokuta, Nigeria**

	Proximate Contents									
Treatment	Alkaloids	Ash	CHO	Crude Fibre	Crude Protein	DM	Fat	Glyco	Vit C	MC %
Control	2.40	8.65	47.57	12.89	14.24	86.41	3.15	0.77	118	13.51
GOF	2.30	8.98	47.29	13.48	16.23	90.43	4.57	0.82	107	9.54
SOF	2.35	9.66	46.19	14.69	18.15	93.26	4.39	0.797	114.3	6.74
LSD (0.05)	0.075	0.77	Ns	ns	1.042	1.02	0.82	ns	ns	0.957

GOF= Gateway Organic Fertilizer, SOF= Sunshine Organic Fertilizer, CHO = Carbohydrate, Glyco = Glycoside, MC = Moisture Content, DM =Dry matter

Conclusion

Incorporation of the two organic fertilizers both had beneficial effects on growth of Peppermint, herbage yield, dry matter yield and foliar proximate contents. The Alkaloids content decreased with the organic addition which is a good indication of food safety.

References

Aflatuni, A. (2005). The yield and Essential oil Content of Mint (Mentha spp.) in Northern Ostrobothaia, Ph. D. thesis, Faculty of Science University of Oulu.

Altieri, M.A.(1987) Agro-ecology: The scientific basis of Alternate Agriculture. Westview press. (Boulders), CO, USA. pp. 179.

Aruleba, J.O. and A.S. Fasina (2004). Degradation and vegetable production in South Western Nigeria. Proc.of the 22nd Annual conference of HORTSON, Kano. Pp. 134 – 137, 2004.

Budavari, S, O'Neil, M.J, Smith A. and P.E. Heckelman (1989). The Merck Index. An Encyclopedia of Chemicals, Drug, and Biologicals. (11th edition). Merck & Co., Rahway.

Guenther, E (1972). The essential oils: History-Origin in Plants Production- Analysis (Vol. 1), Robert E. Kriger Publishing CO. Malabar, Florida, pp. 427.

Joseph-Adekunle, T.T. and O.S. Daramola, (2014). Influence of organic amendments on growth and yield of peppermint under tropical condition. *Journal of Organic Agriculture and Environment* Vol. 2 pp 48-53.

Lampkin N.H. Organic Farming. Farming Press Books, Wharfedale Rd., Ipswich IPI 4CG, U.K., 1990.

Olubode, O.O., Aiyelaagbe, I.O.O., Olasantan, F.O. and , J.G. Bodunde (2005). Growth and yield response of papaya to intercropping with vegetable crops in an organic farming system. Proc. of the 1st Annual organic agriculture conference held on the 25-28th Oct. 2005 at University of Agriculture, Abeokuta.

Murray, M. J, Marble, P., Lincoln, D. and F. W. Hefendehl (1988). Peppermint oil quality differences and the reasons for them. Flavors and Fragrances: Proceeding of the 10th International Congress of Essential oils, Fragrances and Flavors, Washington, DC, U. S.A., 16-20 November 1986, p 189–208. Myers RJK.

Growth and Yield of Soybean (*Glycine Max* (L.) Merrill) as Influenced by Organic and Inorganic Fertilizers

H. M. Isa and H. E. Bashir

Department of Agronomy,
Bayero University Kano

Corresponding author:
hmisa.agr@buk.edu.ng

Keywords:
Poultry manure, NPK,
Soybean varieties and growth

Abstract

A pot experiment was conducted in the Screen House of the Department of Agronomy, Faculty of Agriculture, Bayero University, Kano to determine the effects of organic and inorganic fertilizers on the growth and yield of Soybean (Glycine max (L.) Merrill*). The treatments consisted of factorial combinations of three Soybean varieties (TGx 1835-10E, TGx 1987-62F, and TGx 1740-2F) and five levels of fertilizers (control, 244.44 kg ha^{-1} NPK, 10 t ha^{-1} poultry manure, 5 t ha^{-1} poultry manure + 244.44kg ha^{-1} NPK, and 2.5t ha^{-1} poultry manure + 355.55kg ha^{-1} NPK). This was laid out in a Completely Randomized Design (CRD) replicated three times. Vegetative traits were taken at 5, 7 and 9 weeks after sowing and yield attributes were measured at maturity stage. Variety effect was significant on plant height, number of branches plant^{-1}, leaf area, number of pods plant^{-1}, weight of grains plant^{-1} and 100 seed weight. Variety TGx 1835-10E proved superior to TGx 1987-62F and TGx 1740-2F. Combination of 2.5 t ha^{-1} + 355.55 kg ha^{-1} NPK resulted in the tallest plant, highest number of branches plant^{-1}, widest leaf area and higher number of pods plant^{-1}. Applying 5 t ha^{-1} poultry manure + 244.44 kg ha^{-1} of NPK to TGX1740-2E recorded heavier seed weight than other treatment combinations. Variety TGX1835-10E out yielded other varieties tested while combination of 2.5 t ha^{-1} of poultry manure and 355.5 kg ha^{-1} of NPK proved to be superior to other rates and combinations of fertilizers.*

Introduction

Soybean (*Glycine max* (L.) Merr) is a legume that grows in tropical, subtropical, and temperate climates. Nigeria is the largest producer of Soybean in sub-Saharan Africa (SSA), followed by South Africa. Low yields (<1 tha^{-1} in tropical Africa) and a shortage of fertilizer constrain the ability of some countries to increase production (IITA, 2008). The crop has been described as the world's chief source of edible vegetable oil and high protein feed for livestock which compares favourably with animal protein source containing all the essential amino acid required by man (Manral and Saxena, 2003). Organic matter acts directly as a source of plant nutrients and indirectly influences the physical and chemical properties of the soil.Poultry manure is very cheap and effective as a good source for Nigerian sustainable crop production, but it's availability remains an important issue due to its bulky nature while inorganic fertilizer is no longer within the reach of resources of poor farmers due to its high cost (Rahman, 2000).

Among the means available to achieve sustainability in agricultural production, organic manure and bio fertilizer play an important and key role on the desired soil properties and exerts a beneficial effect on all soil characteristics (Soleimanzadeh and Ghooshchi, 2013). One of the ways of increasing nutrients status is by boosting the soil nutrient content either with the use of organic materials such as poultry manure, other animals waste and the use of compost with or without inorganic fertilizers (Dauda *etal*., 2008).Therefore, this experiment aimed at determining the influence of Organic and Inorganic fertilizers on the Growth and Yield of Soybean.

Materials and Methods

A pot experiment was conducted in the Screen House of the Department of Agronomy, Faculty of Agriculture Bayero University Kano (11058[1]N, 8025[1]E and 475m above sea level). The treatments evaluated were three Soybean varieties (TGX 1835-10E, TGX 1987-62F and TGX 1740-2E) and five levels of fertilizers (control, 244.44 kg ha^{-1} NPK, 10 t ha^{-1} poultry manure, 5 t ha^{-1} poultry manure + 244.44 kg ha^{-1} NPK, and 2.5t ha^{-1} poultry manure + 355.55 kg ha^{-1} NPK). These were factorially combined and laid in a Completely Randomized Design (CRD**)** with three replications. Forty-five perforated pots were filled with top soil with each pot weighing 14kg. The organic fertilizer was applied one week before sowing, and the in-organic fertilizer was applied two weeks after sowing. Data collected included plant height, number of branches $plant^{-1}$, leaf area, number of pods $plant^{-1}$, weight of grains $plant^{-1}$ and 100-seed weight. The data collected were subjected to Analysis of Variance (ANOVA) using Statistical Analysis System (SAS), and the significant treatment means were separated using Student-Newman-Keuls (SNK) method.

Results

Table 1 shows the soil analysis of the experimental site. The result indicated that the soil was sandy loam with 0.03 % nitrogen, 5.11 ppm available phosphorus, 1.40 organic carbon and a pH of 7.78.

Table 2 shows the growth components of Soybean (*Glycine max* (L.) Merr.) varieties in response to different levels of fertilizer in 2014 dry season at Bayero University, Kano. TGX 1740-2E produced significantly taller plants than the other varieties. TGX 1835-10E produced plants with significantly highest number of branches $plant^{-1}$ and greater leaf area than TGX 1987-62F and TGX 1740-2E at all the sampling periods. Application of fertilizers significantly influenced these characters. A combination of 2.5 tha^{-1} PM + 355.55 kg ha^{-1} NPK produced significantly the tallest plants, highest number of branches $plant^{-1}$ and greatest leaf area.

Table 1. **Physico – Chemical Properties of Soil of the Experimental Site**

Soil variable	**Composition**
Particle size distribution (%)	
Sand	67
Silt	17
Clay	16
Textural class	Sandy loam
Chemical properties	
pH (water)	7.78
pH ($CaCl_2$)	6.93
Organic Carbon (%)	1.40
Total Nitrogen (%)	0.03
Available Phosphorus (ppm)	5.11
Exchangeable bases	
Potassium (Cmol/kg)	0.27
Sodium (Cmol/kg)	0.18
Calcium (Cmol/kg)	1.30
Magnesium (Cmol/kg)	1.37

Table 2. **Effect of Variety and Fertilizer Rate on Plant Height, Number of Branches Plant^{-1} and Leaf of Soybean at 5, 7 and 9 Weeks after Sowing**

Treatment	Plant height Weeks after Sowing			Branches plant^{-1} Weeks after Sowing			Leaf area Weeks after Sowing		
	5	7	9	5	7	9	5	7	9
Variety (V)									
TGX 1835-10E	32.85	48.39	57.23b	3.26	5.03a	5.70a	60.26a	64.70a	79.07a
TGX 1987-62F	32.27	48.05	66.76a	2.80	4.13b	4.90b	45.33b	63.11a	75.06a
TGX 1740-2E	31.91	50.39	67.08a	3.00	3.97b	4.62b	42.96b	51.65b	57.29b
SE ±	1.352	1.637	1.840	0.147	0.227	0.246	3.641	3.695	3.116
Fertilizer (F)									
Control	21.25c	37.89b	55.27b	3.26	5.03a	5.70a	35.26c	49.86b	65.60
244.44 kg ha^{-1} NPK	31.76b	53.62a	67.55a	2.80	4.13b	4.90b	48.19abc	50.63b	67.40
10tha^{-1} Poultry manure	24.86c	39.04b	55.67b	3.00	3.97b	4.62b	45.21bc	56.39b	66.50
5tha^{-1} PM + 244.44 kg ha^{-1} NPK	42.63a	56.62a	69.13a	1.47	2.27b	2.46b	54.89ab	62.93b	71.68
2.5tha^{-1} PM + 355.55kg ha^{-1} NPK	41.20a	57.55a	70.83a	3.26	5.03a	5.70a	64.03a	79.30a	81.20
SE±	1.745	2.114	2.375	2.800	4.130	4.900	4.700	4.770	4.023
Interaction									
V × F	*	NS	*	NS	NS	NS	NS	**	NS

Means with the same letter (s) are not significantly different at 5% level of probability using Student-Newman-Keuls Test (SNK).
* = Significant at 5%
** = Highly significant at 1%

Table 3. **Chemical Properties/Composition of Poultry Manure (PM)**

Nutrients	**Composition**
pH (water)	8.50
pH (CaCl2)	8.17
Organic carbon (%)	85.79
Total Nitrogen (%)	0.08
Total Phosphorus (ppm)	20.89
Potassium (mg/kg)	250
Magnesium (mg/kg)	250
Calcium (mg/kg)	450
Sodium (mg/kg)	250

Table 3 shows the nutrient composition of the poultry manure. The result indicated 6.08 % nitrogen, 20.89 ppm available phosphorus, 85.79 organic carbon and a pH of 8.50.

Table 4 shows the yield components of Soybean (*Glycine max* (L.) Merr.) varieties in response to different levels of fertilizers. TGX 1987-62F had plants with significantly highest number of pods plant^{-1}. However, TGX 1835-10E had plants with the heaviest grain weight and 100 - seed weight. Combination of 2.5 tha^{-1} PM + 355.55kg ha^{-1} had plants with the highest number of pods plant^{-1}.

Table 5 shows the interaction between variety and fertilizer rates on leaf area of Soybean. Significant interaction was observed only with variety TGX 1835 – 10E where application of a combination of 2.5 t ha^{-1} + 355.55 kg ha^{-1}NPKhad plants with significantly wider leaf area while control had plants with narrow leaf area.

Table 4. **Effect of Variety and Fertilizer rate on Number of Pods Plant^{-1}, Grain Weight Plant^{-1} and 100 Seed Weight of Soybean**

Treatment	Number of Pods Plant^{-1}	Grain Weight Plant^{-1} (g)	100- Seed weight (g)
Variety (V)			
TGX 1835-10E	17.83b	4.06a	8.53a
TGX 1987-62F	21.76a	1.87b	6.88b
TGX 1740-2E	19.61ab	3.46a	9.07a
SE ±	0.776	0.333	0.290
Fertilizer (F)			
Control	16.28c	3.08	7.62
244.44 kg ha^{-1} NPK	19.58bc	2.62	8.21
10tha^{-1} Poultry manure	17.14c	2.77	7.75
5tha^{-1} PM + 244.44 kg ha^{-1} NPK	20.98b	4.08	8.42
2.5tha^{-1} PM + 355.55 kg ha^{-1} NPK	24.69a	3.09	8.80
SE±	1.001	0.430	0.375
Interaction			
V × F	NS	NS	**

Means with the same letter (s) are not significantly different at 5% level of probability using Student-Newman-Keuls Test (SNK).
** = Highly significant at 1%
NS = Not significant

Table 5. **Interaction between Variety and Fertilizer on Leaf Area (cm^2) at 7 WAS**

Variety Fertilizer	TGX1835 10E	TGX1987 62F	TGX1740 2E
Control	29.81c	45.62bc	28.98c
244.44 kg ha^{-1} NPK	74.97ab	55.72abc	66.36abc
10tha^{-1}Poultry manure	59.49abc	59.96abc	49.71bc
5tha^{-1} PM + 244.44 kg ha^{-1} NPK	64.61abc	70.83abc	53.35bc
2.5tha^{-1} PM+355.55kg ha^{-1} NPK	94.63a	83.40ab	59.86abc
SE±	8.262		

Means within and across column followed by the same letter (s) are not significantly different at 5% level of probability using Student-Newman-Keuls Test

Discussion

Application of 2.5 tha^{-1} PM + 355.5kg ha^{-1}NPK increased both growth and yield characters of Soybean measured. The taller plants recorded could be attributed to internodes elongation which led to increased number of branches plant^{-1} while the wider leaf area could be due to higher photosynthetic efficiency as leaf area is a medium of photosynthesis which translate to more assimilate production. The increased yield components could be due to the fact that increase in the fertility status of the soil and poultry manure led to vegetative growth of the crop which might translate into yield components such as high number of pods with heavier grain weight and 100 - seed weight. This result supported a well-known fact that poultry manure have been known to increase the abundance of soil organisms by providing organic matter and micro-nutrients such as fungal mycorrhiza (Pimentel *et al*., 2005) which aids plants in absorbing nutrients and can drastically reduce external inputs of pesticides and fertilizer. TGX 1987-62F variety gave the highest number of pods plant^{-1} than TGX 1835-10E TGX 1740-2E which might be probably due to better utilization of the nutrients applied. This supports the findings of Falodun *et al.* (2010) who reported that moderate rates of NPK fertilizer with low levels of organic manure improve yield and yield components of soybean. However, TGX 1835-10E had seeds with the heaviest grain weight and 100-seed weight. This could be due to the fact that this variety usually resist pod shattering and other prevalent diseases (Adeyeye, 2009).The significant interaction between variety and fertilizer rate on leaf area of Soybean recorded by TGX 1835 – 10E means that the variety is nutrient dependant and had respond favourably to fertilizer application which led to efficient utilization of poultry manure in combination with NPK that led to higher photosynthetic efficiency since the leaves are medium of photosynthesis. However variety TGX 1740 - 2E and TGX 1987 - 62F had non-significant response which means that being leguminous crops, they can fix atmospheric nitrogen with the aid of root bacteria and for this reason, these varieties are not dependent on nitrogen fertilization. In conclusion, variety TGX1835-10E out yielded other varieties tested while combination of 2.5 t ha^{-1}of poultry manure and 355.55 kg ha^{-1} of NPK proved to be superior to other rates and combinations of fertilizers.

References

Adeyeye, A.S. (2009). Pod shattering attributes and response of soybean (Glycine max (L.) merr) to compost, Nitrogen fertilizer and rhizobium inoculation. Ph.D. Thesis in the Dept. of crop protection and environmental Biology, University of Ibadan. Nigeria.

Dauda, S.N., Ajayi, F.A. and Ndor, E. (2008). Growth and yield of water melon (*Citrullusslanatus*) as affected by poultry manure application. *Journal of Agriculture and social science,* 121-124.

Falodun, E.J., Osaigbovo, A.U. and Remison, S.U. (2010). "The effect of packaged organic and inorganic fertilizer on the growth and yield of soya bean (Glycine max), *African Journal of General Agriculture,* vol. 6, No. 3.

IITA (2008). Thirty years R4D in soybean: what's next? *r4dreview.org/tag/soybean/ (accessed 14/07/2010).*

Manral, H.S, and Saxena, S.C. (2003). Plant growth, yield Attributes and grain application of inorganic and organic sources of nutrients. ENvis Bulletin, 8 no 1, PP 1- 4.

Pimentel, D., P. Hepperly, J. Hanson, D. Douds and R. Seidel (2005). Environmental, energetic and economic comparisons of organic and conventional farming systems. *Bioscience* 55: 573-582.

Rahman, S.A. (2000). The place of organic manure in Sustaining Agricultural Development in Nigeria. Paper presented at Science Technology and Society National Workshop in Lafia, Nasarawa state, 11th July, 2004.

Soleimanzadeh, H. and Ghooshchi, F. (2013). Response to growth and yield of maize to biofertilizer in organic and conventional cropping systems. *Intl. J. Agric. Crop Sci.* 5 (7): 797-801.

Evaluation of Environmental Impacts of Organic Farming by LCA Method – Greenhouse Gases from Corn Production

J. Moudrýjr.[1], J. Bernas[1], J. Moudrý[1], P. Konvalina[1], and M. Kopecký[1]

[1]University of South Bohemia in ČeskéBudějovice, Branišovská 31a, ČeskéBudějovice, Czech Republic

Corresponding author: jmoudry@zf.jcu.cz

Keywords:
LCA, green house gases emissions, corn, organic farming

Abstract

Organic farming is perceived as a system with a number of positive impacts on all components of the environment. For more precise assessment of differences in environmental impacts of conventional and organic farming, we need to be able to measure and quantify such impacts. For this the LCA (Life Cycle Assessment) method maybe used as a tool. Among other, the LCA method is also an invaluable tool for assessing GHG emissions related to agricultural production. In this paper, the use of LCA for evaluation of GHG emissions from Zea Mays L. growing is presented. The emission load was calculated by the simplified method LCA, impact category: climate change. The calculation was performed by SIMA Pro software with integrated ReCiPe Midpoint (H) method. The functional unit of the system was represented by 1 kg of corn grain. The model life cycle includes the farm phase (field emissions, seed and planting, fertilizers, plant protection products, agrotechnical operations), calculation of field emissions is also included. The results based e.g. on the yields in Cameroon show clear differences between conventional and organic growing of corn. The GHG emissions expressed in $CO_{2e}$are after calculation on production unit 38.57 % lower in organic farming, compared to conventional farming.

Introduction

Organic farming is perceived as a system with a number of positive impacts. Environmental friendliness is often considered as one of its most significant features (Robertson *et al.* 2000, Pretty *et al.* 2002). This positive impact is usually mentioned in connection with all components of the environment, i.e. soil, which in general has higher organic matter content in organic farming (Mondelaers *et al.* 2009; Fliessbach *et al.* 2007; Mäder *et al.* 2002), biodiversity and agrobiodiversity (Demo *et al.* 2004; Šarapatka *et al.* 2008; Hole *et al.* 2005), water (Lies *et al.* 2001; Haas *et al.* 2002; Niggli *et al.*2011) and, last but not least, climate. For example, American research comparing impacts of organic and conventional farming on a long-term basis, Rodale Institute's Farming Systems Trial, confirms that by introducing organic farming across the USA, the increased carbon sequestration in soil would reduce CO_2 emissions by up to a quarter (LaSalle and Hepperly 2008). Brandt and Svendsen (2011) also point out that organic farming has greater potential to reduce GHG emissions compared to conventional farming systems, with the greatest difference being due to the absence of synthetic fertilizers. Küstermann and Hülsbergen (2008) also came to similar conclusions, saying that organic farming systems generally generate lower amount of N_2O and CO_2 emissions due to lower inputs. This is consistent with the findings previously made by Haas *et al.* (1995).

The impact of the environmental system on mitigation is usually quantified per unit of area, but it is important, from the point of view of objectivity, to recalculate it also to the unit of production. GHG emissions are typically lower in environmental systems, both per unit of area and per unit of production. However, the environmental saving per unit of area is roughly double compared to calculation per unit of production due to lower organic farming yields (Nemecek *et al.* 2005). Thus, the disadvantage of organic farming is lower production per unit of area, increasing the unit load of production by emissions. Average yields in Europe, for example, of organic wheat reach 80 % compared to conventional production (Lackner, 2008). Also Mondelaers *et al.* (2009) report that organic farm yields are on average by 17 % lower than in the conventional farming system. Pimentel *et al.* (2005), on the other hand, state that even with some high-production plants, such as corn, organic farming systems can reach yields comparable to conventional systems. Thus, the yield level plays a key role also in assessing the emission load of organic farming and its comparison with the loads arising from conventional farming systems.

In order to be able to verify the argumentation on lower climate load, or lower GHG emissions by organic farming, it is necessary to evaluate and measure agricultural processes in different conditions and areas. To measure GHG emissions, the Life Cycle Assessment (LCA) method also seems to be one of the suitable methods. It is a tool for evaluating the environmental impacts of the product life cycle based on the assessment of the influence of material and energy flows that the monitored system exchanges with its surroundings (Kočí 2009). Social or economic aspects can be included in its framework, but the main focus is on the environmental component. The LCA method is also an invaluable tool for assessing GHG emissions related to product formation (Finnveden *et al.* 2009). Stern *et al.* (2005) and Brentrup *et al.* (2004) also consider the LCA a suitable tool for evaluating the environmental impacts of agricultural production. This is consistent with the findings of Jensen et al. (2005), who note that over the past decades, the LCA has been supplemented by methods and databases that enable it to be used also in the assessment of impacts within the agricultural sector.

Within the crop production, it is appropriate to assess first the cultivation of crops that are significant in terms of the extent of the areas on which they are grown. These include corn (*Zea Mays L.*), which is one of the world's most widely grown crops, and together with wheat, rice and soya covers about 70 % of caloric consumption of mankind (Šarapatka *et al.* 2008). In many countries of the world, it is one of the most cultivated crops, as one of most important in Cameroon is mentioned by Molua and Lambi (2007) or Matthews *et al.* (2003) and it is the most cultivated one also in many European countries or in the USA. The right choice of the system of its cultivation can thus have a significant impact also in terms of mitigating GHG emissions.

Materials and Methods

A simplified Life Cycle Assessment (LCA) method, defined by international standards ČSN EN ISO 14 040 (CNI 2006a) and ČSN EN ISO 14 044 (CNI 2006b), has been used as a tool for calculating the emission load rate. The results of the study were related to *Climate change* impact category, expressed by carbon dioxide equivalent indicator (CO_{2eq} = 1x CO_2 or 23x CH_4 or 298x N_2O). The calculation was performed by SIMA Pro software with integrated ReCiPe Midpoint (H) method. The functional unit of the system was represented by 1 kg of the final product, i.e. 1 kg of corn grain. Technological procedure of corn cultivation was based on data from specialized literature and the Ecoinvent database. The database was partially adjusted in accordance with the conditions of the evaluated region.

The model life cycle includes the farm phase (field emissions, seed and planting, fertilizers, plant protection products, agrotechnical operations). Infrastructure loads (agricultural buildings, machinery, manufacturing infrastructure, means of transport) were not included in the life cycle and data were not evaluated. In addition to emissions from inputs in the form of fertilizers, the so-called field emissions (N_2O emissions) released after the application of nitrogen fertilizers are produced. The IPCC (*Intergovernmental Panel on Climate Change*) methodology serves for their quantification (De Klein *et al.* 2006).

Results and Discussion

The impacts of corn cultivation in conventional and organic farming systems show different impacts in terms of GHG emissions. In terms of the LCA method, emissions are divided into five subcategories (agrotechnical operations, fertilization, seed, pesticides, and field emissions), with conventional farming showing higher load in the majority of them even after recalculation per unit of production.

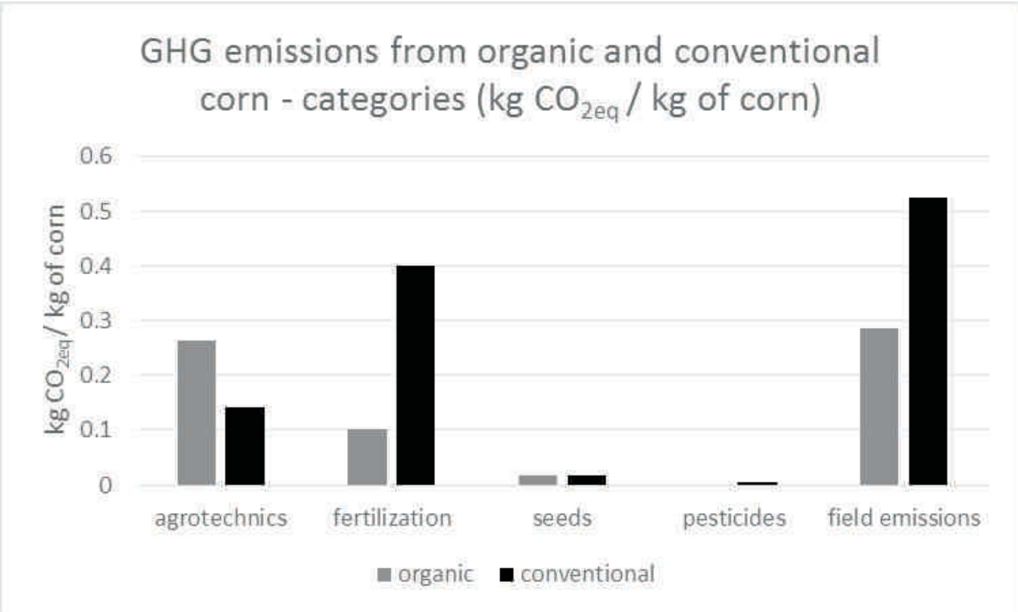


Figure 1. **Greenhouse gases emissions from organic and conventional corn – categories (kg CO_{2eq} / kg of corn)**

As can be seen from the Chart no. 1, only in the agrotechnical operation category, the load of organic farming is higher in relation to conventional farming (0.265 kg of CO_{2eq} / kg of corn in the organic farming system and 0.141 kg of CO_{2eq} / kg of corn in the conventional farming system). This is due to greater need for interventions in the treatment of corn without the use of pesticides and, at the same time, due to lower corn yield in the organic farming system. The category of seed has a relatively negligible impact from the point of view of GHG emissions (0.017 kg of CO_{2eq} / kg of corn in the organic farming system and 0.018 kg of CO_{2eq} / kg of corn in the conventional farming system) and also pesticides that are used only in the conventional farming system (0.005 kg of CO_{2eq} / kg of corn). However, pesticide application has a great environmental impact in other impact categories. From the point of view of GHG emissions, the main difference between conventional and organic farming system originates in particular in the fertilization phase (0.101 kg of CO_{2eq} / kg of corn in the organic farming system and 0.400 kg of CO_{2eq} / kg of corn in the conventional farming system) and in the subsequent phase of field emissions (0.286 kg of CO_{2eq} / kg of corn in the organic farming system and 0.525 kg of CO_{2eq} / kg of corn in the conventional farming system). This difference is caused mainly by the use of synthetic fertilizers in the conventional farming system. This is consistent with the findings of, for example, Tokuda and Hayatsu (2004), Mori *et al.* (2005) and Zou *et al.* (2005), who claim that with the increasing use of chemical fertilizers and manure, the proportion of N_2O released from the soil is usually also increasing.

Higher load. The increase of the emission load due to the use of synthetic fertilizers is then also stated by Fott *et al.* (2003), or Biswas *et al.* (2008).

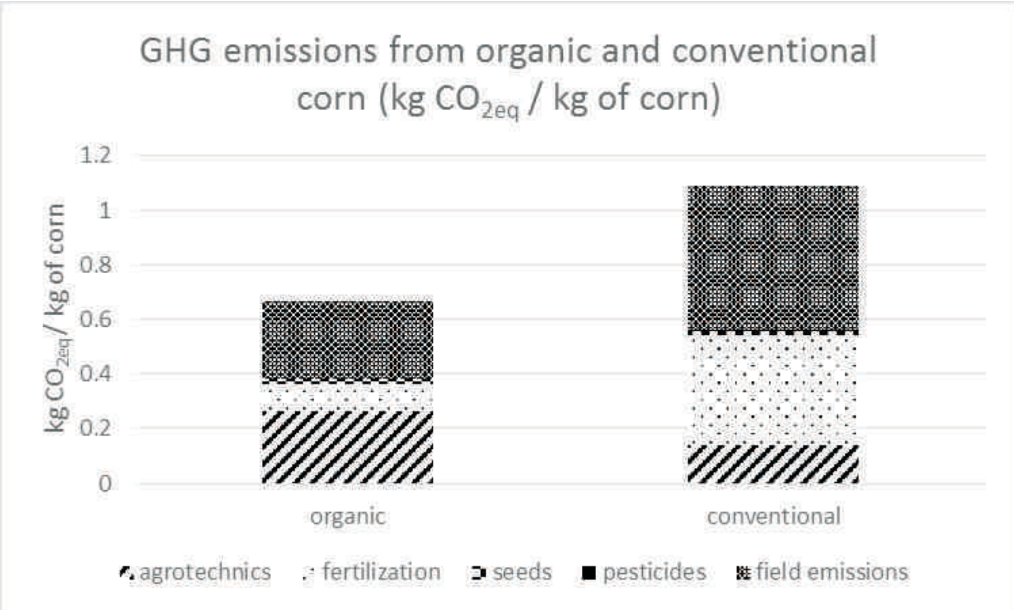


Figure 2. **Greenhouse gases emissions from organic and conventional corn (kg CO_{2eq} / kg of corn)**

The overall emission load in the environmental system, as can be seen from the Chart no. 2, is 0.669 kg of CO_{2eq} / kg of corn in the organic farming system, compared to 1.089 kg of CO_{2eq} / kg of corn in the conventional farming system. An important factor is the conversion of the load from the unit of area to the unit of production, i.e. to the kilograms of CO_{2eq} per one kilogram of corn. For example, Brandt and Svendsen (2011) note that the difference in the emission load of conventional and organic farming is very significant, when we relate this load to the unit of area, but it is partially reduced after conversion to the unit of production.

The emission load quantified per unit of area can be almost two and a half times higher in conventional farming system (3267.8 kg of CO_{2eq} / ha) compared to organic farming system (1338.7 kg of CO_{2eq} / ha).

Conclusion

Organic farming shows lower emission load when cultivating corn, both after conversion to the unit of area and to the unit of production. Since corn is one of the world's most significant cultivated crops also in terms of sown areas, a change in the system may be a tool for reducing GHG emissions. Partial savings can be achieved in particular by changes in fertilization by nitrogen fertilizers and partially also in agrotechnics.

Acknowledgement

This work was supported by the University of South Bohemia in České Budějovice research project GAJU 094/2016/Z.

References

Biswas WK., Barton L, Carter D (2008). Global Warming Potential of Wheat Production in South Western Australia. A Life Cycle Assessment. *Water and Environment Journal.*22.pp.206-216.

Brandt US, Svendsen GT (2011). A Project-Based System for Including Farmers in the EU ETS. *Journal of Environmental Management.* 92.pp. 1121-1127.

Brentrup F, Küsters J, Kuhlmann H, Lammel J (2004). Environmental Impact Assessment of Agricultural Production Systems Using the Life Cycle Assessment Methodology - I. Theoretical concept of a LCA method tailored to crop production. *European Journal of Agronomy.* 20.pp. 247-264.

ČNI 2006a. ČSN EN ISO 14 040: Environmentální management Posuzování životního cyklu – Zásady a osnova. (Environmental Management Life cycle Assessment – Principles and Framework.) Český normalizační institut. Praha.

ČNI 2006b. ČSN EN ISO 14 044: Environmentální management Posuzování životního cyklu - Požadavky a směrnice. (Environmental Management Life Cycle Assessment – Requirements and Instructions.) Český normalizační institut. Praha.

De Klein C, Novoa RS, Ogle A, Smith KA, Rochette P, Wirth TC, McConkey, BG, Mosier A, Rypdal K (2006). N_2O emissions from managed soils, and CO_2 emissions managed from lime and urea aplications. In: Eggleston S *et al.* (eds.). 2006 IPCC Guidelines for National Greenhouse Gas Inventories., Agriculture, Forestry

Finnveden G, Hauschild MZ., Ekvall T, Guninée J, Heijungs R, Hellweg S et al (2009). Recent developments in life cycle assessment. *Journal of Environmental Management 2009.* 91.pp. 1-21.

Fliessbach A, Oberholzer HR, GunstL, Mäder P (2007). Soil Organic Matter and Biological Soil Quality Indicators after 21 Years of Organic and Conventional Farming. *Agriculture, Ecosystems and Environment.* 118.pp. 273–284.

Fott P, Pretel J, Neužil V, Bláha J (2003). Národní zpráva České republiky o inventarizaci emisí skleníkových plynů. ČHMÚ, Praha.

Haas G, Berg M, Köpke U (2002). Nitrate leaching: comparing conventional, integrated and organic agricultural production systems. In: Steenvoorden J, Claessen F, Willems J (eds.) *Agricultural Effects on Ground and Surface Waters: Research at the Edge of Science and Society. Oxfordshire, IAHS, 2002.* pp. 131-136.

Haas G, Geier U, Schulz D, Köpke U (1995). A Comparision of Conventional and Organic Agriculture - Part 1: Climate-Relevant Carbon Dioxide Emission from the Use of Fossil Energy. *Berichteüber Landwirtschaft.* 73.pp. 401-415.

Jensen AA, Hunkeler D, Gaillard G, Hellweg S, Christiansen K (2005). LCM 2005 - Innovation by Life Cycle Management. *International Journal of Life Cycle Assessment.* 10. pp. 451-453.

Kočí V (2009). Posuzování životního cyklu – Life cycle assessment LCA. Ekomonitor spol.s.r.o., Chrudim.

Küstermann B, Kainz M, Hülsbergen KJ (2008). Modeling Carbon Cycles and Estimation of Greenhouse Gas Emissions from Organic and Conventional Farming Systems. *Renewable Agriculture and Food Systems.* 23.pp.38–52.

Lackner M. (2008). Sozialökologische Dimensionen der österreichischen Ernährung: Eine Szenarienanalyse. Institute of Social Ecology, Klagenfurt University, Vienna, Austria.

LaSalle T, Hepperly P (2008). Regenerative Organic Farming: a Solution to Global Warming. Rodale Institute, Kutztown, Pensylvania, USA

Liess M, Schulz R, Berenzen N, Nanko-Drees J, Wogram J (2001). Pflanzenschutzmittel-Belastung und Lebensgemeinschaften in Fliessgewässern mit landwirtschaftlich genutztem Umland. Technische Univerität Braunschweig, Berlin.

Mäder P, Fliebbach A, Dubois D, Gunst L, Fried P, Niggli U (2002). Soil Fertility and Biodiversity in Organic Farming. *Science.* 296.pp. 1694-1697.

Matthews G, Wiles T, Baleguel P (2003) A survey of pesticide applicationin Cameroon. *Crop Protection.* 22. pp. 707-714.

Molua EL, Lambi CM (2007) The Economic Impact of Climate Change on Agriculture in Cameroon. *The World Bank,* Washington, USA.

Mondelaers K, Aertsens J, Van Huylenbroeck G (2009). A Meta-Analysis of the Differences in Environmental Impacts between Organic and Conventional Farming. *British Food Journal.* 111. pp. 1098-1119.

Mori A, Hojito M, Kondo H, Matsunami H, Scholefield D (2005). Effects of Plant Species on CH_4 and N_2O Fluxes from a Volcanic Grassland Soil in Nasu, Japan. *Soil Science & Plant Nutrition.* 51.pp. 19–27.

Nemecek T, Erzinger S (2005). Modelling Representative Life Cycle Inventories for Swiss Arable Crops. *International Journal of Life Cycle Assessment.* 10.pp. 68-76.

Niggli U, Fliessbach A, Hepperly P, Scialabba N (2011). Zemědělství s nízkými emisemi skleníkových plynů. Bioinstitut, Olomouc, Czech Republic.

Pimentel D, Hepperly P, Hanson J, Douds D, Seidel R (2005). Environmental, Energetic, and Economic Comparisons of Organic and Conventional Farming Systems. *BioScience.* 55. pp. 573–582.

Pretty JN, Ball AS, Xiaoyun L, Ravindranath NH (2002). The Role of Sustainable Agriculture and Renewable-Resource Management in Reducing Greenhouse-Gas Emissions and Increasing Sinks in China and India. *Philosophical Transactions of the Royal Society.* 360.pp. 1741-1761.

Robertson GP, Paul AP, Harwood RR (2000). Greenhouse Gasses in Intensive Agriculture: Contributions of Individual Gases to the Radiative Forcing of the Atmosphere. *Science.* 289.pp. 1922-1925.

Šarapatka B, Niggli U, Čížková S, Dytrtová K, Fišer B, Hluchý M, Just T, Kučera P, Kuras T, Lyth P, Potočiarová E, Salaš P et al. (2008). Zemědělství a krajina – cesty k vzájemnému souladu. Univerzita Palackého v Olomouci, Olomouc

Stern S, Sonesson U, Gunnarsson S, Oborn I, Kumm KI, Nybrant T (2005). Sustainable Development of Food Production: A Case Study on Scenarios for Pig Production. *Ambio.* 34.pp. 402-407.

TokudaS, Hayatsu M (2004). Nitrous Oxide Flux from a Tea Field Amended with a Large Amount of Nitrogen Fertilizer and Soil Environmental Factors Controlling the Flux. *Soil Science & Plant Nutrition.* 50. pp. 365–374.

Zou J, Huang Y, Lu Y, Zheng X, Wang Y (2005). Direct Emission Factor for N_2O from Rice-Winter Wheat Rotation Systems in Southeast China. *Atmospheric Environment.*39. pp. 4755-4765.

Composting of Tomato Wastes and Sheep Manure: An Eco-friendly Waste Valorisation for Enhancing the Environmental Sustainability in Souss Massa Region (Morocco)

*Ilyass Tabrika[1,2], Khalid Azim[1], El Hassan Mayad[2] and Mina Zaafrani[2]

[1]Regional Centre of Agricultural Research, Agadir, Morocco

[2]Laboratory of Environmental Engineering and Biotechnology, National School of Applied Sciences, Ibn Zohr University, Agadir, Morocco

*Corresponding author: itabrika@gmail.com

Keywords:
Eco-friendly, sheep manure, organic, Morocco

Abstract

Each season, a huge amount of crop residues is regenerated by horticultural production. The main type of wastes are tomato stalks, leaves and axillary buds which are subsequently the result of crop operations like trimming and plants trellising and uprooting. The landfilling of corps residues is a serious problem that need to be solved. Therefore, the valorisation of these organic wastes by composting is a simple way for suitable management and the produced compost could be used as an organic amendment to satisfy the crop growth needs and agronomic soil requirements. The aim of the study is to investigate the impact of the mixing proportion of tomatoes residues and sheep manure using an experimental biocomposter of capacity 220 L with passive aeration system. Two different mixing ratios were set-up on volume basis: R1 (2/3 tomato plant residues "TPR" + 1/3 sheep manure "SM") and R2 (1/3 tomato plant residues "TPR" + 2/3 sheep manure "SM") and two controls CTRP (1/1 tomato plant residues "TPR") and CSM (1/1 sheep manure "SM"). Parameters such as Temperature, pH, EC, Carbon-to-nitrogen ratio, mineral and organic nitrogen, potassium and phosphorous were monitored for a period of 60 days. According to the results, tomato wastes proportion is negatively correlated to the Germination Index (GI) of the final compost, the nitrogen and the organic matter loss. After 9 weeks of composting, GI was 87%, 91%, 92%, and 95% respectively for CTRP, R1, R2 and CSM. Tomato plant residues are not adequate for composting alone, and could limit the efficiency of the process.

Introduction

Tomato waste generated by greenhouse industry has become environmental problem that is facing Morocco country and could have a greater impact on the environment. In Souss Massa region, tomato corps production is one of the most important horticultural scope were tomato representing 96% of national production (APEFEL 2017). In 2011, more the 1.000.000 tons of organic waste are generated which 29% are tomato plant residue(leaves, axillary buds, and the entire end cycle plant) with important proportion of organic manner and macro-nutrient (0.7% N, 0.31% P_2O_5, 1.8% K_2O) (Azim *et al,* 2017). Therefore, Tomato wastes represent a valuable source of macro-nutrient that can be profitable. On global perspective, composting can put back this nutrient into the agricultural system as compost which can be considered as a valuable source of humic substances, nitrogen, phosphorous, essential trace elements to support plant growth and might be possible to decrease their dependence on chemical fertilizers and enhance the sustainability of the nutrients cycle. (Karak *et al.,* 2013). Composting efficiency of all crop residues depends mainly on their physicochemical characteristic and environmental conditions together. According to (Onwosi *et al.* 2017) Certain chemical characteristics of the tomato plant residues are not adequate for composting alone and could limit the efficiency of the process: high N concentration for the organic-C gives low C/N ratio which can result in nitrogen loss as NH_3 and even N_2O, excess of moisture content and low porosity, which together make aeration challenging. To overcome the challenges that these peculiarities impose mixing with other compost feedstock materials can be employed. In this scenario, (Gavilanes- Terán *et al.,* 2016) sawdust and laying hen manure were added to tomato waste in order to calibrate C/N which results in a ratio range of 29-30. The C/N ratio of compost feedstock is the leading parameter when setting up a new composting process. However, the C/N should not be used as absolute parameter as it is important to identify the nature of C in the composted materials. (Maheshwari *et al.,* 2014). A similar suggestion assuming a C/N effect has been done by (Kumar *et al.* 2010), they revealed that that C/N alone is not a limiting factor for composting efficiency and low C/N is possible and depend the moisture content. In this study, the objectives were to determine whether addition of sheep manure to the stage composting of tomato plant residues, to monitor the physico-chemical changes and offering an optimal ratio that allows adequate composting and compost quality.

Materials and methods

Feedstock preparation

Composting assay was performed and monitoring at the National Centre of Agronomical Researches Melk Zhar. Tomatoe plant residues (TPR) and Sheep Manure (SM) were used to formulate starting mixture, tomatoes waste was collected during greening maintenance of greenhouse industry consisted of fallen leaves and branch cuttings. Physicochemical properties of starting material are showed in Table 1. The two wastes were crushed to obtain uniform particle size and mixed with four proportions in order to calibrate nutriment balance in the bench-scale reactors.

Table 1. **Physico-chemical characteristics of the starter material**

	pH[a]	EC (mS/ cm)	TOC (mass%)	C/N (Ratio)	TN (mass%)	TP (mg/Kg)	TK (g/kg)	Ca (g/kg)	Mg (g/kg)	Fe (mg/kg)
TPR	8.33	5.37	27,1	9.9	2.73	0.135	0.075	0.747	0.386	92
SM	7.96	2.03	28.64	12.73	2.25	0.322	0.1	0.682	0.447	153

SM: Sheep Manure
TPR: Tomatoes plant residues
[a] Percentages are based on air-dry weight.
[b] Percentages are based on oven-dry weight.

Table 2. **Starting mixture and parameter of composting assay**

	Starting Mixture (dry weight)[a]		*Starting Parameter*			*Weight (Kg)*
	TPR	SM	C/N Ratio	NT (mass%)[a]	Moisture content (%)	
R1	2/3	1/3	11.2	2.07	60	
R2	1/3	2/3	13.98	1.89		

Composting sampling and monitoring

Samples were collected as the composting mixtures every on day 0, 12, 14, 26, 38, 50, 62, On these days, three subsamples (200 g per subsample) was collected from the top, middle, and bottom of each reactor. The three subsamples were combined to form one composite sample (600 g per simple). Each sample from each reactor was oven-dried at 65°C. When dry, the samples were crushed in a small grinder, passed through soil sieves (0.5mm), sealed in plastic containers, and stored at 4°C. Temperature was measured daily at the middle of each reactor using a self-made temperature sensor with a temperature dial and 1 metre long rod. Ambient temperature was also recorded using the same temperature sensor.

Chemical properties

The pH, electrical conductivity (EC), organic matter (OM), total organic carbon (TOC), total Kjeldahl nitrogen (N-TKN), ammoniacal nitrogen (N-NH+4), total phosphorus ($P\text{–}P_{soluble}$), total potassium (TK), humic acid (HA) and micro-nutriment Ca, Mg, and Fe were determined for oven-dried samples (Pas encore terminer cette paragraphe).

Seed germination test

The germination index (GI) was determined in accordance with (Gu *et al., 2*011). 20 radish seeds and 5 mL compost extract were placed on sterilized petri dish with a filter paper. Deionized water was used as a control. The petri dishes were kept in the dark at 30 °C for 48 h. Germination rates and root length were measured. The calculation of GI was based on the following formula:

$$GI\ (\%) = \frac{\text{Seed Germination} \times \text{Length of Treatment ''mm''}}{\text{Seed Germination } \times \text{Root Length of Control ''mm''}} \times 100\%$$

OM and TN loss

The equations of (Paredes *et al.* 2000) were utilised to calculate the losses of OM and NT from the initial (X1) and final (X2) ash contents:

Losses of organic matter (OM) and TN were calculated according to the following equations (Paredes *et al.* 2000):

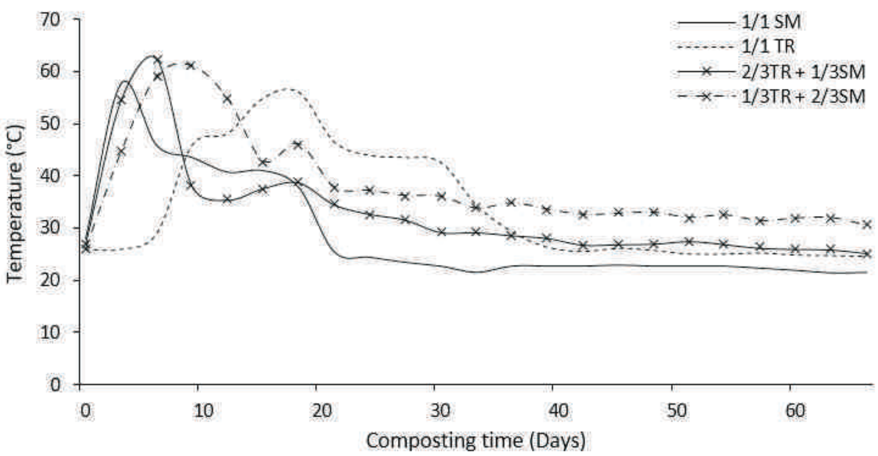
$$\text{OM loss } (\%) = 100 - 100\,[X_1(100\text{-}X_2)] \div [X_1(100\text{-}X_2)]$$

$$\text{TN loss } (\%) = 100 - 100\,[(X_1 \times N_1) \div (X_2 \times N_2)]$$

Where X_1 and X_2 are the initial and final ash contents, respectively and N_1 and N_2 the initial and final TN concentrations.

Results and discussion

Temperature is a major parameter provides composting efficiency, a good thermophilic is important for effective inactivation of pathogens and splitting lignine and cellulose in compost (Soobhany *et al.,* 2017; Tuomela *et al.,* 2000).



After the addition of each mixtures in the bioreactor, increasing in temperature was observed in all treatment, indicating a marked microbial activity. In composters containing the controls CTPR (Tomato plant residues) and CSM (Sheep manure), the thermophilic phase (up to 47°C) lasted 15 and 5 days respectively for CTPR and CSM. The maximum temperature inside of controls composters is 57°C for CSM and 55.7°C for CTRP, reached within 2 days and 4 days respectively. For composters contending the mixtures of tomato plant residues and sheep manure at different ratio R1 and R2, the thermophilic phase is lasted 12 and 5 days for R1 and R2 respectively. The maximum temperature inside composter was higher than all controls and was 62°C observed for R1 and 61 °C for R2, reached within 2 and 5 days respectively. The high temperature reached during composting process in all digesters ensured higher efficiency of hydrolysis rate and was sufficient for destruction of pathogens and weed seeds according to (Converti *et al.,* 1999; Remade Scotland, 2003; Ziemba *et al.,* 2010; Bayr *et al.,* 2012 and). All temperature variation versus time of composting is shown in Fig. 1.

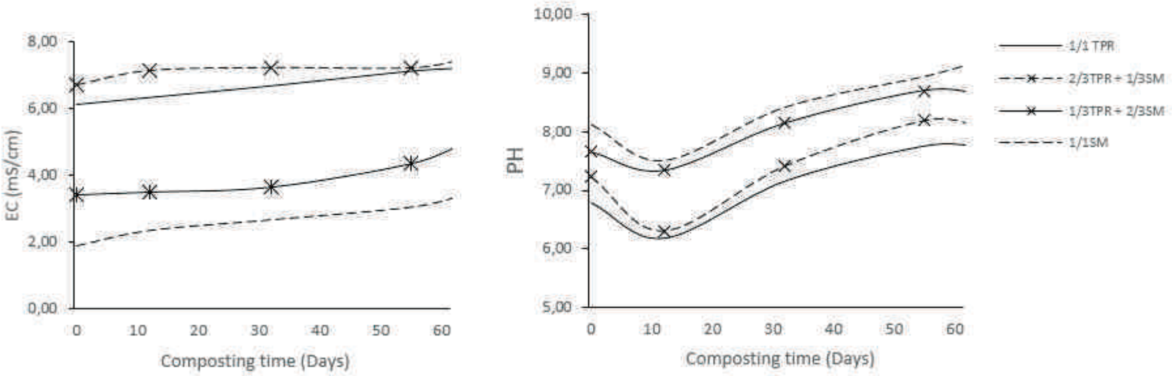


Figure 1. **Change in pH and electrical conductivity (EC) during composting of pH variations**

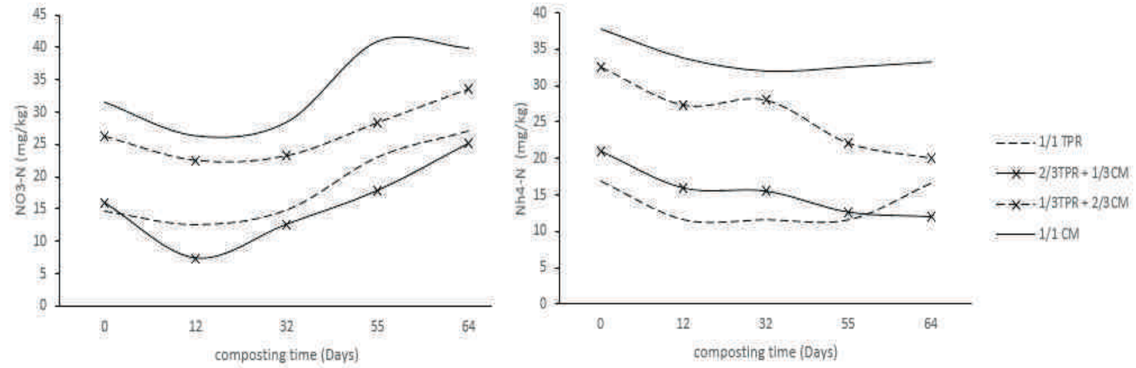
pH is one of selective factors for microbial population and influencing the microbial activities and community during composting process (Chan *et al.,* 2016). As shown in Fig. 2a and 2b, most of starting materials and mixture are a pH value ranging between 6, 75 to 8, 12, generally adequate for composting and couldn't limit the efficiency of the process. pH profile decreased during the first week and then was stable around 6.2 for CTRP, R1 and around 7.4 for R2 and CSM. This decreasing in pH values is likely due to the accumulation of organic acids and volatilization of ammonia as suggested by (Ref). As composting is progress, pH profile show a little alkalization and then was stable in neutral value and R2 and higher than 8 for R1 and CSM. After 9 weeks of composting the final pH values were 7.76, 8, 01, 7, 61 and 8.95 respectively for treatment CTPR, R1, R2, and CSM. This increase in pH is one of indices of compost maturation according to Juarez *et al.* (2015). During this study, the proportion of TPR in the mixture show a direct influence on pH evolution. Since, in two first weeks, CTRP and R2 had slightly higher pH compared to R2 and CSM, the pH becomes more acid if the proportion of TPR in mixture is higher. By against, acidification is low in the control CSM and R1 which the proportion of sheep manure is higher than TPR. After 2 weeks of composting, the pH gradually decreased and stabilized in alkali values for the two composting mixtures and their controls.

Electrical Conductivity

Electrical Conductivity is an important laboratory measurement since it reflects the total salt content coming from microbial mineralization of organic matter fractions present in the substrates of the composting (Jiang *et al.,* 2015; Shah *et al.,* 2015) and thus reflects quality of the compost as a soil amendment. The variations of electrical conductivities of the all treatments are shown in Fig. 2(2a and 2b). During the first week of monitoring, the EC of mixture R2 was constant and they show a gradual increase for R1 mixture and two controls CTRP and CSM. After that, all treatments continued with a slow increase in EC till the end of composting process. Awasthi *et al.* (2014) suggested that increases of EC could be caused to the "biotransformation of complex materials to simple compounds and mineral salts such as phosphates and ammonium ions. This hypothesis is clearly confirmed in Tab which during the composting process, concentration of NO_3^--N increase in all treatments, especially after 2 weeks.

Nitrogen dynamics

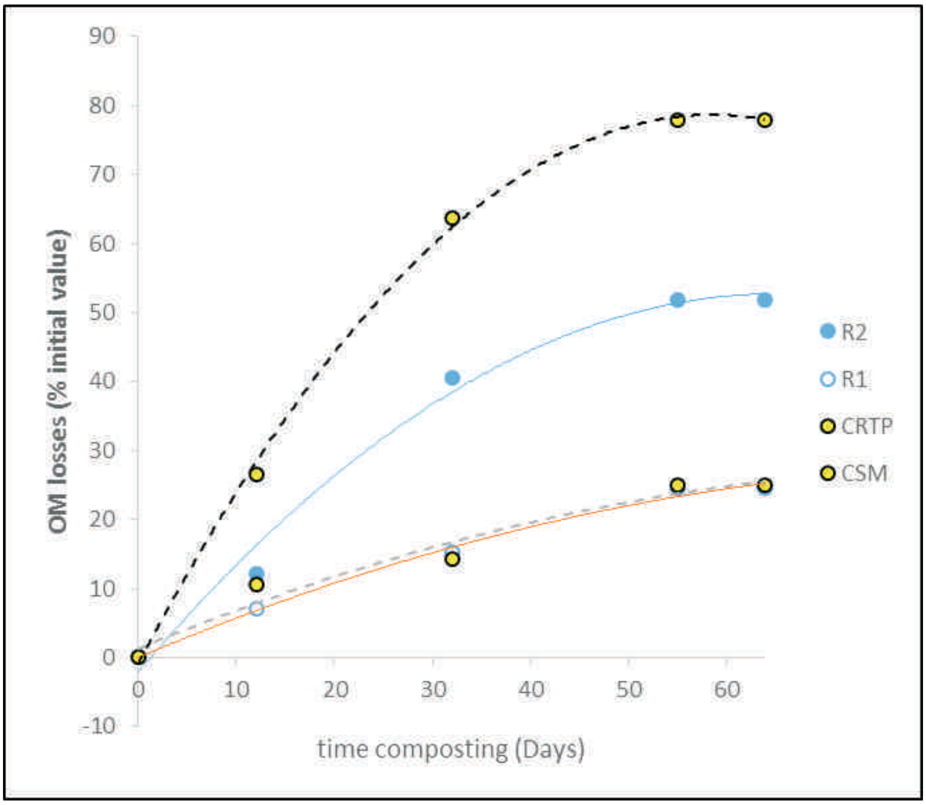
Concentrations of mineral ammonium nitrogen ($NH4^+$-N and $NO3^-$-N) in all the treatments increased only during the two first weeks. After that, $NO3^-$-N continued their increasing. The release of $NH4^-$-N through ammonification coincided with the active degradation of organic matter during thermophilic phase (voir Karak 2015).



Composting times (Days)	HA (%)	C_{ha}/C_{ha}	C_{org}/T_N	GI
Biocomposter 1 : TRP (1/1 tomato plant residue)				
0				
12				
32				
55				
64				
Biocomposter 2 : R1 (2/3 TPR + 1/3 SM)				
0				
12				
32				
55				
64				
Biocomposter 3 : R2 (1/3TPR + 2/3SM)				
0				
12				
32				
55				
64				
Biocomposter 4 : CSM (1/1 sheep manure)				
0	44±4		13,62±1	
12	47±4		13,69±1,09	
32	45±5		11,74±0,7	
55	52,6±1		10,32±1	
64	44±4		8,6±1,52	

	Starting Materials			Final Product		
	TPR	SM	TW	R1	R2	CM
Ca						
Mg						
Na						
K TOT						
P TOT						
Zn						
Fe						
Mn						
Cu						
GI						

Organic matter degradation



Analysis of Use of Organic Farming Practices among Rural fish Farmers in South-South Nigeria

Atoma, C. N[1]., Adesope, O. M.[2], Anyoha, N. O.[3], and Chikaire, J. U.[3]

[2]Department of Agricultural Extension, University of Port -Harcourt, Rivers State, Nigeria

[1]Department of Agricultural Extension and Management, Delta State Polytechnic, Ozoro, Nigeria

[3]Department of Agricultural Extension, Federal University of Technology, Owerri, Imo State, Nigeria

Corresponding author:
nwacharity1211@gmail.com

Keywords:
rural household, fish farmers, Organic Farming Practices

Abstract

The paper focused on the use of organic farming practices amongst fish farmers in South-South Nigeria. Multistage sampling technique was used and three states (Akwa Ibom, Bayelsa and Delta) were randomly selected from the six states that make up South-South zone in Nigeria. Data for the study was obtained with a structured questionnaire administered to a sample size of one hundred and fifteen(115) fish farmers. Findings revealed that fish farmers were aware of six out of the fourteen organic farming practices listed. Use level was low in organic farming practices for fish. The results revealed that out of the fourteen (14) practices outlined, fish farmers engaged in the use of three of such practices. Farmers agreed to the use of eco-friendly design ($\bar{x}$ = 2.56 and SD = 0.86), site is far from polluting substances ($\bar{x}$= 2.57 and SD =1.01) and pond protection from predators ($\bar{x}$= 2.70 and SD = 0.89). From the result, the following were identified as not being used: Management without growth hormones ($\bar{x}$= 2.41 and SD = 0.89), antibiotics is used in critical cases where no other treatment would work ($\bar{x}$= 1.97 and SD = 0.88), cultivate without genetic engineering ($\bar{x}$ = 2.21 and SD = 1.18), quality water source ($\bar{x}$= 2.14 and SD = 1.09), organic fertilizer ($\bar{x}$ = 1.89 and SD = 0.98), low stock density 10kg/m3 ($\bar{x}$= 1.62 and SD= 0.98), manage without synthetic appetizer and coloring ($\bar{x}$= 1.92 and SD= 1.78), poly-culture ($\bar{x}$= 1.98 and SD = 0.99), proper record keeping ($\bar{x}$= 1.98 and SD = 1.10), use of resistant species ($\bar{x}$= 2.43 and SD = 1.00) and natural treatment (homeopathy) ($\bar{x}$= 1.86 and SD = 0.89). The low use of organic farming practices among fish farmers could be as a result of challenges or difficulties in carrying out such practices and lack of awareness of the dangers associated with the conventional practices. It is recommended therefore that training on organic fish production practices be emphasized in Extension activities.

Introduction

A rural area in Nigerian context is defined by Ekong, (2010) as an area of settlement in which half or more than half of the household working population is engaged in farming. Rural communities are different from urban ones. They are very important for the development of the nation and the National Economy. Akpabio (2005) outlined the importance of rural areas. A high percentage (70%) of Nigeria populace resides in the rural communities and this makes it impossible to ignore them in national issues. Rural dwellers according to him cultivate and provide the bulk of food that is consumed by the entire populace aside importation. Fish is an important source of protein anda means of improving nations economic base (World Bank, 2000). A Hotel in Kenya (Bridge organic and Health restaurant) is a place where all the food served is considered organic because the raw materials used are grown organically (Kagai, 2005). The fish that are produced under natural conditions according to the organic agricultural principles, not exposed to any protective additives or genetic modification, fed with baits prepared with completely natural materials and certificated by a control agency are called "organic fish' (Awuror and Karugu 2014). . Organic fish production is a model of production which raises fishes with low stock density and attaches importance to human health without using any chemical pesticides or the products modified genetically (Do cytowanian *et al,* 2010). The Council of Europe adopted a recommendation on the welfare of farmed fish in 2005 and in 2008 the World Organization for animal health, (European Food Safety Authority (EFSA), 2009). Organic fish farming system rely on practices such as cultural and biological disease management and virtually prohibit utilization of synthetic chemicals in fish production. Ponds and cages are the recommended rearing system for organic aquaculture. Tank systems are permitted for hatcheries and nurseries but not for grow out operations on the farm. The stocking density of cultured species is limited and must be less than that of conventional aquaculture 10kg/m$^{2..}$The use of mechanical aeration is usually banned, while an exception is made for mechanical mixing of the water column for a limited number of hours per day with a small number of devices. Organic aquaculture aims to reduce instances of diseases and emphasizes preventive treatments. Chemicals and antibiotics are not permitted but vaccines and probiotics are permitted in aquaculture (Prein*et al*., 2012). Feeds should come from certified organic agricultural inputs or from aquatic sources that have been cultured under controlled organic conditions. There is no doubt, organic produce are superior to the conventionally grown food. In spite of the benefits of organic farming, research on organic livestock and fish farming is low. Previous studies on organic farming concentrated more on crop production. Availability of information on the importance of any agricultural practice could enhance its adoption among farmers. It is pertinent therefore to find-out the level of awareness of organic farming practices and level of use of such practices among farmers in South -South Nigeria

Methodology

Fish farming was selected from the three prominent agricultural enterprises of fishery, livestock and crop. Multistage sampling technique was used. Firstly, three states- Delta, Bayelsa and Akwa-Ibom were selected from the six states that make up South-South Nigeria. Data for the study was obtained with a structured questionnaire administered to a sample size of one hundred and fifteen fish farmers. The instrument elicited information on level of use of organic fish farming practices identified with responses on a four point rating scale of very regularly = 4, regularly =3, rarely =2 never =1. A decision rule of mean score of 2.50 was established.

Result and Discussions

Level of awareness of organic farming practices amongst fish farmers

Amongst fish farmers, out of the fourteen (14) listed organic farming practices; results as shown in Table 1 revealed that farmers were aware of six of such practices. They are eco friendly design ($\bar{x}$ =2.91, SD = 1.06), high quality water source ($\bar{x}$= 2.90, SD = 1.24), pond protection from predators ($\bar{x}$ =.36, SD = 0.97), use of resistant species ($\bar{x}$= 2.95, SD = 1.21), natural treatment ($\bar{x}$= 2.64, SD = 1.38), cultivation without genetic engineering ($\bar{x}$ =2.58, SD = 1.34) and management without growth hormones ($\bar{x}$= 2.60, SD = 1.06). Other practices were below mean score of ($\bar{x}$=2.50). These were low stock density 10kg/m ($\bar{x}$= 2.46, SD = 1.16), management without synthetic appetizer and colouring ($\bar{x}$= 2.31, SD = 1.09), organic fertilizer ($\bar{x}$= 2.24, SD = 1.29), location of site faraway from polluting substances ($\bar{x}$= 2.11, SD = 1.30), antibiotics only use in critical cases ($\bar{x}$= 2.10, SD = 1.32) and poly-culture ($\bar{x}$ = 1.79, SD = 1.10).The grand mean was 2.49. This implies a high awareness level which could be as a result of organic fish farming practices being in line with the traditional method of fish farming.

Level of use of organic farming practices among fish farmers.

Table 2, presents the level of use of organic farming practices among fish farmers. The result revealed that out of the fourteen (14) practices outlined, fish farmers engaged in the use of three of such practices. Farmers agreed to the use of eco-friendly design ($\bar{x}$= 2.56 and SD = 0.86), site is far from polluting substances ($\bar{x}$= 2.57 and SD =1.01) and pond protection from predators ($\bar{x}$= 2.70 and SD = 0.89). From the result, the following were considered not being used; Management without growth hormones ($\bar{x}$ = 2.41 and SD = 0.89), antibiotics is used in critical cases where no other treatment would work ($\bar{x}$ = 1.97 and SD = 0.88), cultivate without genetic engineering ($\bar{x}$ = 2.21 and SD = 1.18), quality water source ($\bar{x}$ = 2.14 and SD = 1.09), organic fertilizer ($\bar{x}$ = 1.89 and SD = 0.98), low stock density 10kg/m3 ($\bar{x}$ = 1.62 and SD= 0.98), manage without synthetic appetizer and coloring ($\bar{x}$ = 1.92 and SD= 1.78), poly-culture ($\bar{x}$ = 1.98 and SD = 0.99), proper record keeping ($\bar{x}$ = 1.98 and SD = 1.10), use of resistant species ($\bar{x}$ = 2.43 and SD = 1.00) and natural treatment (homeopathy) ($\bar{x}$ = 1.86 and SD = 0.89).

The low use of organic farming practices among fish farmers could be as a result of challenges or difficulties in carrying out such practices and lack of awareness of the dangers associated with the conventional practices. This does not augur well for the quest for healthy living. The work of Sakib *et al.* (2014) revealed a positive relationship between knowledge of agricultural practice and innovativeness of farmers. Shibanda (1996) in his assessment of small holder fish farmers information needs underscored the value of information as a commodity itself and the need to recognize it as an essential resource for the small farmer in taking decisions and improving farming practices. Also, policy makers have continued to draft and pass policies such as those encouraging the importation and use of cheap agro- chemicals and fertilizers (East Africa Community, 2004). Farmers have no choice but to stick to conventional practices.

Table 1. **Distribution of fish farmers by level of awareness of farming practices**

Organic Farming Practices	**Not at all**	**Low**	**Moderate**	**High**	**Mean**	**Std deviation**
Eco-friendly design	22 (19.1)	4 (3.5)	51 (44.3)	38 (33.0)	2.91	1.06
Manage without growth Hormone	31 (27.0)	3 (2.6)	61 (53.0)	20 (17.4)	2.60	1.06
Antibiotics is only used in clinical cases where no other treatment would work	65 (56.5)	2 (1.7)	19 (16.5)	29 (25.2)	2.10	1.32
Cultivate without genetic engineering.	44 (38.3)	5 (4.3)	21 (18.3)	45 (39.1)	2.58	1.34
Site is far from polluting substances	63 (54.8)	4 (3.5)	20 (17.4)	28 (24.3)	2.11	1.30
High quality water source (stream, river)	31 (27.0)	1 (0.9)	31 (27.0)	52 (45.2)	2.90	1.24
Organic fertilizer	54 (47.0)	4 (3.5)	20 (17.4)	31 (27.0)	2.24	1.29
Low stock density 10kg/m	39 (39.9)	6 (5.2)	47 (40.9)	23 (20.0)	2.46	1.16
Manage without synthetic appetizer and coloring	40 (34.8)	15 (13.0)	44 (38.3)	16 (13.9)	2.31	1.09
Polyculture	70 (60.9)	13 (11.3)	18 (15.7)	14 (12.2)	1.79	1.10
Proper record keeping	65 (56.5)	3 (2.6)	18 (15.7)	29 (25.2)	2.09	1.32
Pond protection from predators	13 (11.3)	2 (1.7)	36 (31.3)	64 (55.7)	3.31	0.97
Use of resistant species	29 (25.2)	1 (0.9)	34 (29.6)	51 (44.3)	2.95)	1.21
Natural treatment (homeopathy)	43 (37.4)	8 (7.0)	11 (9.6)	53 (46.1)	2.64	1.38

Source: Field survey, 2015.

Mean score ⩾2.50 = aware (A), mean score < 2.50 = not aware (NA)

Values in parenthesis stand for percentages

Table 2. **Distribution of fish farmers by level of use of organic farming practices**

Organic Farming Practices	Never	Rarely	Regularly	Very. regularly	Mean	Std Deviation
Eco-friendly design	24 (20.9)	6 (5.2)	81 (70.4)	4 (3.5)	2.56	0.86
Manage without growth hormone	31 (27.0)	5 (4.3)	79 (68.7)	0 (0.0)	2 41	0.89
Antibiotics is only used in clinical cases where no other treatment would work	45 (39.1)	29 (25.2)	40 (34.8)	1 (0.9)	1.97	0.88
Cultivate without genetic engineering.	51 (44.3)	7 (6.1)	38 (33.0)	19 (16.5)	2.21	1.18
Site is far from polluting substances	28 (24.3)	9 (7.8)	62 (53.9)	16 (13.9)	2.57	1.01
High quality water source (stream, river,	52 (45.2)	2 (1.7)	53 (46.1)	8 (7.0)	2.14	1.09
Organic fertilizer	59 (51.3)	11 (9.6)	43 (37.4)	2 (1.7)	1.89	0.98
Low stock density 10k/m	80 (69.6)	2 (1.7)	29 (25.2)	4 (3.5)	1.62	0.98
Manage without synthetic appetizer and colouring	69 (60.0)	1 (0.9)	30 (26.1)	15 (13.0)	1.92	1.78
Polyculture	56 (48.7)	7 (6.1)	50 (43.5)	2 (1.7)	1.98	0.99
Proper record keeping	62 (53.9)	1 (0.9)	44 (38.3)	8 (7.0)	1.98	1.10
Pond protection from predators	22 (19.1)	1 (0.9)	81 (70.4)	11 (9.6)	2.70	0.89
Use of resistant species	35 (30.4)	3 (2.6)	69 (60.0)	8 (7.0)	2.43	1.00
Natural treatment (homeopathy)	50 (43.5)	35 (30.4)	26 (22.6)	4 (3.5)	1.86	0.89

Source: Field survey, 2015
Mean score ≥ 2.50 ≥ Use (U), mean score < 2.50 ≥ Non Use (NU)
Values in parenthesis stand for percentage

Conclusion and Recommendations

There is low use of Organic Fish Production Practices of farmers in South-South, Nigeria. To enhance the practice of organic fish production in the study area, there should be training on organic production practices in extension activities and awareness should be created on the difference between organic and conventional fish production.

References

Akpabio, (2005).Rural and Agricultural Sociology In Ike Nwanchukwu (Ed) *Agricultural extension and rural sociology*. Snap press limited Enugu.

Awuror, E., &Thuo Karugu, C., (2014). Assessment of establishment and management of organic fish farming in Kenya; A case study of Kiambu District.*European Journal of Business Management vol 6,* no 12.Pp 194-195.

Do cytowanian, O. Y., Ozden, O., &Orles, S. (2010). Organic fish production and the standards.*Acta Sci. Pol,Technol Aliment. 9(2),* 125-131.

East African Community (EAC) (2004).*Climate, Food, Trade: where is the policy Nexus? Lessons from teh East African Community?* Retrieved from http://.

European Food Safety Authority.(2009). In Awuror E., &Thuo Karugu, C. (2014).Assessment of Establishment and management of organic fish farming in Kenya; A case study of Kiambu District. *European Journal of Business Management vol 6,* no 12.Pp 194-195.

Kagai, J.K. (2005). National plan for Development of Aquaculture in Kenya-In FAO *Aquaculture Planning in Africa. ADCP/REP/75/1*.Pp 61-65.

Prein, M., Bergleiter, S., Ballauf, M., Brister, D. J., Halwart, M., Hongrat, K., Kahle, J., Lasner, I., ... &Wainberg, A.A. (2012). The future of expanding niche markets. In R. P. Subasinghe., S. S. De Silva., M. Halwart., N. Hishamunda., C. V. Mohan. and P, Sorgeloos. Farming the water for people and food. *Proceedings of the Global conference on Aquaculture Phuket, Tailand*22-25 September 2010 Pp 549-567.

Sakib, H., Alfred, S.I., &Prodhan, F.A. (2014). Farmers knowledge on aquaculture practices in Bogra District of Bangladesh .*International Journal of Agricultural* Extension 02(02) 121-127.

Shibanda, G.G. (1996). Fish Farming: The small holder information needs in Kenya. *NAGA, the ICLARM quarterly. 19* (3) Pp 25-26.

World Bank. (2000). World Development Indicators 2000 – CD Rom, World Bank Washington, D.C In Awuor E. Assessment of establishment and management of organic fish farming in Kenya: A Case study of Kiambu District. *European Journal of Business and Management. ISSN 222 Vol 6,* No 12, 2014.

Ginger as an Antimicrobial Agent in the Preservation of Smoke Dried *Clarias Gariepinus*

M. O. Ipinmoroti

Osun State University,
Osogbo, Nigeria

Corresponding author:
mabel.ipinmoroti@uniosun.edu.ng

Keywords:
Ginger, preservative,
Clarias gariepinus, antioxidant,
microbes

Abstract

Freshly caught fish were treated with ginger roots extracts at various levels of dilution, 25% (T2), 50%(T2), 75% (T4) while T1, the control was 10% saline solution and then smoked in separate chambers of smoking kiln. Smoking temperatures ranging between 100 and 200^{0}C. Products were packaged in labelled sterile paper bags and assessed biweekly for spoilage and organoleptic properties. Results showed that peroxide value was lowest in 75% Ginger (6.04m/Eq/kg) treatment and highest (7.86mEq/kg) in 10% saline solution. Microbial load reduced with increasing concentration of extract. Similar trend was observed the peroxide values. Ginger preserved products were accepted by consumer even after six weeks of storage. Gingerroot extracts could serve as preservative for smoked Clariasgariepinus.

Introduction

Fish is a perishable biomaterial especially in the tropics where high temperature and humidity accelerate spoilage and bio-deterioration of fish immediately after catch (Okonta and Ekelemu, 2005). Deterioration sets in immediately after fish dies because of the presence of resident bacterial flora on the flesh, enzymatic activities that continue even after death and other biochemical reactions that follow. These cause fish to lose its organoleptic qualities, and generally become unacceptable for human consumption. It is this perish ability of fish that makes it to be processed into fish based products, such as smoked, canned fish, fish cake, fish meal and fish burger. The reduction of these losses can only be achieved by systematic improvements in handling, processing, storage and distribution.

This necessitated the need to use of natural anti-oxidants and antimicrobial agents such as herbs and spices to prevent rancidity in smoked fish (Kumolu *et al*, 2013) and the entry of pathogens to food. Ginger *Zingiberofficinale* is a common spice that could be used as anti-oxidants and anti-bacterial on stored food materials. The antioxidant and antimicrobial ability of this spice has been reported in various studies.

Ginger, *Zingiberofficinale* as a spice has a geographical spread that covers every part of the globe and it is consumed whole as a delicacy, used in traditional oriental medicine, or as spice in foods, such as fish (Onyeagba *et al*, 2004; Abdul *et al*, 2008; Akram *et al,* 2011; Prasad and Tyagi, 2015). Ginger contains a number of biologically active essential oils such aszingiberene, β-bisabolene, β-farnesene, β-sesquiphell and rene, and β-curcumene which are terpenes, and phenols which include gingerol, paradols, and shogaol. These essential lipids constitute about 1-3% of the wet weight (Akram *et al*, 2011;Shalaby, and Hamowieh, 2010). These compounds make it a stimulant and give it its characteristic pungent aroma and flavour. The terpenes are responsible for the aromatic flavour while the phenols cause the pungency.

This study was designed to investigate the preservative potentials of ginger extracts as a potential preservative and organoleptic quality enhancer for *Clariasgariepinus*.

Methodology

Fresh ginger (*Zingiberofficinale*) roots were washed, their skin removed and ground the juice was extracted at a weight ratio of 1:3, 1:2, 3: 1 ginger to water representing 25%, 50% and 75% dilution the control was 0% of ginger of 10% saline solution. The mixtures were heated (100^0c) and later centrifuge (2200rpm) to remove the filtrate and then cooled in room temperature. Whole fresh *Clariasgariepinus* weighing 250g±10 were obtained from Osun State University fish farm gutted, cleaned and soaked for 90minutes in each of the extracts the experiment was a complete randomised design labelled respectively as T1, T2, T3, T4 in triplicates of 9 fish per set up making 27 fish per treatment. The fish were smoked in separate chambers of smoking kiln for 8hours at temperatures ranging between 100 and 150^0C to mean moisture content of 10.0±2.21g/100g of sample. The products were packaged in sterile paper bags, kept at room temperature and assessed biweekly for bacterial, fungal, and organoleptic properties. Organoleptic assessment was carried out using a 5-point hedonic scale. The peroxide value and aflatoxin content were measured after the sixth week. Results using descriptive statistics and One Way Analysis of Variance (ANOVA). Duncan Multiple Range test was used to separate the mean of all treatments at the 5% level of significance. SPSS version 23 for Microsoft windows was employed for the analysis.

Results and Discussion

Bacteria load was visible on the flesh of fish in treatment T1 (1.0 $X10^5Log_{10}$Cfu/g) first, in the second week it was observable in T4 (20.00±0.58 $X10^{5c}$) but not visible in the flesh of *C. gariepinus* in treatment T2 and T3 until fourth week (Table 1). Bacteria load was however visible in the second week in all the head samples by the second week (Table 2).Generally apart from T1 which is the control bacterial population decreased significantly ($P<0.05$) in the sixth week after an increase which was observed between the first and the fourth week.

Table 1. **Mean population of Bacterial in the flesh of ginger extract preserved smoked C. *gariepinus* (($X10^5Log_{10}$Cfu/g)**

Treatment	Week 0	WEEK 2	WEEK 4	WEEK 6
T1	1.00±0.00 $X10^{5a}$	10.00±0.58 $X10^{5a}$	20.00±0.58 $X10^{5ab}$	80.00±0.58 $X10^{5a}$
T2	0.00±0.00^b	0.00±0.00^b	10.00±0.58 $X10^{5b}$	5.00±0.58 $X10^{5b}$
T3	0.00±0.00^b	0.00±0.00^b	10.00±0.58 $X10^{5b}$	3.50±0.00 $X10^{4c}$
T4	0.00±0.00^b	20.00±0.58 $X10^{5c}$	3.0.00±0.58 $X10^{5c}$	1.00±0.58 $X10^{4c}$

Means of values with same superscripts along column are not significantly different (P>0.05)

Table 2. **Mean population of Bacterial in the head of ginger extract preserved smoked C. *gariepinus* (($X10^5Log_{10}$Cfu/g)**

Treatment	Week 0	WEEK 2	WEEK 4	WEEK 6
T1	4.00±0.00 $X10^{5b}$	20.00±0.00 $X10^{5b}$	60.00±0.58 $X10^{5a}$	7.50±0.00 $X10^{6a}$
T2	0.00±0.00	20.00±0.00$X10^{5b}$	7.50±0.58$X10^{5b}$	6.50±0.58 $X10^{5b}$
T3	0.00±0.00	10.00±0.00$X10^{5b}$	20.00±0.00$X10^{5c}$	2.50±0.00$X10^{4c}$
T4	0.00±0.00	3.00±0.58$X10^{5b}$	20.00±0.58$X10^{5c}$	2.21±0.58$X10^{4c}$

Means of values with same superscripts along column are not significantly different (P>0.05)

Similar trend was observed with fungal population, there was an initial increase in population in the first four weeks which was later followed by a decrease in the sixth week (Table 3 and 4).The results for treat varied significantly with treatment at $p<0.05$.

Table 3. **Mean population of fungi in the flesh of ginger extract preserved smoked C. *gariepinus* (($X10^5 Log_{10}$Cfu/g)**

Treatment	Week 0	WEEK 2	WEEK 4	WEEK 6
T1	4.00±0.00 $X10^{5b}$	20.00±0.00 $X10^{5a}$	60.00±0.58 $X10^{5a}$	20.00±0.00 $X10^{5a}$
T2	0.00±0.00	20.00±0.58 $X10^{5a}$	20.00±0.58 $X10^{5\,b}$	2.00±0.58 $X10^{5b}$
T3	0.00±0.00	10.00±0.00 $X10^{5b}$	20.00±0.00 $X10^{5\,b}$	1.00±0.00 $X10^{5b}$
T4	0.00±0.00	0.00±0.00^{c}	20.00±0.58 $X10^{5\,b}$	2.60±0.58 $X10^{5b}$

Means of values with same superscripts along column are not significantly different (P>0.05)

The result obtained is similar to that of observed by Vwioko *et al* (2013) ginger treated soursop fruit juice were found to have less microbial flora than the control(no treatment).

Table 4. **Mean population of fungi in the head of ginger extract preserved smoked C. *gariepinus* (($X10^5 Log_{10}$Cfu/g)**

Treatment	Week 0	WEEK 2	WEEK 4	WEEK 6
T1	0.00±0.00	30.00±0.00 $X10^{5a}$	20.00±0.58 $X10^{5a}$	20.00±0.00 $X10^{5a}$
T2	0.00±0.00	10.00±0.58 $X10^{5a}$	20.00±0.58 $X10^{5\,b}$	12.00±0.58 $X10^{5b}$
T3	0.00±0.00	30.00±0.58 $X10^{5b}$	30.00±0.58 $X10^{5\,b}$	11.00±0.00 $X10^{5b}$
T4	0.00±0.00	0.00±0.00^{c}	20.00±0.58 $X10^{5\,b}$	22.00±0.58 $X10^{4c}$

Means of values with same superscripts along column are not significantly different (P>0.05)

The heads were observed to have more microbial flora than the flesh this could be because the head has a direct contact with external environment through the gills and the mouth. Spores of microbes suspended in water could be swallowed during the normal process of respiration.

The general decrease in growth which was observed with higher concentration of ginger is an indication of the potency of ginger as an antibacterial agent. However, higher potency of synthetic antimicrobial agents were was linked to the probability that the active agents in the natural spices may not be completely soluble hence the reduction in their potency. There is also the possibility that the volatile ones escaped, thus reducing the potency against microbes.

Peroxide value and Acceptability

At the end of six weeks the peroxide value was highest in T1(7.86mEq/kg) and lowest in T4 (6.04mEq/kg), the higher the peroxide value the higher the extent of rancidity, the implication is that antioxidant components of ginger were able to retard oxidative rancidity in the samples (Ikeme and Bhandary, 2001; Sallam*et al*., 2004; Johnson *et al*., 2013). Panellists preferred the colour of T1 (one without ginger) followed by T4. The texture of T1 and T2 were preferred. T2 was the best accepted followed by T4, ginger treated smoked *Clariasgariepinus* is acceptable to consumers (Table 5).

Table 5. **Mean population of fungi in the flesh of ginger extract preserved smoked C. *gariepinus* (($X10^5 Log_{10}$Cfu/g)**

Treatment	Colour	Texture	Flavour	Taste	Peroxide valuemEq/kg	acceptability	Aflatoxin level%
T1	2.8	3.5	2.7	3.1	7.86	2.7	35.22
T2	2.3	3.3	2.9	3.1	6.67	3.5	26.25
T3	2.2	2.9	2.7	2.5	6.25	2.6	25.25
T4	2.7	2.8	3.2	2.9	6.04	2.9	18.21

Means of values with same superscripts along column are not significantly different (P>0.05)

Conclusion

The study shows that ginger extract could control microbial invasion on smoked dried *Clarias gariepinus* the extract is best for the control of bacteria and fungi at 75% dilution with water. Acceptability of the ginger preserved products was better at the end of weeks for in the 25% dilution followed by 75% dilution. Garlic treatment of fish products could be a good additive for preservation of *Clarias gariepinus*.

References

Abdul, A.B., S.I. Abdel-Wahab, A.S. Al-Zubairi, M.M. El-Hassan and S.M. Murali, 2008.Anticancer and antimicrobial activities of zerumbone from the rhizomes of *Zingiberzerumbut*. Int. J. Pharmacol., 4: 301-304.

Akhani, S. P., Vishwakarma, S. L. and Goyal, R. K. (2004). Antidiabetic activity of

Akram, M., M.I. Shah, K. Usmanghan, E. Mohiuddin and A. Sami *et al*., 2011. *Zingiberofficinale* roscoe (A medicinal plant). Pak. J. Nutr., 10: 399-400.

Grzanna, R., Lindmark, L and Frondoza, C. G. (2005), "Ginger— an herbal medicinal product with broad anti-inflammatory actions," *Journal of Medicinal Food*, vol. 8, no. 2, pp. 125–132, 2005.

Ikeme, A.I. and Bhandary, C.S. (2001). Effect of spice treatment on the quality of hot smoked mackerel (*Scomberscombrus*) presented at the seventh FAO expert consultation in Africa, Senegal. 2001.1-10 pp.

Kumolu-Johnson C.A, Ndimele P.E, Olasehindi F.I (2013).Preliminary study on the antioxidative and antimicrobial effects of fresh garlic (Allium sativum) on the shelf-life of hot-smoked catfish (*Clariasgariepinus*).*Journal of Fisheries and AquaticSciences*; 8(1): 253-256.

Okonta A, Ekelemu J (2005). A preliminary study of micro-organisms associated with fish spoilage in Asaba, Southern Nigeria. Proceedings of the 20th Annual Conference of the Fisheries Society of Nigeria (FISON) 557-560.

Onyeagba, R.A., O.C. Ugbogu, C.U. Okeke and O. Iroakasi, 2004.Studies on the antimicrobial effects of garlic (*Allium sativum* Linn), ginger (*Zingiberofficinale* Roscoe) and lime (*Citrus aurantifolia* Linn). Afr. J. Biotechnol., 3: 552-554.

Prasad, S. and Tyagi, A. K. (2015). Ginger and Its Constituents: Role in Prevention and Treatment of Gastrointestinal Cancer. *Gastroenterology Research and Practice Volume 2015, Article ID 142979, 11 pages http://dx.doi.org/*10.1155/2015/142979.

Sallam K.I, Ishioroshi M, Samejima K (2004). Antioxidant and antimicrobial effect of garlic on chicken sausage. Lebens on WissTechnol 2004; 37(8):849-855.

Shalaby, A.M. and Hamowieh, R.A. (2010). Safety and efficacy of Zingiberofficinale roots on fertility of male diabetic rats, *Food and Chemical Toxicology*, 48(10): 2920–2924.

Vwioko, D. E, Osemwegie, O. O. and Akawe, J. N. (2013).The effect of garlic and ginger phytogenics on the shelf life and microbial contents of homemade soursop (*Annonamuricata* L) fruit juice. *Biokemistri: An International Journal of the Nigerian Society for Experimental Biology* Vol. 25 (2).

Influence of the Cultivated Plant Diversity on the Abundance of Arthropod Trophic Groups and *Helicoverpa armigera* Biological Control in Tomato Cropping Systems in Benin

Anicet Gbèblonoudo Dassou[1], Simplice Davo Vodouhè[2] and Aimé Bokonon-Ganta[3]

[1]Laboratory of Biotechnology, Genetic Resources and Plant and Animal Breeding (BIORAVE); Faculty of Sciences and Technology; BP 14 Dassa; UNSTIM, Benin

[2] Department of Economics, Socio-Anthropology and Communication for Rural Development (DESAC), Faculty of Agronomic Sciences (FSA), UAC, Cotonou, Benin

[3] Department of Plant Production (DPV), Faculty of Agronomic Sciences (FSA), University of Abomey-Calavi (UAC), 01 BP 526 RC, Cotonou, Benin

Corresponding author: dassoua5@gmail.com

Abstract

With the aim of optimizing pest management, a study was carried out to determine the effect of cultivated plant diversity on arthropod communities and Helicoverpaarmigera regulation in tomato cropping systems. Therefore, the diversity of cultivated plants and arthropod communities were assessed within and around tomato fields from 30 farmer's fields randomly selected in South of Benin. In each tomato field, an experimental plot (or elementary plot) (20x20m) in the center of each tomato field was delimited. Each experimental plot was subdivided into a 4 m by 4 m quadrats in which all cropped plants were identified and counted. In the center of each quadrat, one Pitfall trap with soapy water leading to 25 Pitfall traps per field was placed and uplifted after 72 hours to capture the soil and littermacrofauna. The study showed that at the field scale, the abundances of omnivore predators, generalist predators and herbivores were greater in mixed cropping systems than in monocropping systems while the abundance of Helicoverpaarmigera was lower in the mixed cropping systems than in monocropping systems. Multiple intercropped plant species increased the abundance of generalist and omnivore predators. This study allowed better understanding how plant diversity associated to tomato field structures arthropod food webs to finally enhance the ecological management of H. armigera.

Keywords:
Tomato, Helicoverpaarmigera, arthropods, predators, pest management

Introduction

Cultivating plant mixtures is expected to provide a higher overall productivity, a better control of pests and diseases , and enhanced ecological services . Mixed cropping systems are often seen as a strategy to reduce the risk of pest incidence through ecological processes as diverse as barrier, dilution and trophic effects (Ratnadass *et al.,* 2012). Increasing natural regulations constitutes an important component of more sustainable cropping systems. The management of animals and plants communities in the agroecosystems represents one of most important levers to improve these regulations. Understanding trophic interactions between different species in agroecosystems is essential to develop more efficient pest control strategies based on ecological regulation processes.

In Benin, tomatoes are grown in cropping systems ranging from monoculture to intercropping with diverse food crops including maize, roots, tubers and vegetables. These un-mechanized cropping systems rely on family labor and receive very little chemical inputs. The cultivation of tomato is very important for the economy of many countries and contributes to the food security of populations . The tomato fruit is involved in several daily dishes and is a source of minerals and vitamins that can help reduce micronutrient and vitamin deficiencies .

Pests and diseases greatly reduce the yield and the market value of the tomato fruits. The main tomato pest is *Helicoverpaarmigera* which feed on tomato fruits. *Helicoverpaarmigera* is polyphagous and also causes massive damages to the tomato fruit, thus greatly reducing tomato yield. Several studies showed that the generalist predators are important predator groups and can improve pest control in cropping systems . Generally, arthropod biodiversity declines with cropping intensification, yet little is known about the mechanisms for predator declines and how the fall in diversity may affect the role of the generalist predators. Few studies showed the role of associated crops on generalist predator abundance increases and on pest regulations. The crop diversity is expected to change the structure of arthropod trophic groups in tomato cropping systems and *in fine* should modify the control of *H. armigera* by predators.

The management of plant diversity in tomato fields is the primary pest management practice that farmers can do. It is thus important to understand how cultivated plant diversity in these systems influences the structure of arthropod food webs and the control of *H. armigera*. In this study, we studied 30 tomato fields (in monocropping or in mixcropping) to investigate how the cultivated plants mixed with tomato plants affects the abundance of generalist predators and of *H. armigera*. Our goal was to identify the plants intercropped with tomatoes that participate to improve the control of *H. armigera* and to reduce the postharvest damages.

Materials and Methods

Study sites

The study was realized at the southern part of Benin in the regions of Atlantic, Mono and Couffo. The tomato fields were located in the small villages of Allada, Kpomassè, Sèhouè, Ouègbo, Grand-popo, Azovè, Djakotomey and Aplahoué, in areas where tomato is a major production. The climate is humid tropical with, an average temperature of 28 ° C and rainfall up to 1400 mm per year. The soil is sandy clay soil. All fields contained the tomato plants and a diverse array of other annual (e.g. maize, groundnut and vegetable crops) and perennial crops (e.g. palms and pineapples).

Measurement of plant diversity and arthropod communities in tomato cropping systems

In 30 fields covering a gradient of situations ranging from 1 to 10 associated crops, we characterized the vegetation structure (species composition) at the field scales. In each tomato field, an experimental plot (or elementary plot) (20x20m) in the center of each tomato field was delimited. Each experimental plot was subdivided into a 4 m by 4 m quadrats in which all cropped plants were identified and counted. In the center of each quadrat, one Pitfall trap with soapy water leading to 25 Pitfall traps per field was placed and uplifted after 72 hours to capture the soil and litter macrofauna. At total 25 pitfall traps were used per field in order to maximize the trapping. Additionally, all flying insects were captured with an entomological net and the others were collected directly on the plants using a mouth aspirator. All arthropod individuals collected with the traps, nets and aspirator were identified up to the genus or to the species and counted. The same measurements were realized between 8 to 12 AM in two periods: 3 months in the long rainy season (May, June and July) and 3 months in the short rainy season (August, September and October). The identification of arthropod taxa collected in the fields was completed at Entomological Museum of IITA – Benin. Each taxon was associated to a trophic group (herbivore, predator…) according to the literature.

Data analysis

The cultivated plant diversity was evaluated with Shannon Index which was calculated with the diversity function of the vegan package version 2.2-1 . Poisson Generalized Linear Models (GLMs) was used to analyze the effect of cultivated plant diversity on the abundance of arthropod trophic groups. The student test was used to test the difference between pluricrops and monocrops of tomato with respect to the abundance of each arthropod trophic group. Statistical analyses were performed with R 2.15.0 at a significant level of 5% (alpha=0.05).

Results

Abundance of the arthropod species in tomato agroecosystems

As a whole, 3351 individual arthropods from 12 orders were collected inside tomatoes fields. The most abundant orders were Hymenoptera with 1937 individuals followed by Orthoptera with 391 individuals, Araneae with 384 individuals, Coleoptera with 353 individuals. On the literature basis, 5 arthropod trophic groups were constituted as follows: omnivores (1905 individuals), herbivores (940 individuals), generalist predators (467 individuals), detritivores (30 individuals) and parasitoids (7 individuals). We retained for further analyses the arthropods for which the trophic group abundances were > 400 individuals. The arthropod species the most abundant and for which the occurrence was > 50 in tomatoagroecosystemswere*Paltothyreustarsatus, Pheidole*spp., *Gonocephalum simplex*, *Araneus*sp., *Aiolopussimulatrix, Erigone*sp., *Zonocerusvariegatus, Helicoverpaarmigera, Camponotus*sp.

Difference of *Helicoverpaarmigera* abundance between monocrop and multi-crops in tomato agro-ecosystems

The abundances of *Helicoverpaarmigera*weresignificantly lower in the mixed crop fieldsthan in monocropwhile the abundances of the predators were significantly higher in the mixed crop fieldsthan in monocropfields (Figure 1). While the abundances of herbivores and omnivores were not correlatedwith the crop type (Table 1). All the diversity indices such as arthropod abundance, arthropod diversity, arthropod richness and arthropod evenness were significantly higher in the mixed crop fieldsthan in monocropfields (Figure 2 & Table 2).

Table 1. **Kruskal-Wallis tests on abundance according to the crop type. ns : no significant**

Species/Trophic group	Chi²	p value	Significance level
Helicoverpaarmigera	33.50176	< 0.001	****
Predator	46.66613	< 0.001	****
Omnivore	3.696173	0.054	ns
Herbivore	2.990399	0.084	ns

Table 2. **Kruskal-Wallis tests on arthropod community indices according to the crop type**

Community index	Chi²	p value	Significancelevel
Abundance	19.32724	1.101238e-05	****
Richness	11.46436	7.094359e-04	***
Diversity	6.31877	1.194665e-02	*
Evenness	8.507922	3.536036e-03	**

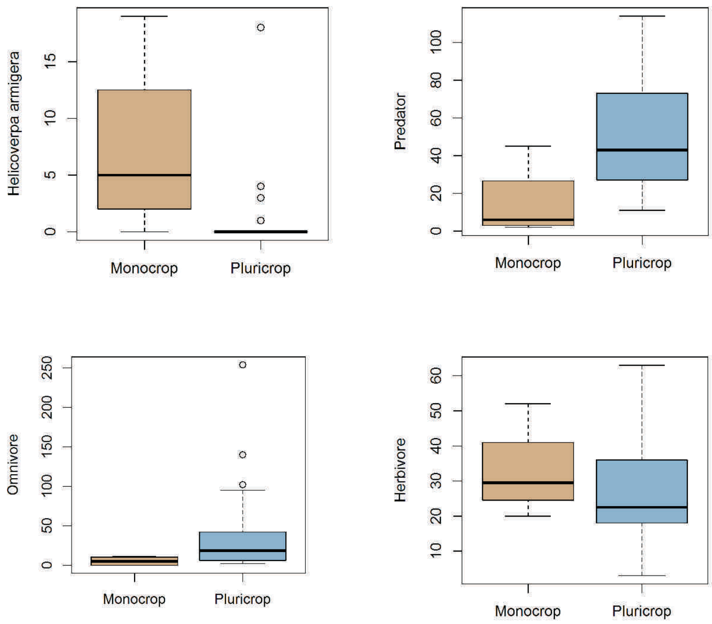


Figure 1. **Abundance of *Helicoverpaarmigera* and of 3 trophic groups according to the crop type**

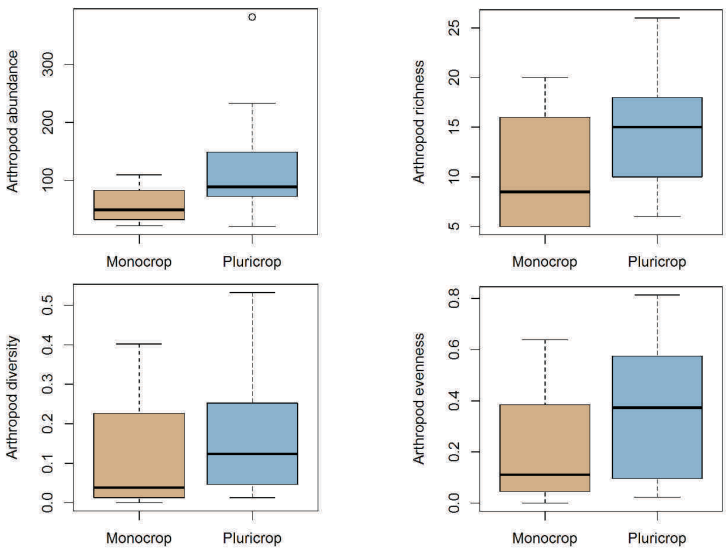


Figure 2. **Arthropod community indices according to the crop type**

Survey on Traditional Knowledge that are Compliant to Organic Standard

AyanfeOluwa, O. E.,*[1]
AdeOluwa O. O.[2] and
Gbadamosi, R. O[2]

[1]Department of Agriculture,
Federal College of Agriculture,
Ibadan, Nigeria

[2]Department of Agronomy,
University of Ibadan,
Ibadan, Nigeria

*Corresponding author:
ayanfeoluwaolufemi@gmail.com

Abstract

The adoption of organic agriculture has been limited in Africa by inadequate organic alternatives in addressing some agricultural problems. This survey therefore sought to identify some of the ecological traditional methods that could conform to organic standards. Farmers with vast experience in both crop and livestock production, from various parts of Nigeria were gathered using a focused group discussion (FGD), in the year 2017. Various traditional knowledge were captured from the FGD and the ones that were organic standard compliant documented. The information covered crop protection, livestock health management, preservation methods, bio-security, fruit set induction, etc. However, the efforts of scientists shall be required to validate and or calibrate some of the methods, which could serve as efficient alternatives (to conventional methods) in organic system.

Keywords:
Organic agriculture,
organic alternatives,
organic inputs,
traditional knowledge

Introduction

The advocacy and awareness on benefits of organic agriculture is vast spreading among farmers today in Africa. This has been aided by some projects, one of which is the Ecological Organic Agriculture Initiative (EOAI) project. However, a major challenge facing the adoption of organic system among farmers isinadequate organic alternatives in addressing some key agricultural problems such as crop pest and diseases control, storage and preservation, livestock pest and diseases control, etc. (AdeOluwa and Adeogun, 2011).Organic agriculture combines traditional knowledge, innovation and modern science to benefit the shared environment and promote fair relationships and a good quality of life for all involved (International Federation of Organic Movement, 2004). Hence, it could be possible to explore some indigenous (traditional) knowledge in addressing the problems limiting the practice of organic agriculture.

It has been observed that traditionally experienced farmers have some very useful and efficient indigenous knowledge in addressing their agricultural challenges (Sofia *et al*., 2006). Such knowledge could be compliant to organic standards, and might only require validation and or calibration. This survey work therefore documented some indigenous knowledge that could be compliant to organic system.

Methodology

Farmers with vast experience in both crop and livestock production, from various parts of Nigeria were gathered in the Federal Capital Territory, Abuja for a focused group discussion in the year 2017. The farmers provided information on traditional knowledge they are used to in solving various agricultural problems and these were captured and collated, while the ones that conform to organic standard were reported in this paper.

Farmers during the deliberations

Results and discussion

Some botanicals and natural products and their uses as reported by farmers

1. Siam weeds; *Chromolaenaodorata*: The leaves extract or grounded leaves are mixed with water and applied on crops to prevent pests. The leaves also has allelopathy properties against other plants / weeds. This is evident on why the growth of other weeds are suppressed around siam weeds. The leaves are fed to animals as antibiotics, it was reported to have been very useful in raising poultry from day olds.
2. Lemon grass; *Cymbopogonspp:* The leaf scent scares snakes from farm. The grass has been proven as a strong pesticide and preservative due to its anti-fungal properties.
3. Castor plants; *Ricinuscommunis*: The leaves if squeezed with water are used in plant protection. The plant may also provide bio-security for the farms if planted round the farm land. This is because animals like cattle resented the scent from the plants.

4. Chili pepper; *Capsicumannuum*: When grinded and applied on crops, it prevent insects' infestation in stored products, due to the presence of capsin.
5. Pawpaw; *Caricapapaya*: The leaves when fermented in water could be used as liquid fertilizers for crop production. The seeds have antibiotic properties and are used to build the immune system of livestock against diseases. They could be dried, grinded and added to animal feeds. Filtrates of pawpaw leaves and unripe fruits soaked in water could be giving to poultry to address coccidiosis.
6. Garlic; *Alliumsativum*: Garlic has a strong anti-fungal, anti- bacterial and anti-viral characteristics. It is used as pesticides in crop production and an antibiotic in animal health management. The active ingredients called allicin is released when the cloves are crushed.
7. Cassava; *Manihotesculenta*: The water waste from fermented cassava produces methane which prevent pest build-up on the farm. Also, the fermented waste water has been noticed to have weedicide properties. This could be as a result of the hydrocianide present in the cassava.
8. Bitter leave; *Vernoniaamygdalina*: The leaves extracts are squeezed mixed water to treat crops infestation. The dried leaves could also be mixed with animal feeds to serve as antibiotics.
9. Turmeric (*Curcumalonga*) and ginger (*Zingiberoffcinale*): These two spices are used in addressing health challenges in livestock production. Small, dry, grounded quantity could be added to animal feeds. They could also be blended and the extract is added into drinking water for livestock. Ginger, when crushed and spread around repels several pests from crops.
10. Bitter kola; *Cassiasinguena*: It is chopped to pieces and drop around the farm, repels snakes, insects and other reptiles.
11. Tobacco; *Nicotianatabacum*: The leaves are used as repellant of carrot fly and flea beetles.
12. Onion; *Aliumcepa*: This is a very strong repellant of rabbits, cabbage loopers, and small white flies.
13. Clove basil; *Ocimumgratissimum*: Basil has shown to have very potent anti-fungal and anti-bacterial characteristics. It also has insect repelling properties.
14. Jute mallow; *Corchorusolitorius*; Extract of fresh leaves of jute mallow is given to animals with dystocia (difficult birth). It is administered orally to animals to aid delivery.
15. Cassava peels: sprinkle dried cassava peels on hot coals, inside a pineapple field. The smoke induce fruit setting for pineapple. This could serves as alternatives to the use of synthetic chemicals to induce fruit setting in pineapple orchard.
16. Honey: Honey could be given to animals especially poultry as an anti-stress. This would replace the synthetic anti-stress required for poultry especially when they are moved from one location to the other. The honey is added to the drinking water for the animals.
17. Shea butter: This is very useful in treating mange and similar skin diseases in animals.

Specific challenges and the identified traditional solutions

S/N	Challenge	Materials used	Method/principles
1	Cattle invasion of farmers' crop field	1.Jatropha (*Jatrophaspp*) 2. Hot pepper (*Capsicumspp*) 3. Soybean (*Glycinemax*)	Plant jatropha or local hot pepper as fence crops. The sap from jatropha is poisonous and also itch their skin, while pepper is a natural repellant. Cattle donot graze on soybean, because it can lead to their death.
2	Monkey invasion of farmers field	Hot pepper	Monkeys by default, usually wash their faces on siting water. Provide bowl/pots of water with pepper solution on your farm. The sting of the pepper on their eyes would drive them away, and henceforth avoid visiting the area.
3	Ants and Termites infestation	Bone	Drop bones around the farm, the ants and termites will focus on the bone.
4	Birds invasion (especially rice fields)	1. Scare crows 2. Local gun	Erect scare crow in the open field or shot local gun in to the air once they infest, it scares them away.
5	Seed treatment	1. Wood ash 2. Soaking	Before planting seeds to the field, mix wood ash paste with seeds. It repels insects, nematodes and acts as fertilizer for the new seedlings. Soaking of some recalcitrant seeds in water breaks dormancy.
7	Rat and rodent infestation	Sodium Bicarbonate (Baking Powder)	Rats and most rodents are not known to fart. Mix baking powder in their trap food, once they eat, it generates gasses in their stomach, which leads to bloating and death.

The findings of this survey revealed that traditional knowledge captured covered crop protection, livestock health management, preservation methods, bio-security, fruit setting induction, etc. However, the efforts of scientists shall be required to validate and or calibrate some of the methods.

Scientists in the field of crop protection, animal health, soil fertility management are therefore required to take up the challenges to convert this set of raw information into goldmine for the farmers. This could be achieved through validation and or calibration of this documented indigenous / traditional knowledge. This would obviously address vast majority of the problems of the organic farmers and encourage other farmers to embrace the system.

Conclusion

The aim of this survey was achieved as various traditional knowledge that were in line with organic standards were documented. The information captured covered crop protection, livestock health management, preservation methods, bio-security, fruit set induction, etc. However, the efforts of scientist shall be required to validate and or calibrate some of the methods, before they could become useful in an organic system.

Acknowledgment

The authors appreciated all farmers that were present for the focused group discussion, where the indigenous knowledge documented in this work were gathered.

References

AdeOluwa, O. O. and Adeogun, O. O. 2011. Evaluation of the Potential of Feather Meal as Organic Fertilizer in Production of Amaranth *(Amaranthuscaudatus)*. Proceedings of the Third Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR), held at the 17th IFOAM Organic World Congress, 28. September – 1. October 2011 in Namyangju, Korea. Daniel Neuhoff, Sang MokSohn, Charles Ssekyewa, NielsHalberg, Ilse. A. Rasmussen and John Hermansen (Editors). 5-8.

International Federation of Organic Movement (IFOAM), 2004. Network building for lobbying in Africa. Compiled by Souleymane Bassoum, René Tokannou and NgujiMutura. IFOAM, Bonn.

Sofia, P. K., Prasad, R. and Vijay, V. K 2006. Organic farming- Tradition reinvented. Ind. J. Trad. Knowledge 5: 139-142.

Developing a Strategy for Sustainable Improved Soil Productivity in the Tropics – Efficient Management of Crop Residue/Farm Waste

*E.C. Odion[1], U. Ibrahim[1], B.E. Sambo[2], A. Ahmed[1] and A.A. Mukthar[1]

[1]Department of Agronomy, Institute for Agricultural Research, Ahmadu Bello University Zaria

[2]Dept. of Crop Production and Protection, Federal University Wukari, Taraba State

corresponding author: ecodion@yahoo.co.uk

Keywords:
Harvest index, crop residue, soil mining, residue burning and pollution, composting

Abstract

If soil productivity must be improved in the tropics, returning nutrients from crop residues back to the soil is a practice farmers must undertake to maintain the soil's fertility without resort to chemicals that can have negative impacts on the soil and the environment. Many smallholder farmers do not own livestock that can be used to process residues, and so they resort to burning of the residues so that the ash will be available to apply as a form of fertilizer. Burning residues result in the loss of most nutrients through volatilization; and the pollution of the environment through production of green house gases, contributing to global warming. If fed to livestock in-situ, they may not reap the full benefit of the crop residue as animals will leave the field after feeding and thus the excrement produced subsequently is not available as manure. To overcome this bottleneck, a method of composting is advocated where crop residues can be chopped in smaller bits, mixed with contents from the rumen of ruminants obtained from abattoir and some water and ensilaged in a pit or containers for some days to decompose. The same process can also be used for non-consumable parts of products taken to the market or home, so that the decomposed product (compost) is then returned to the farm to improve the soil's fertility. Application of compost will build up the soil's organic N, the loss of which is implicated in the loss of the soil's productivity.

Introduction

In many tropical and subtropical regions, land productivity among small-scale farmers has stagnated for years. The soils contain heavily weathered clay minerals with poor ion exchange capacity and their potential to absorb nutrients is low; resulting in the washing of mineral fertilizers applied. In addition, most crop production practices result in soil mining and if no attempt is made to return such nutrients to the soil it will lose its productive capacity; and such a soil is said to be degraded. For example, 8 t/ha of wheat harvested in Germany takes 180 kg of nitrogen, 37 kg of phosphorus and 124 kg of potassium from the soil (LFL, 2006). If however, only grains are harvested and the straw left on the land to be worked in or spread in stables and returned to the fields as manure, the volume of nutrients taken from the system will be reduced to 64 % of the original crop withdrawal in the case of nitrogen, 41 % of the phosphorus and 18 % of the potassium, showing that farming withdraws enormous amounts of nutrients from the soil; and the more intensively the land is farmed, the higher the yields and the greater the withdrawal. Mulvaney *et al*, (2009) showed that loss of organic N decreases soil productivity and the agronomic efficiency of fertilizer N and that this has been implicated in the widespread reports of yield stagnation or even decline for grain production in Asia.

Preserving and sustaining the soil's productive capacity is very important in the tropics due to the vagaries in the production climate of the region. Sunshine and temperatures are high and sometimes for very long periods during the dry season; rainfalls are sometimes scanty, resulting in poor crop establishment, growth and development. The application of chemicals can exacerbate the harsh conditions impoverishing the production environment for crops still further.

The global share of land farmed by smallholders is not known. In the 1980s, it was estimated to be 60% (Francis, 1986); and currently assumed to be at least 40%. Small-scale agriculture is vital for the livelihood of a vast majority of rural people, most of whom have no alternative sources of income. These farmers produce the majority of grains, almost all root, tubers and plantain crops, and the majority of the legumes. If they are therefore to improve productivity of these soils, management practices that will sustain the soil's production capacity must be maintained. These include - that the soil's chemical nutrients removed by crops must be replenished, and the physical condition of the soil must be maintained; that is the humus level must be constant or increasing; no build up of weeds, pests and diseases; no increase in soil acidity or of toxic elements and soil erosion must be controlled to be equal to less than the rate of soil genesis (Greenland, 1975).

Zingore *et al* 2011, reported a village analysis indicating that only a third of the village cropland could be covered with manure produced with its own livestock population in equilibrium with the carrying capacity of local grasslands. Thus, hunger, food insecurity and environmental harms will continue if current trends in population growth, food and energy consumption, and food waste are not curtailed (Tilman *et al.* 2011; Tomlinson, 2013); but to maintain the soil's capacity to produce food, it is imperative that we adopt sustainable and resilient agricultural practices as soon as possible. Currently the shifting cultivation, the bush fallow, the improved fallow, conservation agriculture are employed, but they can be improved by practicing the clipping/thinning management of legume crops for green manure (Odion *et al.* 2007). This will improve the fertility of the soil as well as detoxify acid soils (Woomer and Muchena, 1993; Hue et al 1986; Bell and Besho, 1993). The processes alone may not sufficiently feed the soil to ensure for intensification of production among smallholders, and thus, could necessitate composting; the biological and chemical decomposition and conversion of animal and plant waste into high quality humus. Thus crop/farm residues will be made available for use on the farm instead of either being burned or used for land filling as it is currently being done. But how can they be digested through composting? The process can be modified to involve ensiling crop/farm residues mixed with rumen contents or *Trichoderma* species - where available (Doni *et al.* 2017). If this is possible, it could be enlarged by involving or teaching smallholders to process their crop residues and other wastes from markets. Such wastes turned into compost, can be used to improve and sustain productivity, such that farms and perhaps grazing lands are improved. Cisse (1986), reported by Myers *et al*. (1994), demonstrated the effect of organic inputs on root development and crop yields in Senegal; also improved root production, assessed by the root-pulling resistance, is implicated in improved rice yield in early transplanted SRI rice production, Barison and Uphoff, 2011.

Materials and Method

Crop residues gotten from the farm or market were chopped into smaller sizes that can be managed easily and mixed with the rumen contents from the abattoir together with some water. The mixture was then put in a polythene container and tied to reduce draught and improve the temperature so that decomposition of the residues can take place. It was then put in a bucket, covered up and allowed to ferment for some weeks. The chopping into bits was to mimic chewing of the crop residue by animals; while reducing air draught was to mimic the condition in the rumen. The mixing with the contents of the rumen gotten from the abattoir was done using rubber gloves.

Results

This initial trial to demonstrate the feasibility of digesting crop residues shows that the process of digesting crop/farm residues to return to the farms is possible. However, observations made are that very dry materials are difficult to digest properly and so freshly harvested materials should be ensilaged as soon as possible instead of keeping them to dry. Chopped materials digest better than whole material as they seem to produce more surfaces for the rumen content to interact with the residue. Pictures of the compost made from maize stalk, rice straw and cowpea haulms are shown below.

Analysis of the rumen content used and the compost derived from the mixture will be beneficial to explain what happened to the crop residue and what is being added to the soil.

References

Barison, J and Uphoff, N (2011) Rice yields and its relation to root growth and nutrient use efficiency under SRI and conventional cultivation: an evaluation in Madagascar, Paddy Water Environ (2011) 9:65-78.

Bell, L.C. and Besho, T. (1993) Assessment of aluminum detoxification by organic materials in Ultisol using soil solution characterization and plant response. In: Dynamics of Organic Matter in Relation to Sustainability of Agricultural Systems. John Wiley and Sons, New York, pp. 317-330.

Cassman, K.G. (1999) Ecological intensification of cereal production systems: yield potential, soil quality and precision agriculture. *Proc. Natl. Acad. Sci.* U.S.A. 5952-5959.

Doni, F., Zain, C.R.C.M., Isahak, A., Fathurrahman, F., Anhar, A., Mohamad, W.N.W., Yusoff, W.M.W. and Uphoff, N. 2017. Organic Agriculture. DOI 10.1007/s13165-017-0185-7

Francis, C.A. 1986. *Multiple Cropping Systems*. 383pp. Macmillan. New York.

Greenland, D.J. 1975. Bringing the green revolution to the shifting cultivator. Science 190: 841-844.

Hue, N.V., Craddock, G. and Adams, F. (1986) Effects of organic acids on aluminum toxicity in subsoils. *Soil Science Society of America Journal*, 50: 28-34.

LFL. 2006 see WWF study D 2013. A soiled reputation: adverse impacts of mineral fertilizers in tropical agriculture

Myers, R.J.K., C.A. Palm, E. Cuevas, I.U.N. Gunatilleke and Brassard (1994). The synchronisation of nutrients mineralization and plant nutrient demand. In P.L. Woomer and M.J. Swift (eds). The Biological Management of Tropical Soil Fertility, 1994 TSBF. A Willey-Sayce Publication

Mulvaney, R.L., Khan, S.A., and Ellsworth, T.R. (2009) Synthetic nitrogen fertilizers deplete soil nitrogen: A global dilemma for sustainable cereal production. *J.Enviro. Qual.* 38: 2295-2314.

Odion, E.C., Asiribo, O.E., Ogunlela, V.B., Singh, B.B. and Tarawali, S.A. (2007) Strategies to improve and sustain food production capacity in the savannah: The role of leguminous fodder crops in maintaining soil fertility and soil health. *Journal of Food, Agriculture and Environment;* 5(2):338-344.

Odion, E.C., Ahmadu, I.S., Aminu, A.R., Luka, G.L., Isah, S.A. and Arunah, U.L. (2015) Determination of production efficiency of crop mixtures: The relevance of the agronomic efficiency method. *Agricultura Tropica et Subtropica,* vol. 48 (3-4) p. 59 – 66.

Odion, E.C. and Ahmadu, I.S. (2015) Response of Maize/Soyabean mixture to number of plants/stand, nitrogen fertility levels and green manure from the soyabean companion crop. *Agricultura Tropica et Subtropica,* vol. 48 (3-4) p. 67-74.

Tilman, D., Balzer, C., Hill, J. and Befort, B.L. 2011. Global food demand and the sustainable intensification of agriculture. Proc. Natl Acad. Sci. USA, 108: 20260 – 20264.

Tittonell, P. and Giller, K.E. 2013. When yield gaps are poverty traps: The paradigm of ecological intensification in African smallholder agriculture. *Field Crops Research,* 143:76-90.

Tomlinson, I. 2013. Doubling food production to feed the 9 billion: a critical perspective on a key discourse of food security in the U.K.. J. Rural Stud, 29: 81-90.

Zingore, S., Tittonell, P., Corbeels, M., Wijk, M.T. and Giller, K.E. 2011. Managing soil fertility diversity to enhance resource use efficiencies in smallholder farming systems: a case from Murewa District, Zimbabwe. Nut. Cycl. Agroecosyst. 90: 87-103.

Faecal Analysis of Pullet Birds Administered Aqueous *Lagenaria Breviflora* Robert Extract

*Ekunseitan, D.A.,
Adeleye, A.E. and
Osoyode, B.G.

Department of Animal Production and Health,
Federal University of Agriculture,
PMB 2240, Abeokuta,
Ogun State, Nigeria

*Corresponding author:
ekunseitandeji@gmail.com;
ekunseitanda@funaab.edu.ng

Keywords:
Ethno-veterinary,
Poultry Health, Phytobiotics

Abstract

There is need to eradicate the usage of antibiotics in poultry industry due to the harmful residual effect on human health. A 98-days experiment was carried out at Directorate of University farms FUNAAB to determine the efficacy of aqueous extract of fruits of Lagenaria breviflora Robert on faecal samples of pullet birds. Ninety (90) pullet birds at two weeks old were treated with (100 and 150g of Lagenaria breviflora per litre of water) replicated three times (15 birds each). Data collected on faecal analysis (at weeks 8 and 16) were subjected to independent sample T-test. The analyzed result revealed a significant ($p<0.01$)decrease in the oocyst per gram, egg worm count and total bacteria egg count at weeks 8 and 16respectively. However, higher and best count reduction in oocyst, egg worm and likewise the Total bacterial count was obtained in 150g group compared to the 100g group. Therefore an alternative to conventional drugs, aqueous extract of the fruit of Lagenaria breviflora Robert can be used at the rate of 150g per litre of water.

Introduction

Antibiotics are mostly used at sub-therapeutic level to improve the production performance of poultry birds. However, consistent use of antibiotics has led to various health issues and also a major contributor to higher feed cost. Thus, it is imperative to sort for alternatives that could effectively and economically substitute antibiotics (Toghyani *et al.,* 2011).Phytobiotics are natural growth promoters derived from herbs and spices as alternative to cure poultry diseases. Worthy of mention is *Lagenaria breviflora* Robert (Spotted Pumpkin) which has been relevant in Ethno-veterinary (rural poultry health management) (Ekunseitan *et al.,* 2016a).Ethno-veterinary involves the application of local veterinary knowledge, theory and practice to avoid, control and treat ailments in livestock. *Lagenaria* is a genus of gourd-bearing vines and consists of many species indigenous to tropical Africa (Morimoto *et al.,* 2004). *Lagenaria breviflora* Robert (Spotted pumpkin) is one of the phytogenic plants used as antibacterial and antiviral herbal remedies and common in West Africa. It flowers during the rainy season and fruits during the dry season. It is used as herbal remedy in both man and animals. Its extract has been used indiscriminately by rural poultry farmers in curing wide range of diseases with no real study done to affirm the said potency and action against several disease conditions. This study was therefore carried out to determine the potency of aqueous extract of the fruits of *Lagenaria breviflora* Robert on faecal samples of pullets.

Materials and Methods

Experimental Site
The experiment was carried out at the poultry unit of the Directorate of University Farms, Federal University of Agriculture, Abeokuta, Ogun State, South Western Nigeria. The area lies on latitude $7^{o}10'$Nand longitude $3^{o}2'$E above sea level (Google Map, 2017).

Processing of Experimental Materials
Fresh fruits of *Lagenaria breviflora* Robert fruits were washed, weighed and cut into desirable sizes of 100g per litre of water and 150g per litre of water respectively and left for 24hours.Aqueous *Lagenaria breviflora* Robert extract obtained at different dosages (100g/1litre and 150g/1litre of water) were given orally to the birds.

Experimental Birds and Management
A total of ninety (90) Yaffa Brown at two (2) weeks old chicks were used for the experiment. The birds were randomly allotted to two treatment groups and further sub-divided into three (3) replicates of fifteen (15) birds each. Birds in each treatment were given only aqueous *Lagenaria breviflora* Robert extract three days a week at dosages of 100g/1litre and 150g/1litre of water respectively with no conventional drugs or vaccines used. The experiment duration was 98days (14weeks) and was sectioned into two phases; chick phase (14^{th} -56^{th} day) and growing phase (57^{th} -126^{th}day).The birds were fed *ad libitum* with compounded feed from the starting phase i.e. 0-8 weeks on starter feed of crude protein 23% to the growing phase i.e. 9-18 weeks on grower feed of crude protein 15%.

Data Collection
Faecal Analysis: Faecal samples were collected at week 2, 8 and 16 to determine bacterial load, oocyst and egg worm count. Average faecal samples were collected from each replicate using swab sticks. Bacteria colonies were counted using a colony counter while oocyst and egg worm count was determined using the MacMaster (Maff, 1986) method.

Statistical Analysis
Data collected were analyzed using Independent Sample T-test at 99% confidence interval and presented in bar charts.

Results and Discussion

Effect of *Lagenaria breviflora* Robert administration on the Oocyst count of Pullet Bird
The effect of *Lagenaria breviflora* (Benth) Robert administration on excreta oocyst count of pullets is presented in Figure 1. Both levels of Aqueous extract of *Lagenaria breviflora* Robert highly ($P<0.01$) influenced the oocyst count of birds across the phases of growth (weeks 8 and 16). There was continuous reduction in the counts across each phase of growth, with the highest count reduction observed in 150g group. This is in agreement with Okitoi *et al.,* (2007) who stated that herbal preparations are used traditionally for improvement of poultry health in developing countries. Bioactive components in its fruits has been reported (Adeyemi *et al*., 2017) most especially the phenolic compound termed oocysticide (Williams, 1997) and active against *Eimeria* spp. as observed in the present study (The main parasitic oocyst found in the analyzed faeces was identified as *Eimeria*). This confirms the ability of spotted pumpkin in treating coccidiosis confirming reports of appraisals conducted by researchers

(Tomori *et. al.,* 2007; Ekunseitan *et al.,* 2016) among rural poultry farmers. It could hence be inferred that the effect of the aqueous fruit extract of *Lagenaria breviflora* Robert on coccidian oocyst output was dose dependent. Similar dose related responses in faecal oocyst count on coccidian infection in broiler chickens had been reported previously, Biu *et al.,* 2006 on neem (*Azadirachta indica*) aqueous and El-Khtam *et al. (*2014) in broilers infected with *Eimeria* species and treated with turmeric (*Curcuma longa*) or garlic (*Allium sativum*).

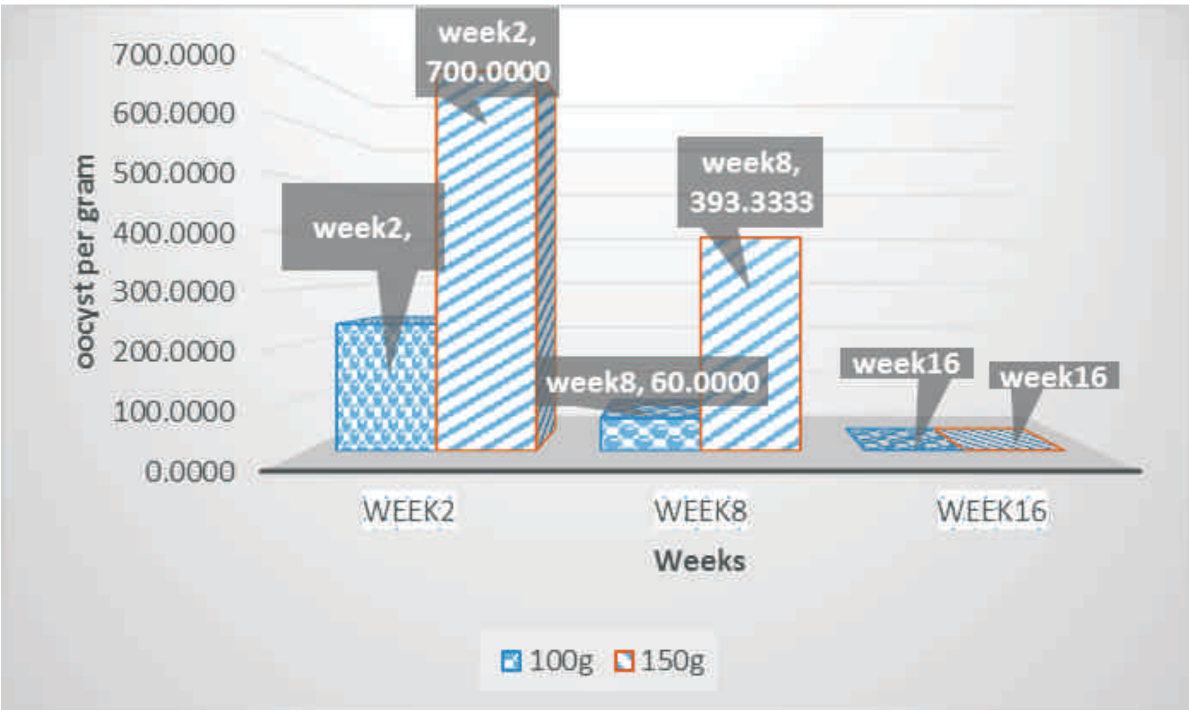


Figure 1. **Effect of *Lagenaria breviflora* Robert administration on the Oocyst count of Pullet birds**

Effect of *Lagenaria breviflora* Robert administration on Total Bacterial Count of Pullet Birds

The effect of *Lagenaria breviflora* Robert administration on the total Bacterial Count of pullets presented in Figure 2 positive effect ($p<0.01$) on total Bacterial Count. The reduction was higher in 150g group recording the least (0.35 cfu/g) value compared to 100g group. This can be attributed to the presence of saponin and tannin (Lai *et al.,* 2010 Ekunseitan *et. al.,* 2016a) which is indicative of its anti-microbial activity. This also affirms the *in vivo* study conducted on its fruit extract on selected pathogenic organisms (Ekunseitan *et al.*, 2016a). Tricosane an active compound identified (Adeyemi *et al.*, 2017) and also present in Neem (Lacikova *et al.*, 2007) is known to have an inhibitory effect and also positively disrupts membranes of bacterial cells. The following bacterials were identified *Escherichia coli, Bacillus spp*, *Klebsiella spp, Streptoccocus faecalis*, *Pseudomonas spp*, *Staphylococcus aureus* and were totally eradicated in the 150g group. Jamroz *et al*. (2005) observed a significant reduction of *Escherichia coli* number following an application of natural plant extract.

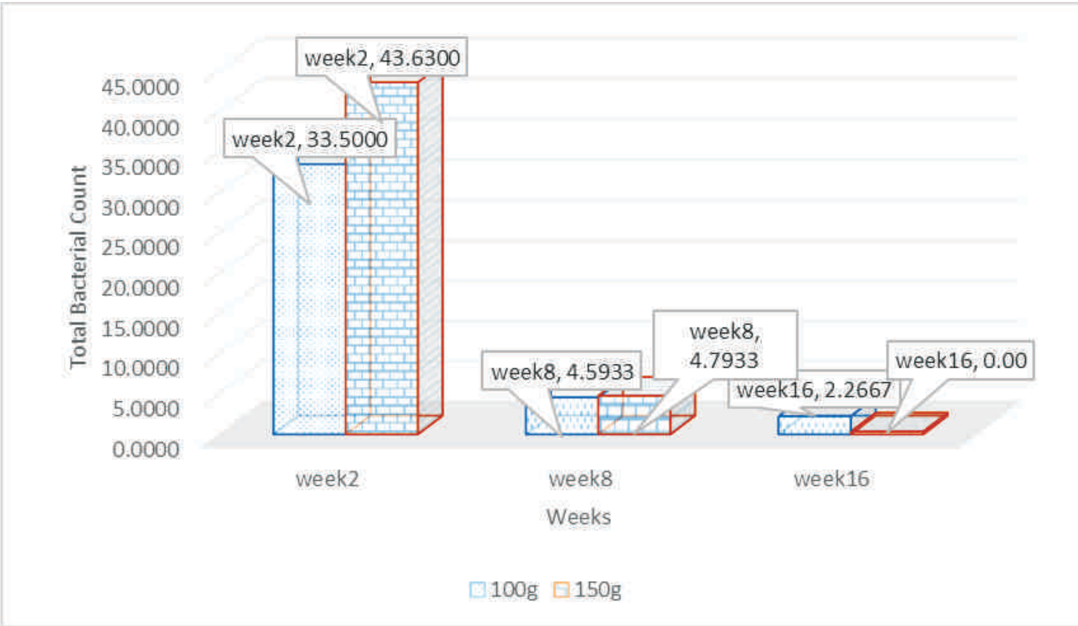


Figure 2. **Effect of *Lagenaria breviflora* Robert administration on Total Bacterial Count of Pullet Birds**

Effect of *Lagenaria breviflora* Robert administration on the Egg worm count of Pullet Birds

The Effect of *Lagenaria breviflora* Robert administration on the Egg worm count of Pullet Birds is shown in Figure 3.Though values observed was similar at the start of the experiment. A highly significant (P<0.01) continuous reduction was observed all through with 100 percent reduction obtained in 150g dosed group. The mode of operation of *Lagenaria breviflora R.* may due to its rich content of saponins, flavonoids and tannins capable of inducing oxidative stress on parasites leading to reduced count and low degree of parasitization. The phenolic metabolites with the highest concentration of occurrence in *Lagenaria breviflora R.* could be responsible for the positive effect on helminthic organisms interfering with the glycoprotein of the parasites cuticle leading to death and expulsion (John *et al.,* 2009) from bird's body system.

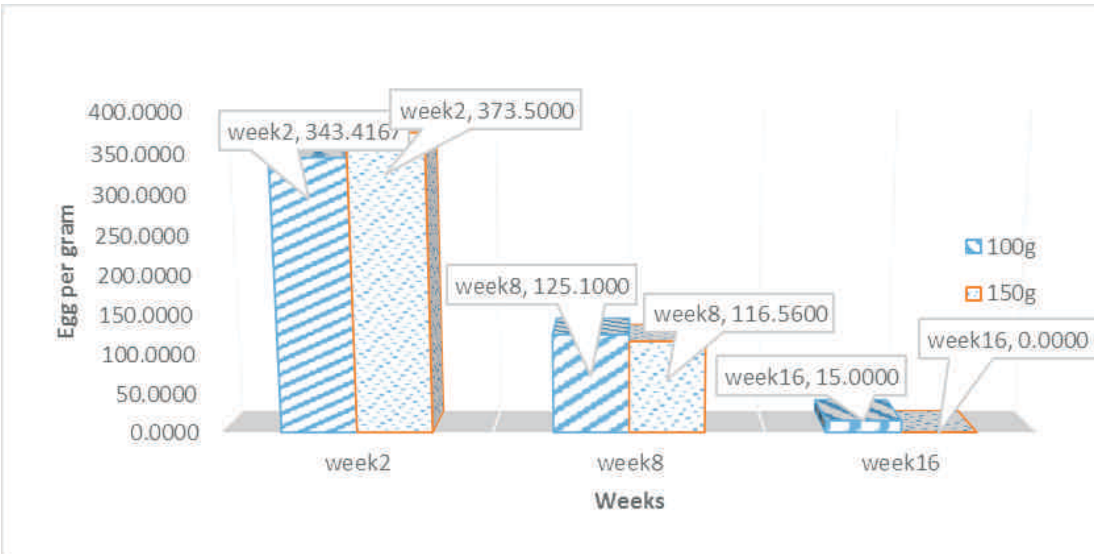


Figure 3. **Effect of *Lagenaria breviflora* Robert administration on the Egg worm count of Pullet Birds**

Conclusion

The administration of the aqueous fruit extract of *Lagenaria breviflora* Robert at 150g/litre of water greatly reduced oocyst count and total Bacterial Count of pullet birds and could therefore be recommended to manage and reduce oocyst and bacterial counts in chickens either as curative or prophylactic measure.

References

Adeyemi, M.A, Ekunseitan, D.A., Abiola, S.S.,Dipeolu, M.A.,Egbeyale, L.T.and Sogunle, O.M. 2017. Phytochemical Analysis and GC-MS Determination of Lagenaria breviflora R. Fruit. *International Journal of Pharmacognosy and Phytochemical Research* 9(7): 1045-1050.

Ekunseitan, D.A., Yusuf, A. O., Olayinka, O.A., Ayoola, A.A. and Adegbenjo, A.A. 2016a. Comparative study of two plants (*Lagenaria breviflora* and *Petiveria alliacea*) and their phytobiotic potential in poultry health. *Nigerian Journal of Animal Production* 43(1): 289-298.

Ekunseitan, D.A., Adeyemi, M.A., Abiola, S.S., Oluwatosin, O. O., Sogunle, O.M. and Fabusoro, E. 2016b, 'Perception of Ethno-veterinary Practices in selected villages in Ogun state, *Nigerian Journal Animal Science,* 18(1):108-127.

Google Maps 2015, 'Federal University of Agriculture', Retrieved January 12, 2017 from https://www.google.com.ng/maps/place/Federal+University+of+Agriculture,+Abeokuta/@7.2232996,3.4381405,17z/data=!4m5!3m4!1s0x103a37c0008d6809:0x62771eac522d2734!8m2!3d7.2233069!4d3.4403401?dcr=0.

Jamroz, D., Williczkiewicz, A., Werteleck, T., Orda, J. and Skorupinska, J. 2005. Use of Active Substances of Plant Origin in Chicken Diets Based on Maize and Locally Grown Cereals. *Britain Poultry Science.,*46(4): 458-493.2.

John, J., Mehta, A., Shukla, D. and Mehta, P.A. 2009. Report on anthelminthic activity of *Cassia tora* leaves. *Journal of Science and Technology* 31: 269 - 271.

Maff, 1986. Manual of Veterinary Parasitological Laboratory Techniques. HMSO, London.

Morimoto Y., Gikugu M., Herwig T. and Maundu, P.2004. Pollinators and biological diversity; the case of the bottle gourd (*Lagenaria siceraria*) in Kenya.

Okitoi L.O., Ondwasy H.O., Siamba D.N., Nkurumah D., 2007. Traditional herbal preparations for indigenous poultry health management in Western Kenya. *Livestock Research Rural Development*. 19 (5) (http://www.cipav.org.co/lrrd19/okit19072.htm)

Toghyani, M. and Gheisari, G. 2011. Performance, immunity and hematological parameters in broiler chicks fed dietary thyme as alternative for an antibiotic growth promoter. *African Journal of Biotechnology*ISSN:1684-5315.

Tomori, O.A., Saba, A.B. and Dada-Adegbola, H.O. 2007. Antibacterial activity of ethanolic extract of whole fruit of *Lagenaria breviflora Roberts*. *Journal of Animal Veterinary Advances* 6:752 - 757.

Williams, R.B. 1997. Laboratory Tess of phenolic disinfectants as oocysticides against the chicken coccidium Eimeria tenella, Vet Rec 141: 447-448.

Parasitic Prevalence and Indigenous Medicinal Plants used in Traditionally Managed Cattle in Odeda Local Government Area, Ogun State, Nigeria

Fasae O.A and Showale, A.G.

Department of Animal Production and Health, Federal University of Agriculture, P.M.B 2240, Abeokuta, Nigeria

Corresponding author:
animalexp@yahoo.co.uk

Keywords:
Cattle management, parasites, indigenous, medicinal plants

Abstract

An investigation was carried out on the parasitic prevalence and indigenous medicinal plants that are used in the traditionally managed cattle rearing in Odeda local government area, Ogun state, Nigeria. Faecal egg count analysis and microscopic identification were used to assess the gastro intestinal and external parasites, respectively, and a structured questionnaire used to collect data on medicinal plant parts and their usage. The overall prevalence of parasitic infection was high across the study area with Strongyles and Eimeria identified as main gastrointestinal parasites while ticks, mites and lice were identified as the major ecto-parasites. Ten indigenous plants were identified and evaluated for the treatment of parasites in cattle with the leaves being widely utilized compared to the other plant parts. Some of these plants provide multipurpose remedies, preventing or curing several kinds of ailments and the mode of preparation and application of these plants parts require different methods. Respondents preferred these plants because of easy accessibility (89.5%), while 81.25% and 51.33% of the respondents prefer it because it is economical and traditional in nature respectively. About 77.5% of the respondents claimed its simplicity and effectiveness in healing without visible adverse effects. It was therefore concluded that the study areas are rich source of medicinal plants for disease management in the traditional cattle production system. However, there is need to scientifically ascertain the authenticity of the use of these medicinal plants.

Introduction

The traditionally managed cattle are an integral part of Nigerian agriculture as they play an important role in the economy as suppliers of milk, meat and draft power. However, parasitic infestations are a major cause of mortality and sub-optimal productivity in grazing cattle in Nigerian pastoral systems (Kudi and Kalla, 2001, Biu and Adindu, 2004) and most of these parasitic diseases are significantly important in the aspect of economic as well as public health. As a consequence, the control methods mainly rely on the use of curative or preventive treatment with anthelmintics which has led to an ever increasing anthelmintic resistance problem.

The search for new and more effective remedies for controlling parasitic diseases of livestock has given rise to the study of plant based remedies. Plants not only grant food and shelter to human beings but have served, through centuries, as a constant source of medication for the treatment of a variety of diseases (Shen *et al.,* 2010). The use of medicinal plants in the treatment of diseases in livestock otherwise called ethno-veterinary medicine is a community-based indigenous knowledge and methods of caring for, healing and managing livestock. It consists of local peoples' knowledge dealing with folk beliefs, skills, methods and practices pertaining to animal health care and production (Misral and Kumar, 2004) which has been part of human culture since ancient times. Using medicinal plants for the prevention and treatment of livestock diseases can be promoted as an alternative or complementary to allopathic drugs and it will help in poverty alleviation by empowering the people to use their own resources. The objectives of the present study were therefore, to investigate into the parasitic prevalence and indigenous medicinal plants used in traditionally managed cattle, thereby facilitating the development and implementation of natural control strategies relevant to cattle production systems.

Materials and Methods

The study was carried out in five different locations, namely: Oojo, Alabata, Odeda, Isolu and Apakila in Odeda local government area of Ogun State, South-West Nigeria, which is located on Latitude 7^0 231 N and Longitude 3^0 411E. It occupies an area of 1,658km^2 with an estimated population of 864,322 according to the 2006 Nigerian census. The area has a tropical climate with distinct dry and wet seasons characterized by the prevalence of the moist south westerly monsoon winds that results in heavy rainfall spread between March and October (Amori *et al.* 2012). The studied villages were selected because of the dominance of the nomadic cattle rearers in the areas. Cattle rearers were selected at random in each community and their cattle were physically examined for parasitic infestation and level of infestation. Parasites were collected from each cattle by forceful detachment and put into different labeled experimental bottles and transported immediately to the laboratory and identified with the aid of a compound microscope.

About 2 to 4 grams of faecal samples were obtained directly from the rectum of the animal with the use of rubber gloves and kept chilled prior to analysis. The faecal egg count analysis was carried out using McMaster techniques. All the specimens were identified and specific species present were determined.

The data on various common disease incidences among their animals, plants or plant parts used in ethno-veterinary practices as well as the mode of preparation and administration of the plants parts were collected using a well-structured questionnaire. Plants were identified through their local names and samples/ pictures collected for identification and confirmation (Odugbemi and Akinsulire, 2006). Descriptive statistics was used to analyze the data. Simple percentage and tables were used to describe the results.

Results

The present study revealed an overall high prevalence of endo-parasites in the five locations (Figure 1) with the most prevalent being Strongyles and *Eimeria* oocyst. The strongyle has the highest infestation percentage compared to *Eimeria* across locations.

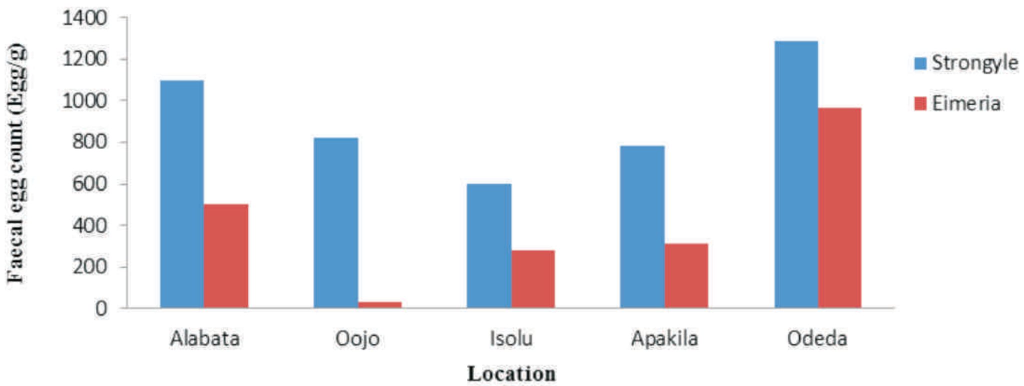


Figure 1. **Infection level of endo-parasites in the study areas**

Figure 2 shows the prevalence of ectoparasites in cattle in the five villages. All the animals examined were infested with ticks, mites and lice, but with higher tick prevalence compared to lice and mites. However, there was variation in the prevalence of various species of ectoparasite across localities.

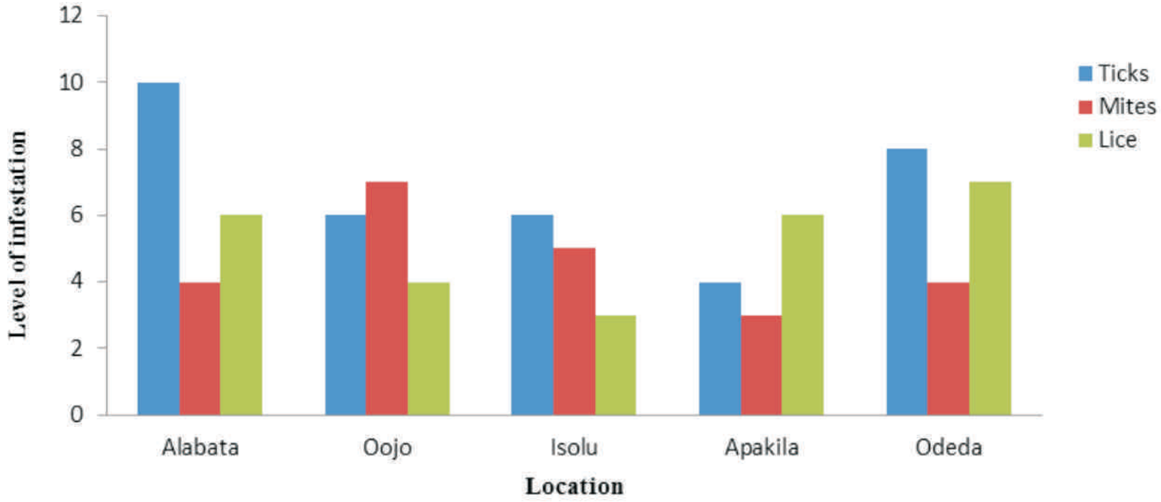


Figure 2. **Frequency level of ectoparasite infestation in the study areas**

Table 1. **Medicinal plants used for the treatment of parasitic infestation in traditionally managed cattle in the study area**

Scientific name	Common name	Local Name*	Part used	Diseases cured	Application
Ficus exasperate	Sand paper	Opoto	Leaves	Ectoparasites	Mash leaves and apply liquid to the affected part.
Azadirachtaindica	Neem	Dongoyaro	Bark/ leaves	Worms/parasites	Soak leaves or bark in water and give orally or drench the animal.
Parkiabiglobosa	Locust bean	Iru	Seeds	Foot pain/ Diarrhoea	Use grinded seeds to rub affected part till symptoms disappear.
Spondiasmombin	Hog plum	Iyeye	Leaves	Ectoparasites	Dry the seeds and mix with water, then administer orally.
Solanumaculestrum	Love apple	Odu	Fruits	Streptothricosis	Roast fruits, slice into halves. Scrub the affected area for 1-3 days.
Citrus aurantifolia	Lime	Osan-wewe	Leaves	Diarrhoea	Give the liquid extract to animal orally until symptoms disappear
Newbouldialaevis	Boundary plant	Akoko	Leaves	Anthelminthic/ Constipation	Leaves are squeezed and given to animals.
Nicotianatabacum	Tobacco	Taba	Leaves	Cold/ Mange	Mash leaves and rub the affected part.
Piliostigmathonningii	Monkey bread	Abefe	Leaves/ Twig	Skin diseases	Apply liquid from mashed leaves and twig to the affected parts.
Tephrosiavogelii	Fish bean	Orobeja	Leaves	Tick	Pound leaves, soak with wood ash in water, stir, filter and add animal urine. Bathe animal with solution.

**Local names are either in Hausa or Yoruba languages*

Table 1 presents the list of plant species and other traditional methods used in the treatment and management of parasitic diseases of cattle in the study areas. Ten (10) plants were identified by respondents for the treatment of parasitic diseases in cattle as depicted in Figure 3. It was evident that various plants were extensively used through different herbal preparations administered to the animals. It was also observed that various plant parts namely the leaves, bark, roots, leaves, twigs, seeds and sometimes the fruits were used as remedies for a variety of parasitic conditions in the traditional cattle production system, with the leaves been widely used. However, the mode of preparation and application of these plants parts in the treatment of parasitic infestation in traditionally managed cattle in the study areas require different methods.

In terms of the reasons associated with the preference for the use of medicinal plants among the cattle rearers, Figure 4 shows that majority of the respondents preferred these plants because of easy accessibility (89.5%), while 81.25% and 51.33% of the respondents prefer it because it is economical and traditional in nature, respectively. However, 77.5% of the respondents claimed its simplicity and effectiveness in healing without visible adverse effects.

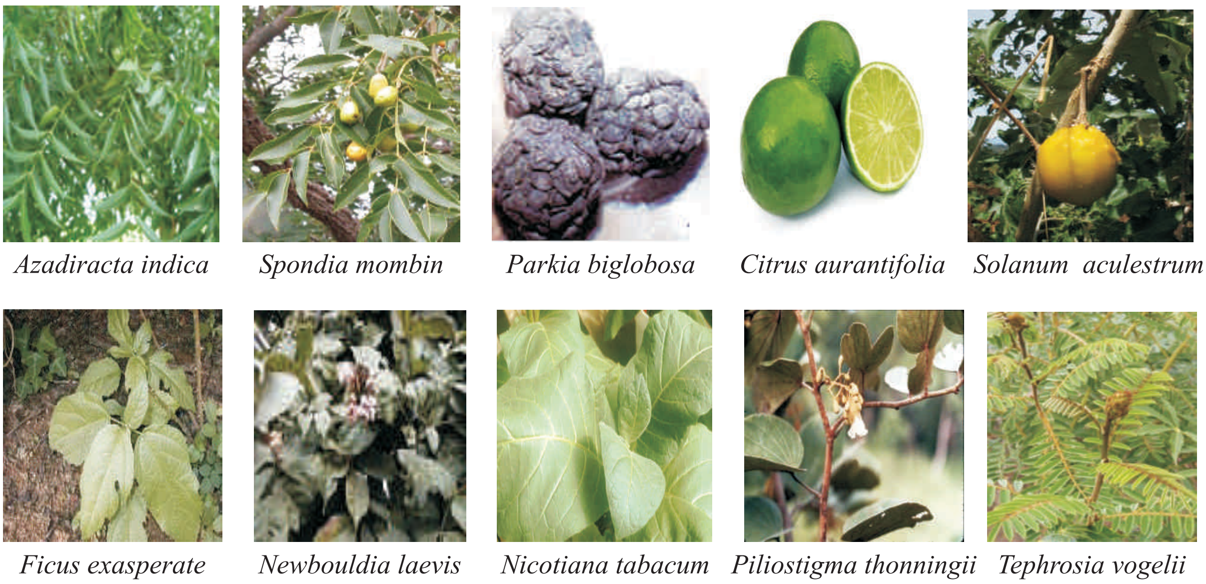


Figure 3. **Pictures of medicinal plants used for the treatment of parasitic infestation in traditionally managed cattle in the study areas.**

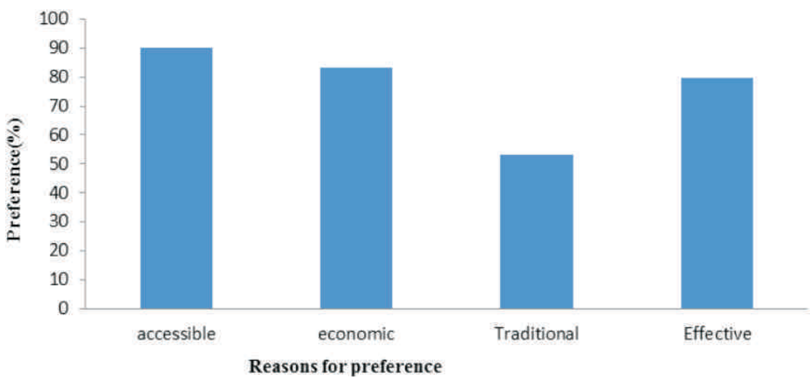


Figure 4. **Reasons for preference of the use of medicinal plants by cattle rearers**

Discussion

The high infection level of endo parasites as shown in the results of this study could be as a result of high levels of parasitic contamination in the pastoral environment. This corroborates earlier findings in different ruminant species grazing natural pastures in the tropical environment (Mulugeta *et al.,* 2010; Edosomwan and Shoyemi, 2012; Pam *et al.,* 2013). In addition, the period of study being in the early rainy season could have contributed to the relatively high parasitic infections. The high moisture content during the period of study could however, have favoured the growth and development of the young stage of these parasites on pasture resulting to increased contact between the host and parasites. Agyei (1997) observed that, the number of infective larvae on pasture was directly related to the pattern of rainfall and influenced by the number of rain days in the period. Moreover, the observed high prevalence of strongyle in this study supports earlier reports of Regassa *et al,* (2006) and Squire *et al.,* (2013) of high prevalence of strongyle in cattle in sub Saharan Africa.

High humidity has been attributed to favour the development of eggs into infective larvae (Hansen and Perry, 1994) and the particular climate of an area has also been found to influence the grazing management of ruminants because egg hatching and larval development both depend on prevailing climatic conditions (Rahmann and Seip, 2007). Moreover, the poor farm management techniques such as poor hygienic conditions, housing, feeding, grazing methods and watering systems could also be contributing towards the high prevalence of parasites within the herd, as disease may be as a result of poor environment and husbandry. Manuel and Galdones (1982) stated that the level of nutrition, kind of management and amount of rainfall influence the severity of parasitism. The severity of endoparasite infection in this study could also have been influenced by the movement of animals from one place to another which is a common feature of the Fulani cattle rearers.

The higher tick prevalence compared to lice and mites, across locations is in consonance with the reports (Leeflang and Ilemobade, 1977; James-Rugu and Iwuala, 2002) that ubiquitous tick species are major parasites infesting a wide range of domestic and wild animals in most parts Africa countries while serving as vector of *Cowdria ruminantium*, the causative agent of heart water disease of ruminants in Nigeria. Skin diseases caused by lice, ticks and mange mites are among the major diseases of cattle causing serious economic loss to the farmer. It has been observed that ectoparasites do not only have direct effects on their host, they may also transmit pathogens, thereby acting as vectors of diseases (Parola *et al.,* 2001). The infestation by ticks is capable of causing bacterial and fungal infestation and other forms of parasitism due to wounds emanating from tick bites in the animal skin, thereby causing a decrease in production and reproduction, and downgrading and rejection of skins (Bekele, 2002; Gumel, *et al.,* 2015).

The high tick infestation observed in this present study compared to other ectoparasites could be attributed to long period of humid climatic condition in the study area. Humidity and prolonged sunlight has been found to favour the survival and reproduction of ticks (Sajid *et al.,* 2008). Other possible factors that could have warranted the prevalence of high ectoparasite infestation in the study area may include environmental conditions under which the animals are kept (Soulsby, 1978). For example, most of the animals observed in this study are kept in extremely dirty environment with organic wastes and under direct sunlight, which are favourable for the transmission of ectoparasites. Also, the process of movement of cattle from one community to another is a possible risk factor which could facilitate transmission of parasites by direct contact. This scenario could enhance direct, prolonged and sustained bodily contact between the cattle consistently, thereby enhancing ectoparasites spread amongst the animals (Mulugeta *et al.,* 2010).

The preference for the use of plant leaves been widely used in this study confirms reports that indicated preference for the use of plant leaves because it is more convenient to collect leaves than root parts, flowers and fruits (Giday *et al.,* 2009). Plant leaves have also been known to be actively involved in photosynthesis and the production of metabolites (Ghorbani, 2005). Thus, the numerous constituents found in leaves could explain their efficacy in the treatment of various ailments in cattle. This therefore suggests that the basic active ingredients used for treating various ailments are accumulated in the different parts of plants being used, showing that most of these plants contain some physiologically active compounds, which are known to be potent medicines (Iwu, 1993).

Some of the medicinal plants recorded in this study have been found by earlier researches to contain antimicrobial activities, with most of them observed to provide multipurpose remedies, preventing or curing several kinds of ailments. *Piliostigma thonningii* have been reported to be used by Fulani herdsmen in the management of animal diarrhoea in Plateau State, Nigeria (Offiah *et al.,* 2012). The potential of *Azadirachta indica* as trypanocidal and anthelmintic has been reported (Nok *et al.,* 1993, Jabbar, 2006). The root and twig of *Piliostigma thonningii* has also been used for the treatment of dysentery, fever, snake bites, hookworm and skin disease as well as laxative, anthelmintic and anti-inflammatory agents (Fakae *et al*., 2000; Igoli *et al.,* 2005). *Spondias mombin* have however been found to be used for treating retained placenta and mastitis in ruminants (Olanipekun *et al.,* 2013; Adeola *et al.,* 2014).

Conclusion

It was concluded from the results of this investigations that the study areas were infested with relatively high parasitic burdens with the possession of rich source of medicinal plants which if adequately harnessed could be a natural option in the treatment and control of parasites in cattle. Consequently, cattle farmers should be encouraged through proper awareness and sensitization programme on the various precautionary measures to prevent parasitic infestation as well as the potential of the available natural medicinal plants in the treatment of parasites in cattle. Also, more detailed studies on indigenous medicines to know their active ingredients and properties are also recommended.

References

Adeola A.O., Adewole, S.O. and Olofintoye L.K. (2014) Studies on Ethnoveterinary Practice in Ruminants in Ekiti State, Nigeria. *Research Journal of Agriculture and Environmental Management.* 3(12): 632-645.

Agyei A.D. (1997). Seasonal changes in the level of infective strongylate larvae on pasture in the coastal savanna regions of Ghana, *Veterinary Parasitology*, 70: 175–182.

Amori A. A., Oduntan, O.O., Okeyode I.C. and Ojo S.O. (2013). Heavy metal concentration of groundwater deposits in Odeda region, Ogun state, Nigeria, *Journal of Environmental Research and Management,* 4(5): 253-259.

Bekele T. (2002). Studies on seasonal dynamics of ticks of Ogaden cattle and individual variation in resistance to ticks in Eastern Ethiopia. *J. Vet. Med*. 49: 285–288.

Biu, A.A. and Adindu, J.U. (2004). The prevalence of bovine hydatidosis in Maiduguri, Nigeria. *Journal of Life and Environmental Science*, 6(2): 360-362.

Edosomwan E. U. and Shoyemi O.O. (2012). Prevalence of gastrointestinal helminth parasites of cattle and goats slaughtered at abattoirs in Benin City, Nigeria, *African Scientist*, 13, (2):109-114.

Fakae B.B, Cambell A.M, Barrett J., Scott I.M, Teesdale-Spittle P.H., Liebau E., Brophy .PM. (2000). Inhibition of gluthathione S-transferase(Gsts) from parasitic nematodes by extracts from traditional Nigerian medicinal plants. *Phytother Res.,* 14: 630-634.

Ghorbani, A. (2005) Studies on pharmaceutical ethnobotany in the region of Turkmen Sahra, north of Iran (Part1): General results, *J. Ethnopharmacol*., 102: 58-68.

Giday M., Asfaw Z., Woldu Z. and Teklehaymanot T. (2009). Medicinal plant knowledge of the Bench ethnic group of Ethiopia: an ethnobotanical Inventory. *J. Ethnobiol. Ethnomed*. 5: 34.

Gumel M.A., Inuwa, S., Qadeer, M.A. and Abdurrahman, S.L. (2015). Dry season survey on abundance and distribution of Ixodid ticks in cattle in Auyo local government area of Jigawa state, Nigeria. *Proceedings of the 40th Annual Conference of the Nigerian Society of Animal Production,* held in NAPRI, Ahmadu Bello University, Zaria, pp. 178- 180.

Hansen J. and Perry B. (1994). The Epidemiology, Diagnosis, and Control of Helminth Parasites of Ruminants.FAO. Rome, Italy, Pp. 317.

Igoli J.O, Ogaji, O.G, Tor-Anyin, T.A, Igoli, N.P. (2005). Traditional medicine practice amongst the Igede people of Nigeria part II. *Afr. J. Trad. Cam*., 2: 134-152.

Ismail, (2004). Nomadic education and education for nomadic Fulanis. Washington DC, USA.

Iwu, M. M., (1993). Handbook of African Medicinal Plants. C.R.C. Press Boca Taton, Ann cbor Tokyo London.

Jabbar, A., Raza M.A., Iqbal Z., and Khan M.N. (2006). An inventory of the ethnobotanicals used as anthelmintics in the southern Punjab (Pakistan). *Journal of Ethnopharmacology*, 108: 152-154.

James-Rugu, N. N. and Iwuala, M. O. E. (2002). Ectoparasites of some domestic animals in Jos Plateau.*Nigerian Science Forum,* 5 (1): 149-156.

Kudi A.C., and Kalla D.J.U. (2001). Prevalence and effect of parasitic infections on cycling in traditionally managed cattle herds in Bauchi, Nigeria. *Pertanika J. Trop. Agric. Sci.* 24(2): 87-93.

Leeflang, P., and Ilemobade, A.A. (1977). Tick-borne diseases of domestic animals in Northern Nigeria II: Research Summary 1966 to 1976. *Tropical Animal Health and Production,* 9: 211-218.

Manuel M.F. and Galdones A.C. (1982). Prevalence of gastrointestinal helminths of cattle and Carabao calves in central Luzon, Phil. *The Phil. J Vet. Med*.,p.60.

Misral K.K., Kumar A.K. (2004). Ethno-veterinary Practices among the KondaReddi of East Godavari District of Andhra Pradesh. *J. Tribes Tribals* 2(1):37-44.

Mulugeta Y., Yacob H.T., Ashenafi H. (2010). Ectoparasites of small ruminants in three selected agro-ecological sites of Tigray Region, Ethiopia. *Tropical Animal Health and Production,* 42(6): 1219-1224.

Nok, A.J., Esievo, K.A.N., Longdet, I., Arowosafe, S., Onyenekwe, P., Gimba, C.E. and Kagbu, J.A. (1993). Trypanocidal potentials of *Azadirachta indica: In vivo* activity of leaf extract against *Trypanosoma brucei*. *Journal of Clinical Biochemistry and Nutrition*, 15:113-118.

Odugbemi T. and Akinsulire O. (2006). 'Medicinal plants by species names' in: Odugbemi T, editor: 'Outlines and pictures of medicinal plants from Nigeria', University of Lagos Press, pp. 95-156.

Offiah N.V., Dawurung C.J., Oladipo O.O. , Makoshi M.S., Makama S., Elisha I.L., Gotep J.G. , Samuel A.L. and Shamaki D. (2012). Survey of herbal remedies used by Fulani herdsmen in the management of animal diarrhoea in Plateau State, Nigeria., *Journal of Medicinal Plants Research,* 6 (312): 4625-4632.

Olanipekun M. K and Dr. Tedela P. O (2013). Ethno-Medicinal Importance of Some Selected Plants Used For the Treatment of Ruminant Animal Diseases in Ekiti State, Nigeria. *IOSR Journal of Agriculture and Veterinary Science,* 5(6): 16-22.

Pam V. A., Ogbu K. I., Igeh C. P., Bot C. J. and Vincent G. (2013). The occurrence of hastrointestinal and Haemo parasites of cattle in Jos of Plateau State, Nigeria, *J. Anim. Sci. Adv.,* 3(2): 97-102.

Parola, P., Inukoma, H., Camicas, J. L., Bronqui, P., Raoult, D. (2001). Detection and identification of spotted fever group Rickettiae and Ehrlichae in Africa ticks. *Emerging Infectious Diseases,* 7(6): 10114-7.

Rahmann G. and Seip H. (2007). Alternative management strategies to prevent and control endo-parasite diseases in sheep and goat farming systems - a review of the recent scientific knowledge,*Landbauforschung Völkenrode* 2, 57:75-88.

Regassa F, Sori T, Dhuguma R and Kiros Y. (2006). Epidemiology of gastrointestinal parasites of ruminants in Western Oromia, Ethiopia, *International Journal of Applied Research in Veterinary Medicine* . 4: 51–56.

Sajid S.M., Iqbal Z., Khan N.M., Muhammad G., (2008). Point prevalence of hard ticks (Ixodids) infesting domestic ruminants of lower Punjab, Pakistan. *Int. J. Agri. Biol.* 10: 349-51.

Shen S., Qian J., and Ren J. (2010). Ethnoveterinary plant remedies used by Nu people in NW Yunnan of China, *J. Ethnobiol. Ethnomed.,* 6: 24.

Squire S.A., Amafu-Dey H. and BeyuoJ. (2013). Epidemiology of gastrointestinal parasites of cattle from selected locations in Southern Ghana, *Livestock Research for Rural Development* 25 (7)

Soulsby, E.J.I. (1978). Helminthes, Arthropods, and Protozoa of Domesticated Animals 7th ed. Bailliere, Jindall and Casse Ltd, London, pp. 450.

Effect of Poultry and Green Manure Sources on the Productivity of Popcorn (*Zea Mays Everta* L.)

G.L. Luka, E.C. Odion and M. M. Maiyaki

Institute for Agricultural Research, Ahmadu Bello University, Zaria

Corresponding author: graceluka@yahoo.com

Keywords:
Green manure, Treatments, cowpea varieties, cowpea

Abstract

A trial was carried out at the Institute for Agricultural Research field Samaru during the 2013 and 2014 rainy seasons to determine the effect of poultry manure and sources of green manure on the productivity of popcorn. Treatments included four poultry manure rates (0, 2, 4 and 6 t ha^{-1}) and green manure from two cowpea varieties (SAMPEA 6 and Kananado). Green manures were obtained by clipping the cowpea foliage at 5cm from the soil surface and incorporated in 6th week to serve as green manure. Data were collected on shoot dry weight and grain yield and significant increases were recorded. It can therefore be said that good popcorn yields can be obtained by using 2 t ha^{-1} of poultry manure in addition to green manure from either of the cowpea varieties.

Introduction

Food production in many parts of Africa is limited primarily by nutrient deficiencies and soil degradation rather than just water availability (Cassman, 1999, Pablo and Ken, 2013). Soil nutrient deficiency could be largely attributed to the decreased soil organic matter as most farmers fail to incorporate or allow their crop residues decompose and recycle nutrients back into the soil. Research has shown that nutrient extraction by crops can be significant. For example in an average wheat harvest in Germany of 8 t ha^{-1} takes 180kg of N, 37kg of P and 124kg of K from the soil. Thus if only the grain is harvested and the straw is left on the land to be worked into the soil or spread in stables and returned to the fields as manure, the volumes that are taken from the system would be significantly lower (Johannes, 2013). In addition, Mulvaney *et al.,* 2009 reported that loss of organic nitrogen decreases soil productivity and agronomic efficiency of fertilizer N and that this has been implicated in the widespread reports of yield stagnation or even decline in grain production. The decline in crop production has resulted in food insecurity manifested as starvation and malnutrition. In order to increase crop production, farmers adopt intensive agriculture using mineral fertilizers and this is often associated with reduced yield due to soil acidity and nutrients imbalance. This challenge could be overcome through the adoption of strategies for better soil management such as the use of manures as nutrient sources.

Materials and Methods

A trial was carried out at the Institute for Agricultural Research field, Samaru (11°11'N, 07°38'E and 686m above sea level) during the 2013 and 2014 rainy seasons. Treatments included four poultry manure rates (0, 2, 4 and 6tha^{-1}) and green manure from two cowpea varieties (SAMPEA 6 and Kananado). Cowpea was clipped at 5cm from the soil surface at six weeks after sowing which was about the peak lush plant material and dry matter accumulation. Clipped foliage was incorporated to serve as green manure. The research was carried with the objectives of improving the nutrient status of the soil and to determine the effect of poultry and green manure on the productivity of popcorn.

Results

These include the nutrient composition of cowpea foliage (green manure), poultry manure analysis, shoot dry weight and grain yield of popcorn. Table 1 shows the nutrient composition of the cowpea foliage incorporated into the soil as green manure. Nitrogen content (%) of SAMPEA 6 tended to increase with increase in the rate of poultry manure applied while with Kananado the converse was true (Table 3a). Organic carbon content was inconsistent. C: N ratio decreased with increase in poultry manure rate in SAMPEA 6 indicating a high rate of decomposition.

The N, P and K contents of the poultry manure used during the experiment in 2013 and 2014 rainy seasons (Table 2) showed that the total nitrogen (N) and available potassium (K) content of the poultry manure used in the trial during 2014 rainy season were higher than that in 2013. While the available phosphorus (P) content was higher in 2013 than the one used in 2014.

Table 1. **Mean nutrient composition of the cowpea varieties incorporated as green manure at Samaru during the years of experiment**

		Percentage (%)			Mg kg		
Treatments	N	P	K	OC	Calcium	Magnesium	C: N
SAMPEA 6							
0tha^{-1} Pm	1.40	0.370	1.53	44.89	2111.10	6734.50	32.06
2 tha^{-1} Pm	2.10	0.455	2.50	33.58	1979.10	7808.44	15.99
4 tha^{-1} Pm	4.73	0.436	1.96	42.46	2106.30	4789.55	8.98
6 tha^{-1} Pm	3.71	0.394	1.42	37.11	1784.50	6347.42	10.00
Kananado							
0tha^{-1} Pm	4.10	0.443	1.71	52.34	2165.40	3846.33	12.77
2 tha^{-1} Pm	4.87	0.374	1.56	47.52	1987.30	4983.72	9.760
4 tha^{-1} Pm	2.63	0.483	1.28	45.88	2066.62	13572.21	17.44
6 tha^{-1} Pm	1.75	0.284	1.18	55.20	2022.60	1368.46	31.54

Pm = Poultry manure, OC = Organic carbon

Table 2. **N, P and K contents of poultry manure used during the experiment in 2013 and 2014 rainy seasons**

Nutrients	2013	2014
Total N (%)	1.70	1.74
Available P (mgkg^{-1})	1.59	1.32
Available K (Meq/100g)	0.63	0.89

Poultry manure analyzed at the analytical laboratory, Department of Agronomy, Ahmadu Bello University, Zaria

Table 3 showed that in 2013, significant increases in shoot dry weight was recorded with increase in application of poultry manure up to 4 t ha^{-1} and further increase to 6 t ha^{-1} gave similar increases. In the 2nd year however, significant increases in dry weight was recorded from 2 t ha^{-1} poultry manure in addition to the green manure from SAMPEA 6. Significant increases were also recorded from 4 t ha^{-1} of poultry manure where Kananado served as source of green manure.

Results on table 4 showed that grain yield of popcorn increased at 2 t ha^{-1} of poultry manure with addition of clipped cowpea foliage from either variety. Application of higher poultry manure rates resulted in statistically similar grain yield increases. This trend was observed in 2014 although the yield increases were higher than the first year.

Table 3. **Effect of poultry manure and green manure sources on the shoot dry weight of popcorn at Samaru during 2013 and 2014 rainy season**

	2013		2014	
Poultry manure (tha^{-1})	SAMPEA 6	Kananado	SAMPEA 6	Kananado
0	131.7b	108.9c	81.7b	92.8b
2	136.8b	128.4bc	102.3ab	92.9b
4	169.3ab	178.0a	104.7a	104.0a
6	191.9a	188.1a	128.0a	108.4a
	SE± 15.67		SE± 9.68	

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT

Table 4. **Effect of poultry manure and green manure sources on the yield of popcorn at Samaru during 2013 and 2014 rainy season**

	2013		2014	
Poultry manure (tha^{-1})	SAMPEA 6	Kananado	SAMPEA 6	Kananado
0	1077c	1325bc	1605c	1941b
2	1668ab	1827a	2307a	2257a
4	1916a	1889a	2390a	2298a
6	1899a	1971a	2335a	2398a
	SE± 124.12		SE± 109.19	

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT

Discussion

The incorporation of poultry manure into the soil enhanced the increases in the parameters taken and this was evident especially in the second year of the trial. This could be because poultry manure fertilization boosted the nutrient status of the soil particularly in the supply of N, P and K. In the first year the result of the soil analysis showed low rates of N (0.063%), P (3.5) and organic carbon (0.5) but in the second year there was a boost to 0.15%, 6.85 and 1.25 for N, P and OC respectively. Increases in soil organic carbon results in release of nutrients for plant growth as well as promote the structure, biological and physical health of the soil. This may imply that continuous feed of feeding of the soil with organic manures will build up the organic matter content of the soil which will result in increase in soil fertility and over time very little or no fertilizers may be required to be added to the soil to cultivate crops. Organic matter serve as a store house for nutrients, improves nutrient recycling, builds soil structure, increase infiltration and water holding capacity and serves as a buffer against rapid pH changes and energy source for micro organisms (Perrings, 1999). Poultry manure helps in soil amendment (improves bulk density, aggregation, organic matter, water infiltration and retention), in addition to provision of nutrients to crops (Agbede *et al.,* 2013, 2014, 2017, Atankora *et al.,* 2014, Warren *et al*., 2006**)**. Analysis of the clipped cowpea showed that C: N ratio of SAMPEA 6 foliage decreased with increase in poultry manure rates and that indicated a higher rate of decomposition of the foliage and as mineralization takes place the nutrient status of the soil is improved. These resulted in increased dry matter production of the crop which was consequently converted into grain yield. Good popcorn yields can therefore be obtained by using 2 t ha^{-1} of poultry manure and green manure from either of the cowpea varieties.

References

Agbede T.M., Adekiya A.O and Eifediyi E.K (2017). Impact of Poultry Manure and NPK Fertilizer on Soil Physical Properties and Growth and Yield of Carrot. *Journal of Horticultural Research.* Volume 25 (1): 81-88.

Agbede T.M., Adekiya A.O and Ogeh J.S. (2013). Effects of organic fertilizers on yam productivity and some soil properties of a nutrient depleted tropical alfisol. *Archives of Agronomy and Soil Science.* 59 (4-6):803-822.

Agbede T.M., Adekiya A.O and Ogeh J.S. (2014). Response of Soil Properties and Yam Yield to *Chromolaena odorata* (Asteraceae) and *Titinia diversifolia* (Asteraceae) Mulches. *Archives of Agronomy and Soil Science* 60 (2):209-224.

Atakora K., Agyarko K., and Aseidu E.K. (2014). Influence of grasscutter, chicken manure and NPK fertilizer on the physical properties of Chromic Luvisol, growth and yield of Carrot (*Daucus carota*). *International Journal of Plant and Soil Science.* 3(2): 197-204.

Cassman K.G. (1999).Ecological intensification of cereal production systems: yield potential, soil quality and precision agriculture. *Proc. National Academic Science.* U.S.A.96: 5952-5959.

Johannes Kotschi (2013). A soiled reputation: Adverse impacts of mineral fertilizers in tropical agriculture. *Association for AgriCulture and Ecology.* Pg 13.

Mulvaney R.L, Khan S.A and Ellsworth T.R (2009). Synthetic Nitrogen Fertilizers deplete soil nitrogen: A global dilemma for sustainable cereal production. *J.Environ. Qual.* 38:2295.

Pablo Tittonell and Ken E.Giller (2013). When yield gaps are poverty traps: The paradigm of ecological intensification in African smallholder agriculture. *Field Crops Research* 143: 76-90.

Perrings C. (1999). The economics of Biodiversity loss and Agricultural Development in Low income countries. University of York, UK.

Warren J.G, Phillips S.B, Mullins G.L, Kealey D and Penn C.J (2006). Environmental and production consequences of using alum amended poultry litter as a nutrient source for corn. *J. Environ. Qual.,* 35:172-182.

Organic Farming in Zambia: From Inception to Date

Munshimbwe Chitalu

Chief Executive Officer
Organic Producers and Processors Association of Zambia

Corresponding author:
gmchitalu@gmail.com

Keywords:
OPPAZ, World Bank, Organic Agriculture, farmers, Zambia

Abstract

Adoption of organic agriculture by Zambian farmers was a strategy for accessing foreign exchange which had become scare due to restrictive policy measures sparked by the economic crunch of the 1990s. To implement the strategy, stakeholders launched Organic Producers & Processors Association of Zambia (OPPAZ) in 2000 and mandated it to provide supportive services and develop a small and medium scale organic production (SMOP) programme Organic agriculture activities in Zambia derive the authority from provisions of the policies of agriculture and environment and the supporting national programmes addressing the millennium development goals. An elected board of OPPAZ, through a technical secretariat implements the organic agriculture programme which is 99% funded from external sources. After the World Bank declared Zambia a middle income country in 2009, external funding dwindled and in 2013 the last donor funded organic project ended. A locally bred business configured private sector led programme was crafted and is being implemented. Since inception OPPAZ has facilitated certification of 12 operations for the external market and 5 for the local market representing a total 6 700 000 hectares of arable and bee pasture land together impacting the lives of 32 542 of the 65 000 associating family farmers. Crop yield increased by 206% for organic groundnuts and 233% for natural and organic honey. On the other hand, productivity increased above the national average figure by 53% for maize and 220% for groundnuts. Organic Avocado production outperformed conventional avocado production in terms of number of years to first fruiting, compliance with market requirements and volume of sales. Through a locally contracted financial facility, honey and groundnuts producers accessed the external market with a sales value of USD 970,000 in 2004 which increased to USD 1 001 200 in 2005. Unfortunately, this was short lived as groundnut and vegetable farmer groups opted out on account of uncompetitive world prices and closure of business respectively. Other grower groups exited organic certification because they faced the challenge of finding the market following certification in the absence of guarantee for a market. Attention then shifted to product promotion at local market. Unfortunately suppliers could not maintain it due to inadequate volumes and supply inconsistencies. Towards establishment of SMOP, capacity was built for organic farming, certification and marketing in twenty farmer groups as a move to build a critical mass and enable adequately servicing of exports consistently. An Organic Code of Organic Production has been formulated. A local certification mark, Certified (Zambia) Organic and user guideline have been developed. A new business configured private sector led initiative, Green-for-All Agriculture Programme has been designed and is working with business-ready farmer groups, business enterprises and chiefdom based cooperatives in delivery of practical training and facilitation of asset and production input acquisition, quality assurance and marketing services at farmers own cost. GAP is envisioned to become the Zambian Centre for Organic Excellence in the near future. Awareness creation and advocacy for pro-organic policy reform has been delivered on the understanding of organic agriculture was not just equal to the *task of food security but also to general economic development. In collaboration with like minds,* OPPAZ *successfully lobbied for enactment of a Biosafety act embracing precautionary principles. Organic farming is now visible in Zambia with OPPAZ acknowledged as lead institution and superintends over several organic activities among them leading a coalition of actors to establish a one-stop centre of excellence for organic farming and acquisitions in Zambia and heading the Zambia Honey Partnership Platform for development of bee keeping in Zambia. Although successes have been scored in driving the organic agenda in Zambia, more significant outcomes could be have been achieved if there was practical involvement of the national government incentivizing private sector investment.*

Introduction

The economic crunch of the 1990s and attendant restrictive foreign exchange monetary policy measures in light of active demand for up selling products in Europe sparked adoption of commercial organic farming in Zambia. Although commercialization of agriculture in Zambia gained momentum in the 1970s, there was a shift from traditional subsistence farming to conventional practices. The reason for the shift was that traditional subsistence farming systems with semblance of modern organic farming were not unproductive. A robust farming culture for hybrid maize production with synthetic chemicals was needed to increase production; Zambia was under pressure to sustain copper production, hence the need to feed a surging population of miners. In the 1990s the performance of copper industry dropped and Zambia suffered serious foreign exchange shocks. Therefore, European organic niche markets offering price premiums on organic products became an opportunity for Zambian farmers to cushion the shocks of foreign deficits. It led to initiation of farming schemes for supply of organic groundnuts, vegetables and honey to the UK. Consequently, Organic Producers & Processors Association of Zambia (OPPAZ) was officially inauguration in 2000 to steer development of Organic subsector. Its mandate included:

1. Delivery of technical knowledge and certification services;
2. Deliver organic marketing services to enable market access;
3. Develop and implement a small and medium organic production (SMOP) programme;
4. Create public awareness and advocacy for pro-organic policy reforms; and
5. Coordinate and manage the organic programme in Zambia.

Justification

Since 2000 to date, OPPAZ implemented eleven organic projects all financed from external sources. The author has analyzed the performance of the organic sector in pursuant of its mandate in the light of the prevailing circumstances. The purpose of this write up is to tell a story of Organic farming in Zambia to Africa and the World for information only. The right-up is based on review of secondary data maintained by OPPAZ on the farmer groups which received consistent donor financing for organic purposes.

Policy context

Implementation of Zambian organic happens in the void of a specific policy guide. Provisions of existing National Policy on Environment (NPE) and National Agriculture Policy (NAP) provided entry of Organic programmes in Zambia. The NPE acknowledges responsibility of citizens and the civil society to protect the environment and conserve its resources in all its aspects. It commits government in partnership with the people to manage the environment for the benefit of present and future generations. The agriculture sector objective in the NPE recognizes sustainable agricultural development through ecologically appropriate production and management techniques. Similarly, provisions of the NAP in favour of increased production, commercialization and sustainable management of Zambia's agricultural resource base embrace the tenets of organic agriculture. The aspects of ecology, healthy, fairness and care propagated as principles of organic agriculture are congruent to the provisions of both the NPE and NAP. They are in line with provisions of Article 112 (2) of the Constitution of Zambia which is to provide a clean and healthy environment for all. They are further anchored in government policies and strategies inclined to achieve Millennium Develop Goals on hunger, poverty, environmental sustainability and economic partnerships on trade and development.

How it all happened

Governance and management

Since its inception in 2000, OPPAZ has implemented the organic programme through an elected management Board of Directors with support of an eight-person Technical Secretariat led by a Chief Executive Officer. Additional staff members are recruited for implementation of specifically projects as the projects emerge.

From inception to 2013, OPPAZ implemented eleven projects to contribute to achievement of its mandates of provision of services, establishment of a Small and Medium Scale Organic Programme (SMOP), public awareness, advocacy for pro-organic policy reform and management and coordination of services and programmes. A total of USD 4,479,000 has been spent of which respectively 99% and 1% were external and local sources. The funds were directed towards i) certification and technical services ii) marketing services, iii) SMOP, and iv) policy reform and awareness activities. Financing management and coordination was restricted to aspects of specific project implementation. Therefore, the technical secretariat operated in project mode, with little flexibility to diverge aspects of management not expressly defined in the project documents. Within the permissions of funding eligibilities of specific projects, OPPAZ produced several governance instruments including:

- Operations Policy Guidelines
- Human Resources and Management Procedures Manual,
- Accounting manual procedures and guidelines
- HIV and AIDS Workplace Policy
- Gender Policy
- Information Technology Communication Policies regarding IT Authority, IT use, Internet use and Email use

Following the declaration of Zambia as a low middle income country in 2009, external donor inflows plunged. The last donor funded project ended in 2013. From this time onwards, OPPAZ has been operating on own locally generated resources, voluntary services by the Board and Management. OPPAZ iterated a Green-for-all Agriculture Programme (GAP) in 2013 which has been successfully marketed to local businesses and given rise to two commercially driven ideas. These are Cluster Approach Revenue Sharing accelerated business economic empowerment strategy (CARS ABEES) in 2015 and Business-Intended Organic (BIO) Farming and Wellness programme in 2018. Coalition members implement CARS ABEES and BIO Farming as *Aarulo Farming-is-business* (AFIB) procedure. AFIB delivers goods and services to clusters of *willing-and-able farmers* to enhance production and upscale market access on equitable benefit sharing basis. AFIB emphasizes production, marketing and household food processing of food crops, spices and herbs in observance of environmental, market and food safety standards. Since May 2018 AFIB has attracted 300 family farmers having 3,000 hectares of land and producing assorted fruits and vegetables using local resources.

Achieving the mandate

Production technology and Certification services

Farmer groups and individuals have been targeted and their capacities built. They have been trained in organic farming, quality management, Internal Control Systems (ICS) and Participatory Guarantee Systems (PGS). Facilitation for training in Fair Trade requirements was also done.

Training in organic farming has led to crop diversification and increases in crop production. At inception of organic farming in Zambia there were countable number crops narrowly defined as cash and food crops. The crop portfolio has expanded to aromatic, medicinal, cover, green manure and soil fertility crops which have unlocked immense opportunities for value addition, employment creation, income generation and healthy living. For example members of Tigwirizane Women Development Club commenced production of sunflower for extraction using a group oil extractor. A total of 9.3Mt of sunflower oil and 21.7Mt of sunflower seed cake with a commercial value of USD30,500 are produced per annum. The oil is used locally by members and the excess with sunflower oil cake are sold. Other growers groups have increased their production from by 233% from 150Mt to 1,000Mt of organic and natural honey and 206% from 18Mt to 35Mt of organic groundnuts. Mpongwe-Bulima Organic Growers Cooperative (MBOCS) increased productivity maize by 53% (1 310Mt to 2007Mt) and groundnuts by 220% (490Mt to 1 570Mt) above the national average.

Training in Internal Control Systems (ICS) has enhanced of compliance with organic standards. In 2010, a total of 19 operators and farmer groups were certified organic through Third Party Guarantee of which 5 were for local and 14 for international markets. Afrisco, with a long standing strategic link with OPPAZ certified 12 operators and Control Union of Ethiopia certified two groups. This represents 6.7 million hectares of arable and bee pasture land impacting 32,542 of the 65,000 associating family farmers.

Three producer groups were trained and they developed capabilities for Participatory Guarantee Systems (PGS) for fruits and fresh vegetables. A group of three organic Avocado growers under this category has outperformed 12 conventional Avocado growers in many respects. They got trees to bear fruits within 3 years of transplanting while the rest managed after six years. Out of the 12 top growers, all three organic growers have been able to supply fruits to the market within five years of establishing the fields. They have more fruits in grade A category of more than 250g than their conventional counterparts. The only one conventional grower to supply the fruits to the markets did it after six years. Organic fruits are of better quality than conventional ones. Over 60% of the conventional fruits have been rejected in the upscale market in 2018 while less than 5% organic fruits have been rejected in the same period in the same market.

Financial and marketing services

Working on increasing exports to Europe, OPPAZ undertook two assignments. Two market assessments were conducted for organic trade in Southern Africa and Europe. The studies and strategic linkages established with national and international development organizations identified marketing opportunities, marketable products, availed market information regarding export requirements, regulations and product qualities and quantities. OPPAZ promotes itself through participation in national, regional and international fairs for promotion of products. It also facilitates and sponsors farmer participation in these fairs to promote their products. At national level, it supports members to exhibit products at local and national agricultural shows. In two years running in 2009 and 2010 OPPAZ won the first price of Best NGO Exhibit; It trailed a top commercial company in 2010 for second price of Best Agribusiness Exhibit at the National Agriculture and Commercial Show in Lusaka. Through exhibitions at BIOFACH, Zambia earned USD970 000 in exports of organic honey and wild mushrooms in 2004 which in 2005 increased to USD1 001 200 with expanded exported of essential oils and groundnuts. A retail honey line for pharmaceutical use was also derived from BIOFACH in 2005. OPPAZ contracted a loan for financing pre and post shipment costs of organic exports to Europe. Sale of fresh vegetables and fair trade organic groundnuts were realized through personal sales.

To the contrary, Zambian organic producers are yet to get benefits of organic certification. There are several hindrances or barriers which make them unable to access the markets even if they are certified. Internally, there is poor infrastructure to ascertain specific quality properties letting to the external buyers to test at great expense to the producer. Until recently most food safety tests could not be performed locally in Zambia. Producers had to ship samples for pre-tests in the importing country. Some consignments have been rejected in the import country and downgraded to conventional with consequences of reduction in market price. There is also the problem of Zambian agriculture being heavily depended on rainfall which is subject to various variations and neither guarantees that demanded volumes would be supplied consistency of as demanded. Therefore, some five farmer groups in groundnuts, rice, sunflower and honey value chains have fallen out of organic certification on account of having no access to the market. An internal market study revealed that only 5% of certified organic products were marketed externally, the rest were marketed locally.

Upon realizing unattainability of export markets by many producer groups, OPPAZ started sensitizing local consumers to generate their interest in organic products. Actions included advertisements, periodical markets, personal sales and acquisition of stall space in retail outlets. Local awareness was created regarding benefits of eating organic food. Local demand for organic food has also risen to the effect where farmers' productive capacity has been over-strained. This is going by the fact that organic food stuffs presented for sale at markets last very short periods and take weeks to replenish. The rebounding effect of this is negation of upscale retail outlets to stock organic products because they cannot guarantee consistent supplies to buyers. Instead, they are confortable to take them just as conventional products.

Small and medium-scale organic producer programme (SMOP)

Direct project support was solicited and capacity for organic farming, certification and marketing was built in twenty small scale producer groups throughout the country. The idea of SMOP is to build a critical mass and enable them to adequately service their exports consistently with sufficient quantities. Strategic alliances with other civil society organization mobilized external resources and financed discrete efforts targeting individual farmer groups to promote export production of rice, honey, wild products, cotton, soy beans, groundnuts, lemon grass, pigeon peas and other products. This generated lots of public interest and OPPAZ membership swelled to an all-time high of 105 registered farmers groups and SMEs with a constituent of 60,000 small holder farmers. A lot more farmers not subscribed to OPPAZ claim that they are organic on account of not making use of synthetic chemicals.

In 2010, OPPAZ worked with the Zambia Bureau of Standards and developed the

Organic Farming and Production Code of Practice to regulate organic farming and production in Zambia. A local certification mark, *Certified* (Zambia) *Organic* and user guideline was developed in 2010.

A new program (GAP), has been designed and is working with business-ready farmer groups, business enterprises and chiefdom based cooperatives. GAP delivers a business configured private sector driven model that builds capacity through practical training and facilitation of asset acquisition for production, quality assurance and marketing at farmers own cost. This is Farming is Business which is done throughout the year (12-1). Practical training for knowledge, skills and transformation are conducted monthly. The programme is currently working with 5 000 family farmers in different chiefdoms and receives support from research and training institutions, civil society organizations and traditional leadership. It is envisioned to become the Zambian Centre for Organic Excellence in the near future.

Create public awareness and advocacy for pro-organic policy reforms

Operating in a policy void environment heavily inclined towards conventional means for self-sufficiency in food production, the sector faced the challenge to assure that organic agriculture was not just equal to the task of food security but also to creation of jobs and increasing income earnings for the rural communities. OPPAZ participated in several policy level activities with resounding approval.

With like minds, OPPAZ successfully lobbied the Government of Zambia to enact a Biosafety act embracing precautionary principles. The act regulates any dealings in genetic modification and sanctions implementation of standards that avert negative socioeconomic and environmental impacts and procedures for managing risks emerging there from.

With private sector actors, OPPAZ is promoting adoption and use of microbial fertilizers for soil fertility management. Microbial fertilizers have been tried on wide range of crops with outstanding results. Trials on farmers' fields have consistently outperformed conventional systems by 15% to 50% in respect of efficiency of soil water use, productivity and product quality, and reduction in use of synthetic chemicals.

Manage and coordinate the organic programme in Zambia

Organic farming is now visible in Zambia with OPPAZ acknowledged as lead institution. In 2012, OPPAZ organized the second African Organic conference which endorsed creation of AfrONet and Southern Africa Network for Organic Development (SANOD). It is now leading a coalition of the willing in establishing a one-stop centre of excellence for organic farming and acquisitions in Zambia. It is also heading the Zambia Honey Partnership Platform for development of bee keeping in Zambia.

Conclusions

Organic agriculture in Zambia has been implemented without active participation of the national government. It denied the sector an opportunity of an amiable policy that would generate private sector interest for investments.

Zambian farming is seasonal and effective from November/December to February/March. There is need to assist farmers expand their operations beyond the four wet months to make them all-weather farmers. Removing seasonality would move them a step closer to being able to supply products throughout the year.

Fallout from organic certification could have been avoided if certification was tied to secured markets in Europe. Absence of a secure market in the current system meant that the farmers were not aware of the minimum quality and market requirements to comply with. Otherwise starting organic certification with flexible less intensive schemes would slowly build up the capacity of the farmer to appreciate the system and be ready to implement more complex ones.

References

OPPAZ 2005. Project Report - GART OPPAZ Extension Project EU-EDP II.

Chewe Nkonde, 2008. The status of organic production and markets in Zambia – an analysis of organic farming households, Baseline report. OPPAZ.

OPPAZ 2008. Project report - Ecological marketing project .

OPPAZ, 2009. Project report - Agribusiness development for natural and organic products project .

OPPAZ, 2009. HIV and AIDS workplace Policy.

OPPAZ, 2009. Gender workplace policy.

OPPAZ, 2009. OPPAZ strategic plan 2010-2015.

Artha Lahai-Conteh, 2010: Baseline survey report - OPPAZ Smallholder Zambian Organic farmers in Employment and Wealth Creation Programme.

OPPAZ 2009. Project report - Extended ecological marketing project.

OPPAZ 2009. Project report - Profitable Organic Vegetable Production for Rural Producers in Southern Province, Zambia.

OPPAZ 2009. Project report - Food Security Initiatives for Vulnerable groups project in Kabompo and Mwinilunga districts co-implemented with Keeper Zambia Foundation .

Felix Chizhuka, 2010. Mid tern evaluation report - Kaoma Agriculture Diversification and Food Security project.

OPPAZ 2010. Project report - Organic agriculture Development in Sub-Sahara Africa (ODISSA) project for organic cotton production.

OPPAZ 2010. Project report- Kaoma Agriculture Diversification and Food Security project.

OPPAZ 2011. Project Report - Integration of Information Communication Technologies for Quality Assurance and Marketing (ICTQAM).

OPPAZ, 2013. Statement of comprehensive receipts and payments.

Munshimbwe Chitalu, 2018: Position paper – Enhancing Farmer empowerment and accelerated rural economic development.

De la Vulnérabilité au Prestige? L'agriculture écologique et biologique, un outil de négociation et d'exercice du pouvoir des femmes

From Vulnerability to Prestige? Ecological Organic Agriculture, a Tool for Negotiation and exercise of women's power

Bodjrenou Delphine[1]

BP 2140 Abomey-Calavi

[1]Coordonnatrice Genre et Système de Contrôle Interne à l'Organisation Béninoise pour la Promotion de l'Agriculture Biologique (OBEPAB)

Corresponding author:
bmdelphine@yahoo.fr
bmdelphine@gmail.com

Résumé

Les études en agriculture écologique et biologique montrent très peu d'intérêt aux questions langagières en général et celles des femmes en particulier en considérant à tort ou à raison les travaux linguistiques comme non adéquates en agriculture. Toutefois, la langue se trouve au cœur de toute discipline et c'est qui nous motive lorsque nous nous intéressons au discours de femmes qui s'investissent dans ce mode de production. Au Bénin, les femmes rurales sont au cœur des systèmes de production agricole où elles jouent des rôles primordiaux. Néanmoins, à l'heure de s'exprimer, elles sont reléguées au second rang et deviennent des invisibles et des sans voix. Ceci revient au fait que si la femme doit parler, étant la propriété privée d'un homme, cet homme devient la courroie de transmission entre ses idées et ses interlocuteurs. Or, l'analyse des comportements discursifs ou des pratiques langagières est un créneau assez révélateur des relations entre différentes couches sociales. Cette étude prend pour base les pratiques langagières des femmes agricultrices produisant le coton biologique, les analyse et révèle les mécanismes rhétoriques et linguistiques utilisés afin d'analyser l'impact de la conversion à l'agriculture biologique en général et surtout le coton biologique sur les discours des femmes. Introduit dans les années 90 comme alternative au coton conventionnel qui était la principale culture d'exportation mais inhibitrice des efforts des femmes, le coton biologique a commencé par faire émerger les femmes au point d'induire un changement remarquable dans leurs discours qui entre temps ne pouvaient qu'être portés par des hommes. Cette recherche, menée dans une perspective sociolinguistique, s'inscrit dans une démarche méthodologique pluridisciplinaire où plusieurs cadres théoriques ont été exploités pour atteindre les objectifs fixés. Elle part de la méthode de collecte de données proposée par Franco Ferraroti (1981; 1990) pour se construire sur le schéma de Teun A. van Dijk. Ce schéma se focalise sur les inégalités sociales et l'exercice du pouvoir en général et comment ces inégalités et réalités s'expriment au quotidien à travers l'usage du langage. Nous avons donc analysé les discours des femmes converties à l'agriculture biologique dans les zones de Kandi, Sinendé, Glazoué et Djidja pour mettre en évidence les avancées notables qui s'y remarquent à travers la force des mots qu'elles emploient et comment elles tendent vers une certaine acquisition du pouvoir, comment elles exhibent un certain prestige qui ne pouvait se manifester avant. Même si cette acquisition de pouvoir pourrait être jugée de relative et éphémère, il est à remarquer qu'il faudrait la valoriser afin de la maintenir avec des efforts constants à divers niveaux pour un changement durable dans les luttes des femmes ; ceci permettra d'atteindre un niveau encore plus élevé et une évolution discursive permettant de déconstruire les mentalités sur le rôle et la place des femmes dans les prises de décision les concernant en milieu rural.

Introduction

Le nombre d'agricultrices adhérant au mode de production biologique évolue de manière considérable dans un contexte où le système est patriarcal et la place de la femme est supposée être au foyer et du coup la marginalise surtout en milieu rural. Vu sous l'angle des pratiques langagières, cette marginalisation de la femme est encore plus profonde et lorsqu'on analyse les effets de la globalisation, l'on se rend compte que tous ces aspects aggravent la position et le pouvoir discursif des femmes rurales même si les postes qu'elles occupent dans l'agriculture sont à la fois multiples et variés. Cependant, le rôle fondamental que leur concède la société est d'être une épouse et une mère qui veille sur une famille nombreuse où son droit est qu'elle s'assure que tout est en ordre, que tous les détails concernant son homme et sa belle-famille sont bien réglés. Ceci revient au fait que le devoir ou l'obligation se transforme en droit et en réalité la femme n'a de véritables droits sinon qu'elle n'a que des obligations matrimoniales. La conséquence est qu'elle n'a même pas le droit ni de parler ni d'exprimer publiquement ses opinions. Si elle a d'opinions, elle doit les garder pour elles-mêmes ou les transmettre à son homme. Et c'est bien dans ce sens que la revue belge *Les Cahiers du Grif* dans sa parution n° 46 (1992 :11) affirmait que

> "Dans toute société l'apport des femmes demeure invisible et anonyme. Pour la plupart du temps, il n'est pas inscrit comme tel dans le capital commun, parce qu'il ne bénéficie pas de la caution du pouvoir: il est occulté ou se manifeste à travers un nom d'homme. Une femme, quel que soit son apport, est le plus souvent la femme de…"

Ceci revient donc au fait que si la femme doit parler, étant la propriété privée d'un homme, cet homme devient la courroie de transmission entre ses idées et ses interlocuteurs. S'il est vrai que le terme *Genre* suscite des interprétations et des débats aussi controversés les uns que les autres, il est également vrai lorsqu'il s'agit de s'intéresser aux discours des différentes couches sociales où les débats idéologies sont des plus controversés. C'est dans ce cadre que Bakhtine (1984 : 284), s'est particulièrement intéressé aux genres de discours où il démontre que chaque discours est marqué par la spécificité d'une sphère d'échange, la variété des genres de discours étant inépuisable. Cette variété est en relation directe avec la variété des domaines de l'activité humaine qui est toujours en développement. "Le vouloir-dire du locuteur se réalise avant tout dans le choix d'un genre de discours. Ce choix se détermine en fonction de la spécificité d'une sphère donnée de l'échange verbal, des besoins d'une thématique (de l'objet du sens), de l'ensemble constitué des partenaires, etc." Et comme le stipulent les éditeurs de la revue 'Les Cahiers du Grif' (1992 :11),

« Les femmes sont aujourd'hui à la charnière de la tradition et de la modernité, de la sous – culture et de la culture. Elles résistent à l'unification et à l'uniformisation qu'opère cette dernière. Elles s'éprouvent souvent comme "polyglottes", même dans une seule langue, ou comme "bilingues", faisant apparaître plus que d'autres ce que Bakhtine a nommé le "carnaval" de la langue, qui comporte toujours, même dans une expression unique, plusieurs voix. »

Méthodologie

La méthodologie utilisée n'a pas été unique vu qu'il s'agit d'une étude quantitative idéologique basée sur l'analyse de cas purement concrets avec une particularité temporaire et localisée à partir des activités que mènent des individus dans leurs contextes locaux. Et comme nous le rappelle Flick (2004: 20 ; 27), s'il est vrai qu'une recherche qualitative ne peut se baser sur un seul cadre théorique unifié, il est aussi pertinent que les diverses approches caractérisent les débats autour de l'aboutissement de l'investigation. C'est ce qui explique que nous ayons choisi plusieurs cadres théoriques.

Pour la collecte des données, nous avons suivi une démarche méthodologique s'inspire du cadre théorique de Franco Ferraroti (1981; 1990). Ce qui nous a permis d'avoir des informations non seulement sur l'interviewé mais également sur la manière à s'adresser à des cibles en situation de marginalisation. Nous avions donc procédé à des interviews individuelles basées sur l'histoire de vie individuelle de 320 femmes dont 150 à Glazoué, 105 à Djidja, 35 à Sinendé et 30 à Kandi. Le nombre élevé de Glazoué et de Djidja s'explique par le fait que nous maîtrisons parfaitement toutes les langues locales parlées dans ces zones. Cette parfaite maîtrise des langues locales est un facteur très important pour pénétrer aisément toutes les tournures, les unités phraséologiques, les colocations linguistiques, proverbes, dictons populaires et autres propres à chacune de ces langues.

La culture du coton ayant été pendant longtemps un espace de marginalisation de la gent féminine en milieu rural, cette démarche nous a permis – à travers de leurs histoires de vie – de nous pencher sur le processus de production biologique, la gestion du revenu du coton biologique. Cette approche favorise le discernement et/ou la pénétration des aspects que le locuteur trouve importants et pertinents dans un espace de négociation et d'exercice du pouvoir. Ces histoires de vie nous ont aidé à voir le processus de changement induit au niveau des femmes par l'adoption d'un type particulier d'activité qu'est l'agriculture biologique et écologique.

Résultats : émergence d'un prestige discursif chez les agricultrices biologiques

L'analyse des comportements discursifs ou des pratiques langagières est un créneau assez révélateur des relations entre différentes couches sociales surtout dans un processus de conversion parce que «*le locuteur ne se livre pas seulement à une énumération chronologique de faits mais procède à une "mise en intrigue*». Faisant références aux processus de conversion vers une nouvelle option, Christine Henry (1998 : 156), rappelle que, dans le récit de conversion,.

«Dans le magma de son histoire personnelle, il sélectionne les faits et les acteurs pertinents, organise les actions, les explique, pour les faire comprendre à son interlocuteur et pour produire sur lui un certain effet».

Et c'est bien la dynamique qui transparaît dans le discours des agricultrices biologiques. Mieux, plus la conscience d'être désormais dans un système plus transparent est forte, plus les épisodes antérieurs de leur vie ont tendance à être rejetés, déformés ou même reconstruits, pour justifier plus fortement le processus de conversion et se conformer aux exigences du commerce biologique, exigences établies par le consommateurs du nord. Et c'est ce qui explique ce refus catégorique « *u'n gbè tahoun* » [je refuse catégoriquement] de l'interviewée AKossiwa[2] dans la commune de Glazoué dans l'arrondissement d'Aklampa à la question de savoir si l'ancien système leur faisait de nouvelles promesses de gratuité des intrants. Si nous nous attelons à déchiffrer cette portion de phrase, le « *U'n gbè* » [je refuse] seul ou un « *éwo* » [non] simple pourrait largement suffire sans y ajouter ce que nous pouvons appeler ici un connecteur de discours[3]. Toutefois, elle tenait à y ajouter « *tahoun* », ceci juste pour marquer sa détermination et montrer que c'est la nouvelle réalité d'appartenance à un groupe de production biologique qui lui paraît plus plausible. Et comme pour comparer un peu le processus aux dynamiques de conversion religieuse, nos interlocutrices procèdent à « *un travail de réécriture de leur histoire personnelle*». Cette réécriture les amenant alors à argumenter voir enjoliver les transformations dans leur vie qu'elles attribuent désormais à leur nouvelle activité, l'agriculture biologique.

D'un autre côté, l'usage du « *je* », pronom personnel, n'est pas anodin lorsque l'on considère le poids de la culture africaine en général et celle béninoise en particulier sur la liberté d'expression de la femme. En effet, la femme étant « *l'épouse de…* », n'a plus de personnalité intrinsèque à elle même sinon devient « *la chose de…..* » qui s'exprime en son nom. L'apparition du pronom personnel « *je* » dans son discours public est donc assez révélatrice et démontre le degré d'endossement de toute la responsabilité de

[2]Ici, ce sobriquet a été adopté pour masquer le nom et prénoms réels de notre interlocuteur à Aklampa.

[3]Les connecteurs de discours ou les connecteurs argumentatifs sont des unités linguistiques invariables, qui ne jouent aucune fonction syntactique dans l'énoncé mais sont en réalité des éléments marginaux qui ont une tâche, une mission dans le discours.

l'assertion. Dans l'ancien processus, il n'est pas évident pour les femmes d'extérioriser tout leur potentiel. Il y a donc une « *rupture dans la biographie subjective de l'individu* » comme le souligne Peter Berger et Thomas Luckmann (1986 : 218-219) abordant les dynamiques sociales. Cette rupture se remarque lorsque Gnon[4], notre interlocutrice scolarisée et parlant couramment français interviewée dans la zone de Kandi plus précisément dans l'arrondissement de Kassakou, affirme que

« ***Maintenant***, tout a changé et plus rien ne sera comme ***avant.*** Je défie n'importe quel homme à vouloir chercher à me brimer.»

Il se perçoit dans ce discours une nette opposition de périodes avec les utilisations marquées des adverbes « **maintenant** » et « **avant** » mettant en exergue une nouvelle ère (*maintenant*) qui s'annonce et s'impose à tous face à une période qui semble être révolue (*avant*). La deuxième phrase de son discours, aussi vaillante qu'elle puisse paraître, est en même temps un discours sexué mettant en opposition les relations sociales hommes – femmes. La portée des mots comme « **défi** », ou des groupes de mots comme « **n'importe quel homme** » en sont l'expression audible et palpable. C'est à croire que les femmes sont déterminées plus que jamais à affronter leurs quotidiens avec plus de courage et de créativité afin de décoller. Ceci s'explique par cette phrase captée de l'une des enquêtées de Sinendé qui déclare,

«***Maintenant***, *je suis prête à décoller comme un avion.»*

Dans le cas de celle-ci, en plus de l'adverbe de temps, il y usage de l'adverbe de lieu « ***chez*** » qui démontre une construction spatiale au sein du discours en faisant référence à un objet gravé dans son mental comme symbole de grande vitesse, l'avion.

D'autres discours non moins négligeables relevés chez les femmes enquêtées sont relatifs à leurs positions actuelles et les réalisations auxquelles elles font face. Ces réalisations concourent à leur épanouissement et renforce leur position sociale et groupale. Comme indices d'épanouissement que l'on peut mettre en exergue, nous avons eu la réalisation d'infrastructures (construction de maison, montage d'atelier pour les enfants déscolarisés), l'acquisition de matériels (téléphone, télévision, radios, décodeurs, vélos, motos, véhicules qui font office de taxi), autonomie dans les besoins fondamentaux de l'être humain tels que l'habillement, les soins corporels, la nourriture, les soins de santé, la scolarisation des enfants filles. Cette analyse transparaît clairement dans le discours de notre enquêtée Adjoua, dans la commune de Glazoué qui dit :

« À l'heure où je parle, j'ai pu construire une maison en matériels définitifs, acheté un poste téléviseur et un groupe électrogène. Ce qui alimente ma maison et tous mes voisins viennent voir la télévision chez moi tous les soirs. En plus, je supporte la scolarité et les soins, bref tous les besoins de mes quatre enfants.»

Ce genre de discours a retenu également l'attention de l'IFOAM (2018) qui, sur son blog, pour marquer les festivités du 08 mars, voit les femmes comme une source de solution aux différents problèmes liés à la mondialisation en analysant aussi bien le nombre croissant des femmes à s'intéresser à l'agriculture biologique qu'en captant leurs discours. Ce discours se focalise sur le « nous », pronom personnel pour s'identifier comme actrices à part entière en opposition aux hommes.

We have seen a rapid increase in the number of women farming around the world, who describe themselves not as the wives of farmers or the daughters of farmers, but as **farmers**

[4]Idem que pour le cas d'Aklampa. Les véritables identités de notre interlocuteur sont gardées dans le répertoire de nos enquêtés

Conclusion

Ces comportements discursifs relevés chez les femmes engagées dans l'agriculture biologique ne viennent pas du néant. Le sous-bassement des discours de femmes est lié à l'acquisition d'une certaine indépendance financière. D'un autre côté, la production biologique du coton les valorise en favorisant une visibilité de leurs efforts. Cette indépendance financière, loin de les rendre rebelles vis-à-vis des hommes, les rend plus efficaces dans leurs foyers où elles contribuent aux maillons essentiels des dépenses liées aux besoins de la famille.

Bibliographie

Bakhtine, M. (1984). *Esthétique de la création verbale,* Gallimard, tr. Fr. 1984.

Berger P. et Luckmann, T. (1986). La construction sociale de la réalité, Paris, Méridiens Klincksieck

Christine, H. (1998). « Le discours de la conversion », in *Journal des Africanistes*, 68 (1-2), 1998, p. 156.

IFOAM (2018). International Women's day: How Women Farmers are driving Change. March 8, 2018 at the Blog of IFOAM received by email on March 20, 2018.

Mahapatra, B. (2017). India, tribal women are leading the conversion to organic agriculture. www.lifegate.com.

Pedron-Colombani, S. (1998). Le Pentecôtisme au Guatemala. Conversion et identité, Paris, C.N.R.S. Éditions, 1998, 238 p.

Environmental Assessments of Impacts of Land-use Changes and Quality Status of Soils in Eleyele Wetland, Ibadan, South West-Nigeria

Tijani, M. N.[1], Olaleye, A. O.[2], Olubanjo, O. O.[3] and Diop, S.[4]

[1]Department of Geology, University of Ibadan, Ibadan, Oyo State, Nigeria

[2]Soil Science Department, The National University of Lesotho, Roma 180, Lesotho

[3]Department of Agric. Economics, OOU, Yewa Campus, Ayetoro, Ogun State, Nigeria

[4]Institut des Sciences de la Terre, Univ. Cheikh Anta Diop de Dakar, BP 5396 Fann, Dakar, 221, Senegal

Corresponding author:
tmoshood@yahoo.com

Keywords:
Ecosystem, soils, Eleyele Wetland, environmental degradation

Abstract

Nigeria is richly endowed with both coastal and inland wetlands while there is no doubt as to the human-induced environmental threats to the ecological quality status of many of the wetlands. Hence, this study assessed land-use changes and environmental degradation of soils quality within the catchment of Eleyele Wetland, in Ibadan SW-Nigeria using GIS-based remote sensing characterization of temporal changes in land-use dynamics and physico-chemical analyses of the quality status of soil samples from riparian buffer zones within the catchment areas of the Eleyele Wetland. The GIS-based spatial assessment revealed considerable impact of human urban development activities with loss of 20-60% of the riparian vegetation (from 1.80 km^2 in 1984 to 0.70km^2 by 2014) and 20-70% loss of the woodland between 1984 and 2014, apparently giving way for the built-up area which had expanded from 4.25 km^2 in 1984 to 8.17 km^2 by 2014. The measured physical parameters of the soil samples revealed relatively acidic soils with pH values of 4.2– 6.8 compared to the typical range in pristine agricultural soils, while organic carbon and CEC values are consistent with medium to high fertility rating. The nitrate and phosphorous concentrations of 690–3,490 mg/kg and 150–1,270 mg/kg respectively are consistent with typical range of values for uncontaminated arable soils. Major cations (Ca, Mg, Na and K) concentrations are generally lower than typical values for uncontaminated agricultural soils, appently due to the sandy nature of the parent rocks. The overall results highlight the negative impacts of human-induced land-use changes on the wetland ecosystem (soils) due to urbanization and the need to integrate proper urban waste disposal management and land-use plan in order to avoid environmental and ecological degradation of wetland ecosystem.

Introduction

Wetlands are among the Earth's most productive ecosystems. The significance of wetlands lies in their roles in the hydrological cycle, for flood and biomass production, as refuge for wildlife and the maintenance of ecological biodiversity. However, many wetlands are threatened by land- use activities and urbanization; hence negative human-induced degradation of wetlands call for concern (Williams *et al., 2*009).

In most of the developing countries of Africa, apart from population increase and the attendant competing water needs for agricultural, domestic, and industrial purposes, wetlands are characterized by drainage and changes in hydrological regimes that are vulnerable to climate-induced rainfall variability and/or river regulation and abstraction activities (Gosselink and Tuner, 1978). Nigeria is richly endowed with both coastal and inland wetlands. In tropical savanna region of the country, the inland wetlands, called *fadamas,* are primarily utilized to sustain agricultural activities at the local communities.

In addition, there is no doubt as to the increasing impacts land-use and human activities on the wetland ecosystem, apart from the threat of climate change phenomenon. Hence, assessment of the environmental degradation of wetland ecosystem in human-dominated landscapes is critical for their effective management and protection. Hence, this study presents the highlights of environmental contamination and ecological degradation of soil/sediment and water quality of Eleyele Wetland, in Ibadan SW-Nigeria. In the face of rapid urbanization with attendant urban land-use activities as well as the prevailing climate change issue, the focus is on the assessment of overall effects of the land-use activities on the wetland ecosystem and physical and chemical characteristics of the wetland riparian soils.

Study Area

Eleyele Wetland

The study Eleyele Wetland, as a modified natural riverine wetland type, is locate in north-eastern part of Ibadan, southwestern Nigeria within longitude N07^{0}25'00" and N07^{0}27'00" and Longitude E03^{0}50'00" and E03^{0}53'00" (Fig. 1). The study area is characterized by Tropical Hinterland Climate Zone with annual rainfall of 1000 to 1500mm, temperature range of 21–25°C and relative humidity range of 50–80%. The elevation is relatively low ranging between 100-150m above sea level and surrounded by quartz-ridge hills. The site surrounded by Eleyele in the south, Apete in the east Awotan in the North and Ologun-Eru in the west. The catchment of the Eleyele Wetland is relatively well drained with network of River Ona (see Figure 1) and its tributaries (such as Ogbere, Alapata and Ogunpa).

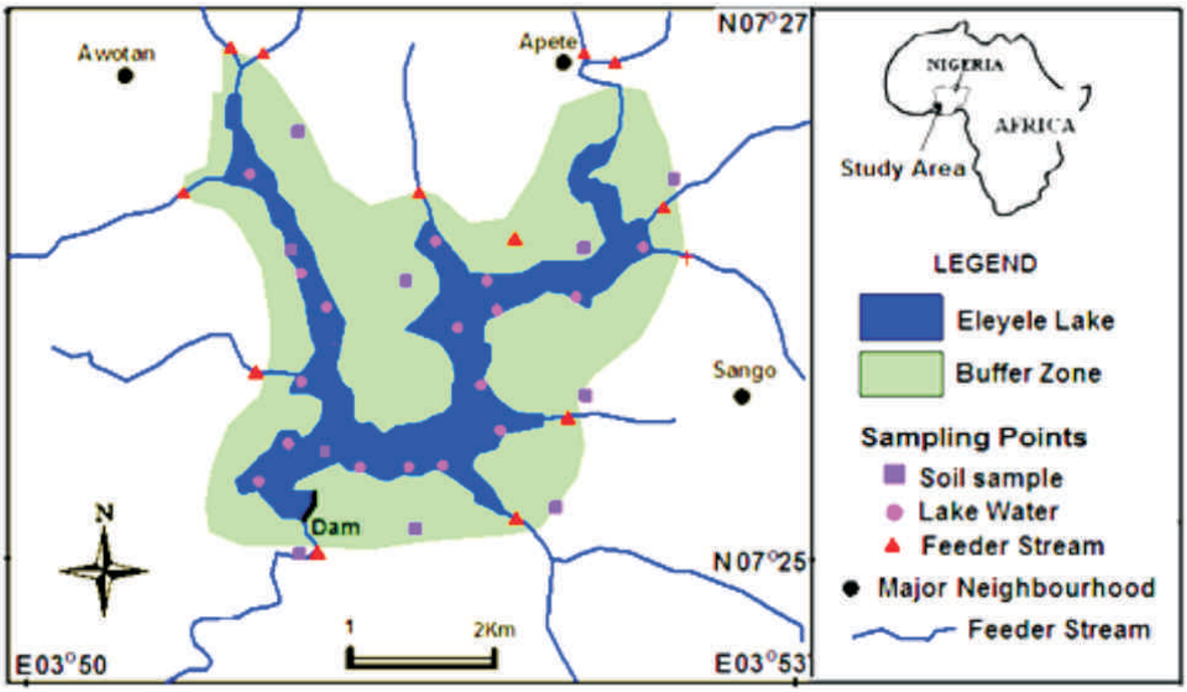


Figure 1. **Location Map of Eleyele Wetland and the feeding streams and sampling points**

The vegetation is characterized by humid tropical forests while derived savannah woodland with forest and shrub characterizes the northern peri-urban zone. The catchment areas of Eleyele Wetland are dominated by forest, riparian vegetation most of which had been impacted by human activities.

Methods and Data Collection

As part of the methods employed, initial desk study involving a GIS-based assessment of the spatial and temporal changes in land-use were undertaken using imageries for 1984, 2000 and 2014. This is followed by field sampling of sixteen (16) wetland soils (A-horizon) within the riparian buffer zones. Soils samples were air-dried followed by textural sieve analyses and indirect estimation of hydraulic characters. In addition to field determination of physico-chemical parameters (EC, pH and temperature etc) chemical analyses of major elements (Ca, Mg, Na, K, Fe etc) and trace metals (Cu, Pb, Zn, etc) were undertaken using aqua ragia digestion followed AAS and ICP-AES analytical method respectively at the ACME Laboratory, Vancouver, Canada.

As part of data evaluation, the results of the *in-situ* physico-chemical measurements and laboratory chemical analyses were subjected to statistical evaluation including quantitative and qualitative indices to quantify the level of wetland contamination / degradation.

Results and Discussions

GIS-based Mapping of Land Use Changes: The GIS-based evaluation of remotely sensed satellite imageries for the period of 1984, 2004 and 2014 revealed temporal changes in the areal extent of the different land-use type within the catchment area of Eleyele Wetland as shown in Fig. 2.

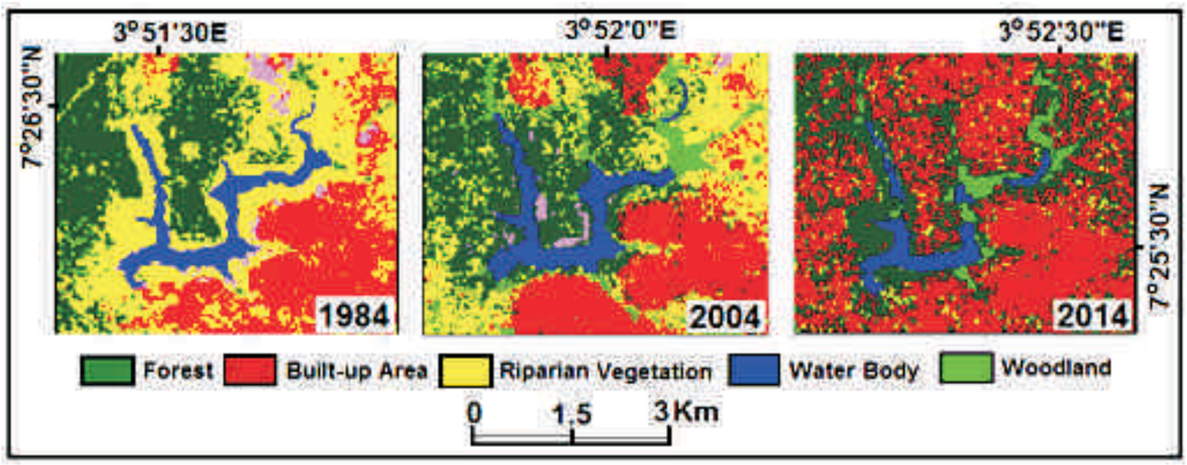


Figure 2. **GIS-based imagery map of the Eleyele Wetland showing the spatial distribution of the land-use type as at 1984, 2004 and 2014**

As presented in Fig. 3a, the imageries revealed that the forest area had reduced in extent from 6.70km^2 1984 to 5.36 km^2 by 2014. The water body also experience relative change with areal extent of 1.72 km^2 as at 1984 decreased to 0.74 km^2 by 2004. Nonetheless, considerable impact of human activities within the Eleyele catchment is reflected in the loss of 20-60% of the riparian vegetation (from 1.80 km^2 in 1984 to 0.70km^2 by 2014) and 20-70% loss of the woodland between 1984 and 2014, apparently giving way for the built-up area which had expanded from 4.25 km^2 in 1984 to 8.17 km^2 by 2014 (Fig. 3b). Hence, the temporal and spatial changes in land-use pattern can be attributed to the impact of urbanized activities within the catchment of Eleyele Wetland.

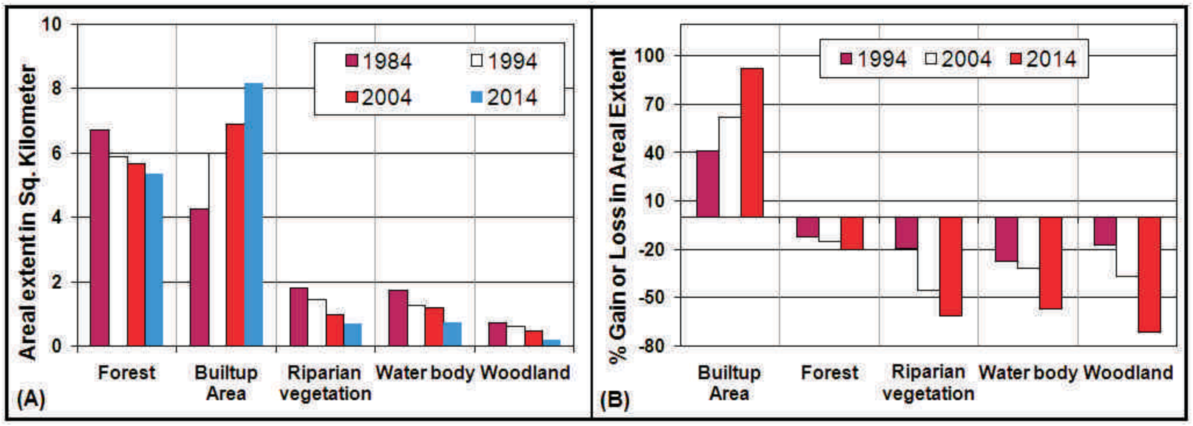


Figure 3. **Temporal variation in the spatial extent of land use types (A) and estimated percentage loss / gain of the different land use with reference to 1984 situation (B)**

In addition, the evaluation of climatic data (1996 to 2009) as presented in Figure 4, revealed minor variations in temperature and evapo-transpiration (ET) apparently due to the humid tropical setting. However, there is a clear temporal variation in rainfall over the years which can be clearly attributed to the impacts of climatic change.

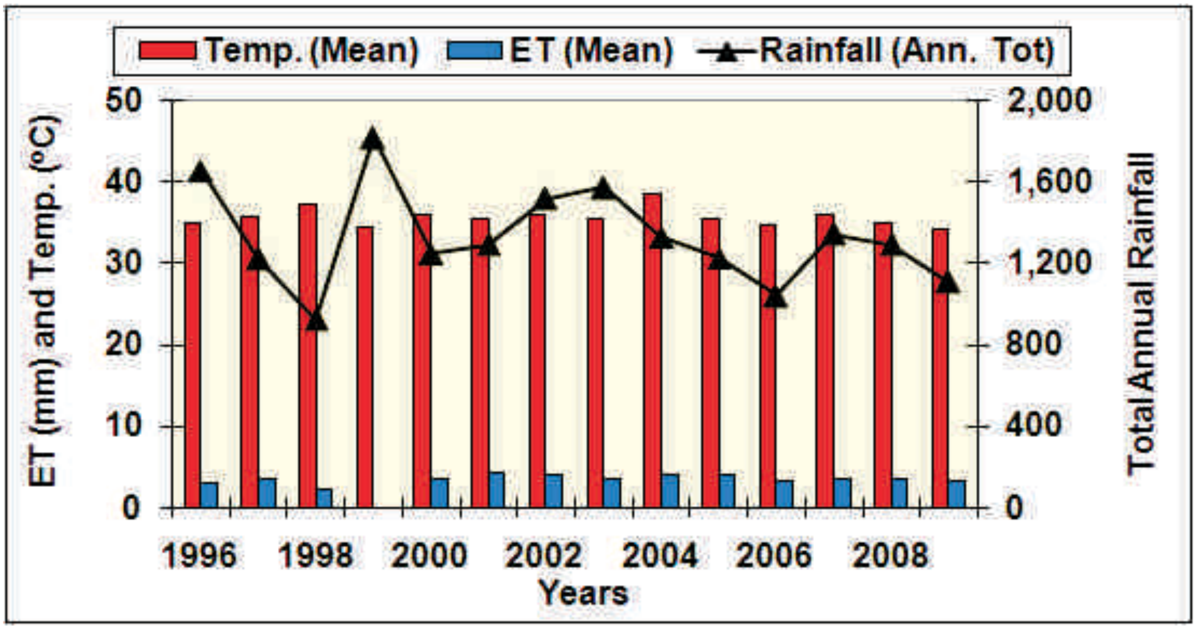


Figure 4. **A composite plot of temporal variability of average climatic data (Rainfall, Temperature and Evapo-transpiration) for the period of 1996 to 2009.**

Therefore, it can be inferred that the Eleyele wetland ecosystem had been impacted by climatic (rainfall) variation in the face of global climate change in addition to the influence of human-induced urban development activities.

Assessment of Soil Physical Characteristics: As part of quality evaluation of the Eleyele Wetland soils, the initial textural analyses revealed dominantly sandy/silty loam soils with sand proportion of 32 – 82%, silt fraction of 11 – 48%, while clay fraction is about 3-20%. Clay fractions are of special importance because of their chemical activity and large external and internal charged surfaces for exchange of nutrient ions (FAO, 2001). Bulk density of 1.5-1.8 g/cm^3 indicates sandy-silt loam soils while permeability of 7.5 – 48cm/hr implies well drained buffer zone soils, especially in the western portion with quartz-schist bedrock setting. Also water-holding capacity of 29 – 41% (av. 34.6 %) suggests mostly sandy loam soils that had been influenced by cover removal and tillage.

As part of further evaluation, FAO method of soil physical status assessment was employed for the rating of the wetland soil fertility based on the measured physical characteristics as presented in Table 1. With exception of bulk density having over 40% of the analyzed soils exhibiting poor / unsuitable rating, other physical characteristics exhibit medium to good rating for greater proportion of the analyzed samples. By and large, the western portion of the Eleyele wetland (underlain by quartz-schist parent rock) has better soil physical quality compared to the eastern section (underlain by migmatite-gneiss parent rock). This could be attributed, in part, to the fact that the western are portion of the Eleyele wetland is planted with Teak and Melina Wood Plantation, which in no small measure will, help to preserve the soil qualities.

Table 1. **Physical characteristics of Eleyele Wetland soils with respect to FOA ratings**

Soil Quality Parameter	**Eastern Riparian Zone**	**Eastern Riparian Zone**	**FOA Rating Class**
Bulk Density (g/cm3)	1.6–1.8 (1.7)	1.5–1.7 (1.6)	Marginal to Unsuitable
Porosity Vol. %	32.1–38.9 (38.2)	35.1–42.6 (38.9)	Medium to Marginal
Permeability (cm/hr)	10.4–48.1 (24.7)	14.0–47.3 (30.10)	Medium to Good
EC (µs/cm)	100–610 (385)	400–760 (550)	Good to Marginal

Note: Class 2 = Good; Class 3 = Medium; Class 4 = Marginal; Class 5 = Unsuitable (FAO, 1992).

However, soils in the eastern portion of the Eleyele wetland are apparently affected by degradation consequent to continuous farming / cultivation and exposure to influence of erosion.

Chemical Characterization Eleyele Wetland Soils:

Summary of the results of analyzed chemical parameters for the riparian soil samples from the Buffer zones of the Eleyele Wetland alongside other nutrients / soil fertility indices as presented in Table 2. The pH-(KCl) revealed a relatively acidic soil with values of 4.2 – 6.8 compared to the typical range in pristine agricultural soils. Such low pH values can cause plant nutrient deficiencies (especially Ca, and Mg) and possible trace metal enrichment with negative effects on crop yield.

Table 2. **Summary of chemical parameters of the soil samples from the buffer zones of the Eleyele Wetland (N=16)**

Parameters	Minimum	Maximum	Average	*Typical normal range
pH (KCl 1:1)	4.2	6.8	5.69	6.5 – 7.5
O.C mg/kg	6,660	33,670	16,700	
Avail N mg/kg	690.0	3,490	1,730	1,000 – 4,000
Avail P mg/kg	150.5	1,270	590.7	200 – 2,000
Acidity cmol/kg	0.11	5.33	1.37	
CEC cmol/kg	5.25	25.27	9.31	10 – 20
Ca (mg/kg)	60.0	18,760	3,990	5,000 – 30,000
Mg (mg/kg)	810	3,720	1,830	1,000 – 15,000
K (mg/kg)	150	1,630	540	1,000 – 30,000
Na (mg/kg)	1,030	2,140	1,590	500 – 15,000
Mn (mg/kg)	7.4	324.01	153.94	20 – 3,000
Fe (mg/kg)	104.03	484.21	219.28	10,000 – 50,000
Cu (mg/kg)	3.48	9.83	6.33	2 - 100
Zn (mg/kg)	6.26	109.12	23.86	10 - 200

* Typical range of elements in non-polluted agricultural soils
Source: McGrath *et al.,* 2001

Nitrate and phosphorus have values of 690–3,490 mg/kg and 150–1,270 mg/kg respectively which compare reasonably well with typical range of values for uncontaminated arable soils. For the base metal (Ca, Mg, Na and K), the observed concentrations, though within the range typical for uncontaminated agricultural soils, are slightly lower. This may not be unconnected with the sandy nature of the parent rock and partly due to human development impact on the soil quality and degradation. Similarly, the trace elements (Fe, Mn, Cu and Zn) concentrations are also consistent with the typical values for uncontaminated agricultural soil.

In addition, further evaluation of the soil chemical quality in terms of the extractable nutrients using the FOA soil fertility rating is summarized in Table 3. With respect to phosphorus, the wetland riparian soils exhibit medium to very high fertility class rating, However, majority of the soil sample have K and Mg concentrations that reflects low fertility class / rating, which is an indication of soil quality degradation within the buffer zone. Aso, organic carbon and CEC also revealed concentration that are consistent with medium to high fertility rating, while pH with values of 4.2 – 6.8 reflect low to medium soil fertility rating, apparently due to possible nutrient loss/depletion consequent to low for some of the soil samples.

Table 3. **Summary of soil fertility rating of Eleyele Wetland riparian buffer zone soils**

Fertility Class	P mg/kg	K mg/kg	Mg mg/kg	Org. C mg/kg	pH	CEC cmol/kg
Minimum	15.53	150	7.4	6.66	4.2	5.25
Maximum	127.43	1,630	324.01	33.67	6.8	25.27
Mean	59.73	540	153.94	16.7	5.7	9.31
*Fertility rating	Medium – very high	Medium – very high	Low – high	Medium – very high	Medium	Medium – high

*FAO, 2011, 2003

Nonetheless, the overall rating implies that the buffer zone soils of the Eleyele wetland still in position to sustain 50–80% crop yield without any amendment application based on FAO fertility rating.

Summary and Conclusions

In this study, GIS-based mapping of land-use changes and assessment of the bio-physical change with respect to soil quality of the Eleyele Wetland, clearly demonstrated the human-induced influence on the Wetland ecosystem with attendant degradation and loss. Like many developing countries, urban environments have greatly changed in Ibadan with increasing population with wetland and green areas subjected to degradation. As highlighted earlier in the intervening period from 1984 to 2014, the built-up area within the catchment of Eleyele Wetland has increased by almost 70%. This has resulted in a reduction or lost of forest and agricultural areas around the Eleyele Wetland to be more than 60%.

By and large, there are clear influence environmental contamination of the water and bottom sediments of the feeding stream and the main wetland lake through effluent discharge from the urbanized catchment as highlighted in earlier study (Tijani and Onodera, 2009; Tijani *et. al,* 2014).

Hence, there is the need for definition of soil and water quality indicators which can measure changes in such Wetland ecosystems and the need to integrate proper urban waste disposal management with land-use plan in order to avoid degradation of wetland ecosystem.

References

FAO, (2001). *Soil and nutrient management in SSA in support of the soil fertility initiative* AGL/Misc.31/01. Rome. 379p.

FAO, (2003). *Assessment of soil nutrient balance – approaches and methodologies*, by R.N. Roy, R.V. Misra, J.P. Lesschen & E.M. Smaling. *Fertilizer and Plant Nutrition Bulletin* No. 14. Rome. 87p.

Gosselink J. G. and R. E. Tuner 1978. The Role of hydrology in fresh water Wetland ecosystems. pp. 63 – 78.

McGrath, D., Carton, O.T., Diamond, S., O'Sullivan, A.M., Murphy, W.E., Rogers, P.A.M., Parle, P.J. and Byrne, E. (2001). Soil, herbage, feed and water. In: *Investigation of Animal Health Problems at Askeaton, Co. Limerick.* EPA, Johnstown Castle Estate, Wexford.

Tijani, M.N., Olaleye A.O. and Olubajo, O.O. (2011). Impact of urbanization on wetland degradation: a case study of Eleyele Wetland, Ibadan, SW-Nigeria. *Africa Geoscience Review*, Vol. 18(3):7-24.

Tijani, M.N. and Onodera, S. (2009). Hydrogeochemical Assessment of Metals Contamination in an Urban Drainage System: A Case Study of Osogbo Township, SW-Nigeria. *J. Water Resource and Protection*, 2009, 3, 164-173.

Williams, A. L., K. E. Wills, J. K. Janes, J. K. V. Schoor, P. C. D. Newton, and M. J. Hovenden. (2009). Warming and free air CO2-enrichment alter demographics in four co-occurring grassland species. *New Phytologist, Vol.* 176: 365-374.

Compliance with Good Handling Practices among Tomato Farmers in Kaduna State

Tijani Sarafat A.

Department of Agricultural Extension and Rural Development, Faculty of Agriculture, University of Ibadan, Ibadan, Nigeria

Corresponding author:
tsarafat@yahoo.com

Keywords:
Tomatoes, Good handling practices, Compliance, Farmers

Abstract

Tomato is one of the most popular fruit vegetables grown in Nigeria because of its nutritional and medicinal value. However, it is highly perishable and large volumes of tomatoes are lost every year due to post harvest handling practices. Good Handling Practices (GHPs) are essential to retain its value which could be lost through microbial contamination and damage. This study therefore examined compliance with GHPs among tomato farmers in Kaduna State. Multi-stage sampling procedure was used to select 150 respondents. Data were obtained through the use of interview schedule and analyzed using Chi-Square and Pearson Product Moment Correlation. The result shows that the mean age of respondents was 52±12 years with majority (96.0%) being males. Respondents produced an average of 1,511 baskets of tomatoes and earned average monthly income of 138,900±47,478. Respondents (90.7%) had high knowledge of GHPs. All the respondents (100%) always handle tomatoes carefully to minimize bruising and breaking of the skin while 92.7% had high compliance with GHPs. The most severe constraint ($\bar{x}$=2.00) to compliance was high cost of packaging materials. Type of labour and knowledge were significantly related to compliance with GHPs. Respondents' association should contribute to buy packaging materials in bulk and provision of subsidized packaging equipment like Returnable Plastic Crates (RPC) by the government will encourage farmers to purchase and use in marketing their produce.

Introduction

Fruit and vegetables are important parts of our daily diet. They are natural and contain vitamins and minerals that can keep us healthy. Fruits and vegetables are also important sources of income, especially in urban and peri-urban areas. The most popular fruit vegetables grown in West Africa are tomato, pepper, okra, carrot etc. The nutritional and economic importance of tomato (*Lycopersicum esculentum)* has led to its global production. Tomato is an important crop to an average Nigerian accounting for about 18% of the average daily consumption of vegetables. Nigeria became the 13th largest producer in the World in the year 2008 that resulted to increased tomato production of about 1,701,000 tons (Babalola, Makinde, Omonona and Oyekanmi, 2010).

Meanwhile, Post-harvest losses of fruits and vegetables have been identified as one of the determinants of the food security in most developing countries (FAO 2004). In Nigeria it amounts to 35 - 45% of the annual production because post-harvest handling procedures of fruits and vegetables are not fully recognized and understood by the major stakeholders. Postharvest loss is a major challenge to tomatoes production in most developing countries (Arah, Kumah and Amaglo, 2015). Tomato being a perishable crop as a result of its high moisture content has short shelf life of about 48 hours under tropical conditions (Muhammad, Bamisheyi and Olayemi, 2011). Hence, specialized postharvest handling practices and treatment methods are needed in order to extend the shelf life of the crop after harvest. Failure of which will result in high amount of losses (up to 50%) between the harvesting and consumption stages of the distribution chain in the tropical countries (Kader, 2005, Pila, et.al, 2010). Gustavo et al. (2003) noted that between 49 and 80% of all agricultural commodities end up with the consumer whilst the remainder is lost. Hence, the need for Good Agricultural Practices (GAP)

GAPs are different sets of codes, standards and regulations developed by government, NGOs and private sector (FAO, 2012. Good Agricultural Practices – Introduction, Retrieved). FAO uses GAP as a collection of principles to apply for on-farm production and post- production processes, resulting in safe and healthy food and non -food agricultural products, while taking into account economic, social and environmental sustainability. GAP relies on four principles: economically and efficiently produce sufficient (food security), safe (food safety) and nutritious food (food quality); Sustain and enhance natural resources; Maintain viable farming enterprises and contribute to sustainable livelihoods; Meet cultural and social demands of society. Good Handling Practices (GHPs), a subsection of GAP are food safety steps that are taken after harvesting and field packing.GHP suggests efforts to reduce the risk of microbial contamination from harvesting, in the packing, handling, storage, transportation and processing stages. Thus, GHP operates the same principles with organic practices in reduction of post-harvest losses and contamination of tomatoes. GHPs have been disseminated to tomato farmers in four states of Nigeria namely; Kaduna, Kano, Jos and Lagos by Growth and Employment in states (GEMS4), a non-governmental organization, hence, the need to ascertain farmers' level of compliance with the GHPs principles in Kaduna state. The study ascertained knowledge of GHPs, constraints to utilizing GHPs and level of compliance with GHPs by tomato farmers in Kaduna state. It was assumed that no significant relationship exists between knowledge, constraints and compliance with GHPs.

Material and Method

The study was conducted in Kaduna State of Nigeria. The state has a coordinate of between latitude 90 and 140 north of the equator and longitude 70 and 100 east of the Greenwich meridian. The State occupies an area of approximately 48,473.2 square kilometers and has a population of 760,084 (National Population Commission, 2006).Agriculture is the main stay of the economy of Kaduna state with about 80% of the people actively involved in farming. The crops grown are guinea corn, millet, carrot, groundnut, tomato, finger millet, onions and maize. Population of the study comprises all tomato farmers in Kaduna state. Purposive sampling technique was used to select 40% of Local Government Areas (LGAs) where tomato is highly cultivated. Two (2) wards from the selected LGA were randomly selected to give a total of fifteen (10) wards. Lastly, 10% of tomato farmers were randomly selected from each of the wards given a total of one hundred and fifty (150) respondents. Knowledge of GHP was measured on a two point scale of “Yes and No” with a score of 1 and 0 respectively. Compliance with GHP was measured on a three point scale of “Always, Sometimes and Never with assigned scores of 2, 1 and 0 respectively. The mean was computed and used for categorization into low or high.

Result and Discussion

The mean age of the respondents was 52±12year and majority (96.0%) was male which might be due to commercial perception nature of tomato. This is in consonance with findings of World Bank (2012) that in Africa when a crop is perceived as commercial, men are more likely to take over from women.

Table 1. **Distribution of respondents based on socio-economic characteristicsn=150**

Variables	Frequency	Percentage	Mean	SD
Age			52	12
25-48	62	641.4		
49-75	88	58.7		
Sex				
Male	144	96.0		
Female	6	4.0		
Marital status				
Single	4	2.7		
Married	146	97.3		
			18	5
Household size				
7-16	57	36.1		
17-28	93	62.0		
			2	0.6
Farm size				
< 1	15	10.0		
1-3	135	90.0		
			24	6
Farming experience				
10-21	60	40.0		
22-35	90.0	60.0		
Type of labour				
Hired labour	65	43.3		
Family labour	52	34.7		
Communal labour	11	7.3		
Self-labour	22	43.3		
			1,511	704
Quantity of tomato produced				
135-1544	74	49.4		
1545-2800	76	50.6		
			138,900	47,478
Income from tomato				
40,000-127,001	66	44.0		
127,002-167,002	39	26.0		
167,003-240,000	45	30.0		
Association				
Membership of Tomato sellers association				
Member	59	60.7		
Non member	91	39.3		

Source: Field survey, 2018

Majority (97.3%) were married thus they have family responsibilities to care for and this could make them comply with GHPs in order to reduce post-harvest losses and increased their income to be able to meet up with family responsibility. The result is in line with Nnadi and Akwiwu (2008) who observed that probability of participating in rural agriculture is higher for married farmers especially males, who are heirs due to increased concern for household welfare and food security following marital responsibilities. In addition, the mean household size of respondents was 18±5persons which implies that most of the respondents had larger household size and this could be attributed to the need for family labour. This corroborates the findings of Nwaiwu, Ohajiaya; Orebiyi, Obasi, Lemchi, Ibekwe, Onyeagocha, Ukoha, Osuji, and Kadiri (2012) that most rural dwellers larger household size were mainly for farm labour. Possession of large hectares of land by 90.0% of respondents shows that farmers in the study area were producing tomatoes on a commercial scale. The mean years of farming experience of 24±6 shows that most of the respondents had been producing tomatoes for a longer period and this could influence their zeal to comply with GHPs as also observed by Assefa and Van den Berg (2010). Quantity of tomato produced by respondents ranged between 135-2800baskets thus most of the farmers were producing big but could reduce post-harvest losses if they comply with GHPs. The mean income from tomato was 138,900±47,478 which suggest that most of the respondents were earning huge income and compliance to GHP can make them to earn more.

Knowledge of respondents on GHPs

Result on Table 2(a&b) shows that majority (90.7%) of respondents have high knowledge of GHPs of tomato. However, respondents have no knowledge on reducing the number of times the tomato is handled which could be as a result of high demand and or unequal ripening of the crop. Lack of knowledge by respondents' on heaped at collection centres on the farm could be attributed to fear of crates falling and loss due to improper heaping or lack of energy to perform the heaping task. It might also be due to availability of space to spread it as they want or avoidance of heat that can induce over-ripening of the fruits. Meanwhile, lack of knowledge on pre-cooling immediately after harvesting could be attributed to market demand and market locations for the crop with the assumption that it will be cooling along the way as it is being transported.

Table 2a. **Distribution of respondents based on knowledge of GHPs**

Practices	Yes Freq. (%)	No Freq. (%)
Harvesting of tomatoes		
Reducing the number of time the commodity is handled	0.0	100.0
Handling with care to minimize bruising and breaking of the skin	100.0	0.0
Heaped at collection center on the farm	0.0	100.0
Not exposed to sun	97.3	2.7
Harvesting of tomato in the cool part of the day	100.0	0.0
Harvesting of tomato at correct stage of ripeness (mature green)	98.0	2.0
Use of sharp knives for harvesting	0.0	100.0
Pre-cooling of tomato		
Precooling immediately after harvesting	0.0	100.0
Cover crates to protect tomatoes, keep them cool and dry	11.3	88.7
Store in cool room to keep tomatoes fresh	100.0	0.0
Cleaning, sorting and grading		
Use recommended detergents and clean water	100.0	0.0
Removal of injured and damaged tomatoes	100.0	0.0
Remove dirt from tomatoes before putting into containers	100.0	0.0
Sort tomatoes according to sizes	100.0	0.0
Packaging		
Use clean, smooth and ventilated containers for packaging	100.0	0.0
Use containers that are appropriate for tomatoes	100.0	0.0
Equipment that touches tomatoes are cleaned and sanitized	100.0	0.0
Establish routine cleaning and sanitizing procedures	100.0	0.0
Maintain all equipments so as to minimize contamination of injuring tomatoes	100.0	0.0
Transportation		
Inspect any vehicle for cleanliness, dirt and debris before loading	100.0	0.0
If there is any doubt regarding previous loads transported in a vehicle, verify records	100.0	0.0
Ensure transporters maintain positive lot identification	100.0	0.0
Use plastic crates in place of raffia baskets	100.0	0.0
Storage		
Separate damage tomatoes and dispose quickly	100.0	0.0
Store under appropriate temperature and humidity	100.0	0.0
Store in sanitary manner	100.0	0.0

Source: Field survey, 2018

Table 2b. **Distribution of respondents based on level of Knowledge on GHPs**

Level of awareness	Frequency	Percentage	Minimum	Maximum	Mean	SD
Low (20-21.0)	14	9.3	20	22	21.1	0.34
High (21.1-22)	136	90.7				
Total	150	100.0				

Source: Field survey, 2018

Constraints to compliance with GHPs on Tomato

High cost of packaging materials such as plastic crates or collapsible cartons was ranked first as the most severed constraint faced by the respondents with the highest mean ($\bar{x}$ of 2.00. This implies that most of the respondents might be restrained from getting material which would help them comply with good GHPs in the study area. However, poor state of vehicles used to convey tomato ($\bar{x}$ = 0.00), inadequate knowledge on harvesting period ($\bar{x}$ =0.00), inadequate knowledge on sorting and grading ($\bar{x}$ =0.00) and inadequate knowledge on the best time to transport fresh tomato ($\bar{x}$ = 0.00) were the least constraints facing respondents in a bid to comply with GHPs.

Compliance with GHPs

Findings from the study revealed that majority (92.7%) of the respondents had high level of compliance with GHPs which suggests that most of the respondents were serious and business minded farmers who would like to protect their tomatoes in order to reduce damages. This in turn could make respondents to have good market price for their produce and consequently increase income. High level of compliance to GHPs by respondents can be attributed to the indigenous or organic nature of the activities in GHPs thus part of the practices have been carried out before the introduction of GHPs and this makes it easy for greater percentage of respondents to adopt and comply.

Table 3. **Distribution of respondents based on level of compliance with GHPs**

Level of compliance	Frequency	Percentage	Minimum	Maximum	Mean	SD
Low (0-30.6)	11	7.3	0	35	30.7	8
High (30.7-35)	139	92.7				
Total	150	100.0				

Source: Field survey, 2018

Relationship between selected socio-economic characteristics of respondents, awareness, constraints and compliance with GHPs

Using Chi-square, table 4a shows a significant relationship between educational attainment, type of labour, secondary occupation and compliance with GHPs. This implies that the more educated the respondents are, the easy they understand the practices. This result agrees with Ozor and Cynthia (2010) who opined that an increase in educational status of farmers positively influence the adoption of improved technologies and practices. Using Pearson Product Moment Correlation table 4b however, the results revealed a significant relationship between age, household size, years of experience, income from tomato and compliance with GHPs. This finding is in line with Abu *et. al,* (2011) that socioeconomic variables particularly farm size and labour significantly influenced tomato output. Large household size as revealed in this study might be for farm activities especially when tomato is to be picked/ harvested by hand as stipulated in GHPs. Members of respondents' household will be more careful in handling the tomatoes so as to reduce losses. Also, significant but inverse relationship was found between respondents' knowledge of GHPs and compliance with GHPs. This implies that the more the respondents' knowledge of GHPs, the less the compliance. The plausible reason for this might be high cost of packaging materials (such as plastic crates or collapsible cartons) and other equipments which were identify by respondents to be major constraints to compliance with GHPs.

Table 4a. **Relationships between selected socio-economic characteristics of respondents and compliance with GHPs**

Variables	χ2	df	P-value
Educational attainment	6.890	1	0.009
Type of labour	22.371	3	0.001
Secondary occupation	36.302	3	0.002

Source: Field survey, 2018
Significant at the 0.05 level (2-tailed)

Table 4b. **Relationship between selected socio-economic characteristics of respondents, awareness, constraints and compliance with GHPs**

Variable	r value	p value
Age	-0.306	0.000
Household size	-0.206	0.011
Years of experience	-0.456	0.000
Income from tomato	-0.168	0.039
Awareness	-0.681	0.000

Source: Field survey, 2018
Significant at the 0.05 level (2-tailed)

Conclusion

Respondents were mostly commercial farmers with high annual income from tomato cultivation. They had high level of knowledge on Good Handling Practices which lead to high compliance in almost all stages of Good Handling Practices. Government should assist the farmers by giving them credit or subsidized inputs such as conveyor, proper washing, packing machines and packaging equipment to enhance compliance and to encourage younger and women to participate in tomato farming. Extension system should be used to sensitize more farmers and to monitor and persuade Good Handling Practices users in order to improve compliance in the study area.

References

Abu, O., Alumunku, M. and Tsue, P.T. (2011). Can Small-scale Tomato Farmers Flourish in Benue State, Nigeria? *Journal of Agricultural Science,* vol. 2 (2): 77-82.

Arah, I. K., Amaglo, H., Kumah, E. K.and H. Ofori (2015). "Preharvest and postharvest factors affecting the quality and shelf life of harvested tomatoes: a mini review," *International Journal of Agronomy,* vol. 2015, Article ID 478041, 6 pages, 2015.

Assefa, Y. and Van den Berg, J. (2010). Genetically modified maize: adoption practices of small-scale farmers in South Africa and implications for resource-poor farmers on the continent. *Asp. Appl. Biol.* 96, pp. 215-223.

Babalola D. A, Makinde Y. O, Omonona B.T., Oyekanmi, M.O. (2010). Determinants of post harvest losses in tomato production: A case study of Imeko – Afon local government area of Ogun state..*J. Life. Phys. Sci.* Acta SATECH 3(2):14-18.

FAO (2004). Fungal Pathogens Associated with Tomato Wicker Baskets. SWJ.2, pp. 38-39. FAO. Good Agricultural Practices – Introduction. Retrieved April 8, 2012, from http://www.fao.org/prods/gap/

Gustavo, B. C. V., Juan, F. M. J., Stella, M., Maria, S. T., Aurelio, L. M. and Jorge, W. C. (2003)

"Handling and preservation of fruits and vegetables by combined methods for rural areas," Technical Manual FAO Agricultural Services Bulletin 149, FAO, Rome, Italy, 2003.

Kader, A. A. (2005)."Increasing food availability by reducing postharvest losses of fresh produce," *Acta Horticulturae,* vol. 682, no. 1, pp. 2169–2176, 2005.

Muhammad, R. H., Bamisheyi, E. and Olayemi, F. F.(2011) "The effect of stage of ripening on the shelf life of tomatoes (Lycopersicon esculentum) stored in the evaporative cooling system (E.C.S)," *Journal of Dairying, Foods & Home Sciences,* vol. 30, no. 4, pp. 299,301, 2011.

National Population Commission, 2006.

Nnadi F. N, and Akwiwu, C.D (2008). Determinants of Youths' Participation in Rural Agriculture in Imo state, Nigeria. *Journal of Applied Sciences,* 8: pp. 328-333.

Nwaiwu, I. U., Ohajiaya D. O., Orebiyi, J. S., Obasi, P. C., Lemchi, J. I., Ibekwe, U. C., Onyeagocha, S. U. O., Ukoha, I. I., Osuji, M. N., and Kadiri, F. A. (2012). Socio-economic determinants of the productivity of Garden egg (solanum melongena) farmers in Imo state, Southeast Nigeria. *International Journal of Agricultural Economics and Rural Development* (IJAERD) 5 (1) pp 1-15.

Ozor, N and Cynthia, N. (2010). Difficulties in adaptation to climate change by farmers in Enugu State, Nigeria. *Journal of Agricultural Extension;* Vol. 14(2): 106-122.

Pila, N., Gol, N. B and Rao, T. V. R. (2010) "Effect of post harvest treatments on physicochemical Characteristics and shelf life of tomato (Lycopersicon esculentum Mill.) fruits during storage," American-Eurasian *Journal of Agricultural & Environmental Science,* vol. 9, no. 5, pp. 470–479, 2010.

World Bank, (2012), "Fact Sheet: The World Bank and Agriculture in Africa."

Participatory Plant Breeding Concept as Tool for Creating Adapted Varieties for Local Conditions

Petr Konvalina[1],
Ivana Capouchova[2]
and Dagmar Janovská[3]

[1]University of South Bohemia in Ceske Budejovice, Faculty of Agriculture, Studentska 1668, 370 05 Ceske Budejovice, Czech Republic

[2]Crop Research Institute in Prague, Drnovska 507/73. 161 06 Praha 6 – Ruzyne, Czech Republic

[3]Czech University of Life Sciences in Prague, Kamýcká 129, Prague, Czech Republic

Corresponding author:
petr.konvalina@gmail.com

Keywords:
Organic farming, participatory plant breeding, varieties

Abstract

Organic farming has been developing worldwide over the last few decades. However, the crucial problem has not been resolved yet – a lack of suitable varieties. It is a serious factor limiting this development. Breeding is a very demanding and expensive process; special varieties are not bred for the organic farming from many crops. A concept called "participatory plant breeding" (PPB) is a possibility for resolving this problem. It is based on a direct involvement and participation of a farmer in the breeding process. Undemanding and cheap breeding methods are chosen there – they do not require any special education or equipment from the farmers involved. Training and professional surveillance are sufficient. One of PPB methods has been used and tested in our climatic conditions – a selection. As far as various wheat species originating from the genetic resources are concerned, the most important production parameters of original seeds and seeds coming from plants selected repeatedly have been studied and evaluated. Production parameters are positive (number of spikes, yield). Some other characteristics (the genetically-conditioned ones) are neutral or of a minimum effect. Considering results of our research, PPB method is highly recommended for improving economic characteristics of less bred or completely inbred crops.

Introduction

A lot of methods have been employed for creating brand new varieties in the agriculture recently. Organic breeders usually use a method of crossbreeding. Not only the method of breeding itself but also a principle of breeding is important. A breeding method called "participatory plant breeding" (PPB) has been introduced in several European countries. It was invented in the early 1980's. It used to make part of a movement supporting a participatory research concept. It was invented in reaction to criticism about a failure of research carried out at trial stations that had aimed at helping poor farmers in developing countries (Ceccarelli *et al.,* 2007).

PPB as a method is based on the idea of farmers and professional breeders having special knowledge and skills they can share with each other. It is defined as a lot of approaches. All of them include a participation of various participants (researchers, breeders and farmers) in the breeding process (GIZ, 2017).

Modern varieties provide higher yield rate in better production areas. However, most of them are not suitable for small farmers or marginal (less favourable) areas, including organic farming. Therefore, PPB may supplement conventional crop breeding, it cannot play the role of alternative breeding system. About eighty PPB programmes exist worldwide nowadays. They include various institutions and crops. Participatory breeding method is mostly followed in tropical countries. It is aimed at acquiring adapted varieties to certain regions. They would be affordable for local farmers and help them be independent on seed supplied from abroad.

There is a different situation in Europe. There is binding legislation on organic farming that requires certified seeds to be used by organic farming system. There is, nevertheless, a shortage of them. A small European market not guaranteeing at least minimum profit to breeding companies is one reason for this organic seed shortage. They do not get their breeding investments back then. Therefore, organic farmers and their associations begin to meet researchers and launch PPB projects. In Germany, for instance, PPB method has been followed in order to grow a specific *Vicia faba* L. variety (Ghaouti *et al.,* 2008). In the Netherlands, a brand new onion variety has been bred with this method (Osman *et al.,* 2008). In Portugal, PPB method has been used for corn breeding since 1984 – the breeding process aims at acquiring traditional technological parameters good or suitable for bread production there (Vatto *et al.,* 2008). In France, cabbage and cauliflower have been bred (Chable *et al,* 2008), and durum wheat as well. They contain enough proteins and are suitable for typical local pasta. Producers of pasta, organic farmers and researchers from the INRA were involved in the selection of suitable materials (Declaux, 2005). In the south-west France, PPB programme has aimed at selecting good-quality varieties of corn and sunflower, resistant against drought (Chable *et al.,* 2014). About thirty species of field crops and vegetables have already been bred with PPB. Since 2009, PPB has been aimed at forage crops and technical crops as well.

Our research and this paper work aim at evaluating PPB method, its effect on inbred land races of various *Triticum L.* (wheat) species. Particular genotypes of spring einkorn, emmer wheat and spelt wheat have been selected and their effect has been evaluated.

Material and Methods

Tested and evaluated genotypes come from the gene bank by the Crop Research Institute in Prague-Ruzyne – six varieties of *Triticum monococcum* L., five varieties of *Triticium dicoccum* Schrank (Schuebl) and seven varieties of *Triticum spelta* L. Two varieties of *Triticum aestivum* L. were used as control varieties in this experiment.

Field trials including the above-mentioned genotypes were carried out at a trial station by the Czech University of Agriculture, Prague-Uhrineves. A method of random blocks was used and repeated twice or three times there. A trial plot – 12 square metres, a seeding rate – 400 germinable caryopses per square metre. Pea was used as a forgoing crop. Impact of selection was studied and evaluated since the project was launched (in 2013). Let us introduce you a list of results we have selected from 2016 yield. They show us how the evaluated parameters of selected materials were changing from 2013 to 2016, and allow us to compare them to the original unselected materials.

The original unselected material and the selected one (the selection) of every single genotype was seeded repeatedly. Since 2013, a negative and a positive selection was made repeatedly (plants of a different habitus, plants affected with diseases, damaged and weak ones were removed during the growing period). The longest and strongest spikes of every single genotype were chosen from a "selected" trial plot and they were seeded next year in the spring (these spare trial plots were not used for the evaluation of yield parameters).

Results and discussion

All the crop stands grown from the selected material (the "selection") have produced higher yield that the crop stands grown from the original unselected material. All the tested and evaluated wheat species have achieved such a result. The selection has had a positive impact on the yield (see Figure 1), on the number of spikes per square metre before harvest (see Figure 2) and on the field emergence (see Figure 3). On the other hand, it has had a negligible impact on the morphological features (length and width of a flag leaf), on the occurrence of diseases and on the quality indicators as well.

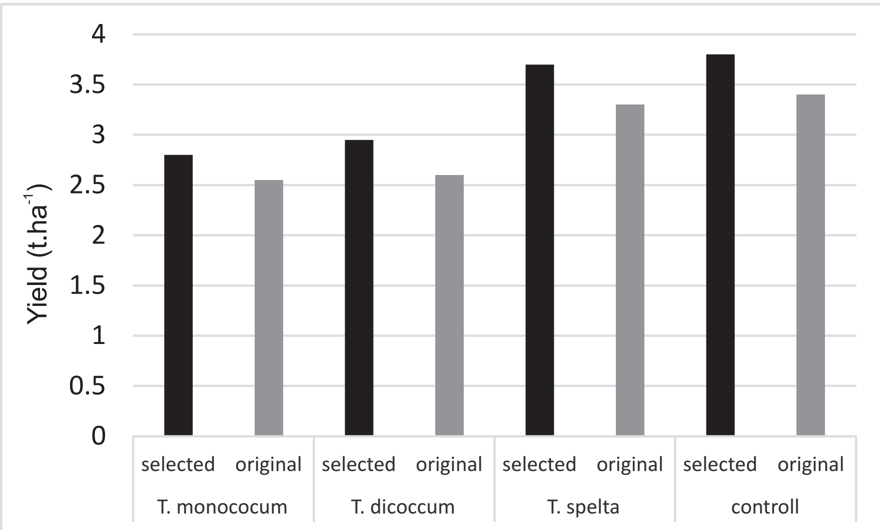


Figure 1. **Impact of selection on yield**

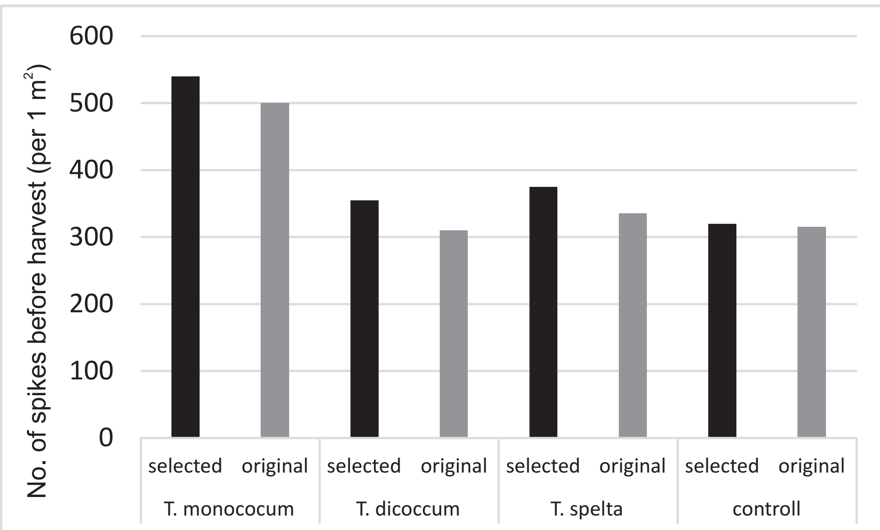


Figure 2. **Impact of selection on number of spikes before harvest**

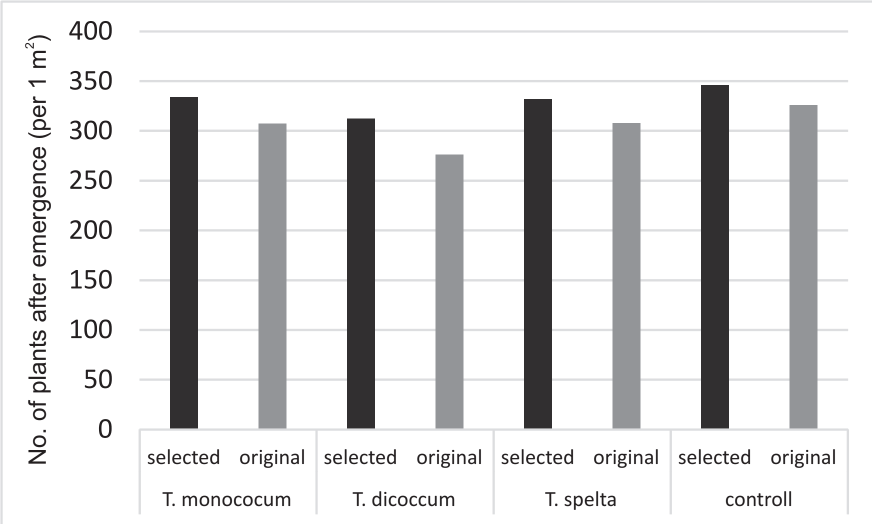


Figure 3. **Impact of selection on field emergence**

Results of our research have shown that the selection may be used for enhancement of various breeding materials (selected genetic resources on einkorn, emmer wheat and spring form of spelt wheat) that have not been crossbred. It has a positive impact on production parameters in particular. The less bred material we use, the stronger impact the selection has (Konvalina *et al.,* 2014). Results of our research have also shown this simple method to be suitable for participatory breeding carried out by farmers. On the other hand, the selection does not usually have any impact on morphological or biological features (e.g. resistance against diseases). They are usually genetically conditioned (Stehno *et al.,* 2010). It is, therefore, important for us to pay attention to the selection of input material (genetic resources) we work with. It is also similar to wheat quality indicators. As far as protein content is concerned (see Figure 4), the selection has a negative impact on it. It is caused by a strong negative correlation between protein content and grain yield (Konvalina *et al.,* 2014 Sedimentation index – Zeleny test (see Figure 5) and falling number are tightly linked to a genotype and the selection does not usually have strong impact on them (Surma *et al.,* 2014).

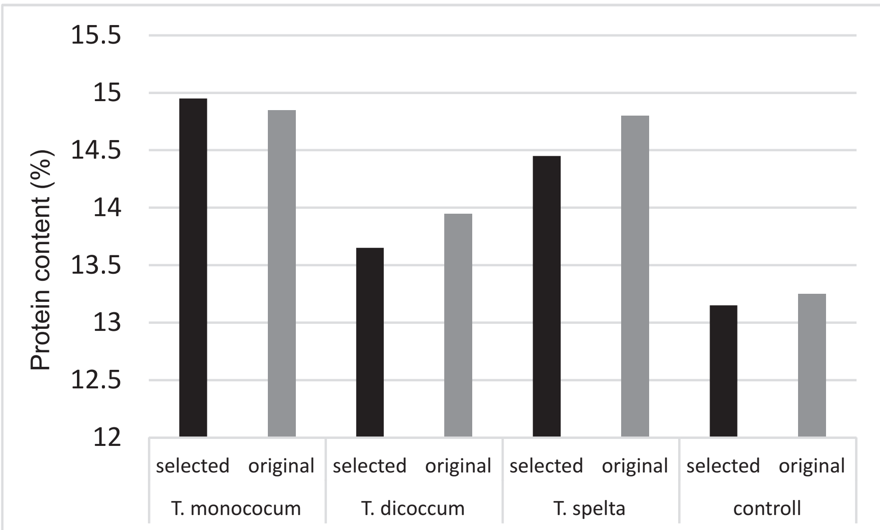


Figure 4. **Vliv selekce na obsah bílkovin v zrnu**

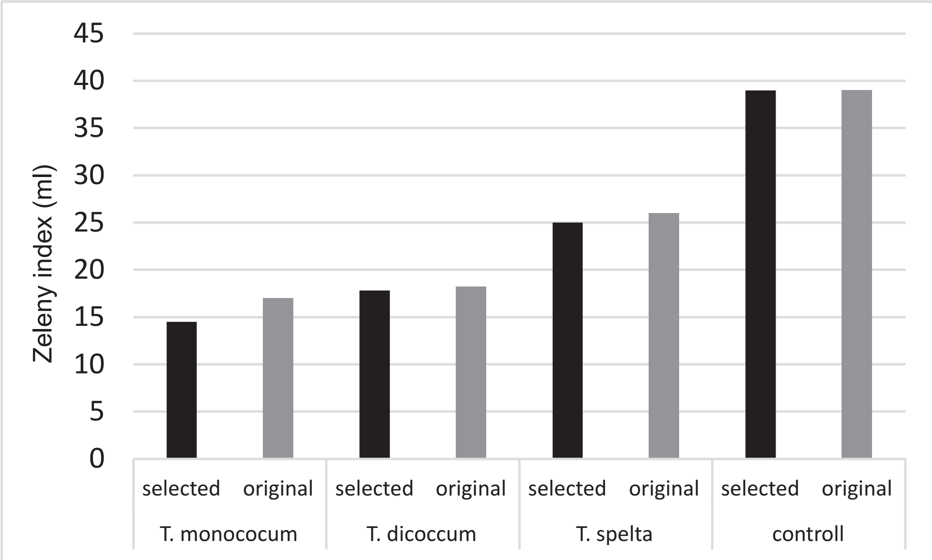


Figure 5. **Vliv selekce na Zeleny index**

Conclusion

Results of our research have shown selection as the simplest and most effective breeding method. It is a method a well-trained farmer can employ. Such a farmer has a big advantage as he knows local conditions well. He can focus the selection on his own needs. As far as financial aspect is concerned, selection is a very cheap method.

PPB may contribute to stronger role of farmers in several ways:

a) it gives farmers with an opportunity to participate in plant breeding process, and influence the development of growing and processing technologies; it takes their specific needs, agro-ecological conditions and cultural preferences into consideration,
b) it gives farmers an opportunity to make a decision, where and how funds and finance will be used for development and external farming services,
c) it allows participating farmers to apply their traditional knowledge and experience,
d) it provides farmers with new contacts, it introduces professional breeders and development workers to them,
e) farmers participate in breeding activities, variety registration process, seed conservation, reproduction and distribution as well.

Acknowledgement

This work was supported by the research project No. NAZV QJ1310072 of the National Agency for Agricultural Research of the Ministry of Agriculture of the Czech Republic and the University of South Bohemia in České Budějovice (project No. GAJU 094/2016/Z).

References

Ceccarelli, S., Grando, S. 2007. Decentralized-participatory plant breeding: an example of demand driven research. Euphytica, 155: 349-360.

Chable, V., Conseil, M., Serpolay, E., Le Lagadec, F. 2008. Organic varieties for caulifowers and cabbages in Brittany: from genetic resources to participatory plant breeding . Euphytica. 164:521-529.

Desclaux, D. 2005. Participatory Plant Breeding Methods for Organic Cereals: Review and Perspectives. E.T. Lammerts Van Bueren, I. Goldringer & H. Østergård (Eds), Proceedings of the COST SUSVAR/ECO-PB Workshop on Organic Plant Breeding Strategies and the use of Molecular Markers, 17–19 January 2005, Driebergen. Louis Bolk Institute, Driebergen. pp.17-23

Ghaouti, L., Vogt-Kaute, W., Link, W. 2008. Development of locally-adapted faba bean cultivars for organic conditions in Germany through a participatory breeding approach. Euphytica, 162(2): 257-268.

GIZ. 2017. Online. [cit.1.4.2018] ˂https://www.giz.de/expertise/downloads/giz2014-en-participatory-plant-breeding.pdf˃

Konvalina, P., Stehno, Z., Capouchová, I., Zechner, E., Berger, S., Grausgruber, H., Janovská, D.,Moudry, J. (2014): Differences in grain/straw ratio, protein content and yieldin landraces and modern varieties of different wheat species under organic farming. Euphytica 199: 31-40.

Osman, A.M., Struik, P.C., Almekinders, C.J.M., Lammerts van Bueren, E.T. 2008. Can onion varieties suitable for organic farming be obtained through conventional breeding programmes? Euphytica, 163:511-522.

Patto, M.C.V., Moreira, P.M., Almeida, N., Satovic, Z., Pego, S. 2008. Genetic diversity evolution through participatory maize breeding in Portugal. Euphytica, 161:283-291.

Stehno Z., Bradová J., Dotlačil L., Konvalina P. (2010): Landraces and Obsolete Cultivars of Minor Wheat Species in the Czech Collection of Wheat Genetic Resources. Czech Journal of Genetics and Plant Breeding, 46 (Special issue): S100-S105

Surma, M., Adamski, T., Banaszak, Z., Kaczmarek, Z., Kuczyńska, H., Majcher, M., Ługowska, B., Obuchowskił, W., Salmanowicz, B., Krystkowiak, K. (2012): Effect of Genotype, Environment and Their Interaction on Quality Parameters of Wheat Breeding Lines of Diverse Grain Hardness Journal Plant Production Science Volume 15 (3): 192-203.

The Use of Cartoons in Promoting Ecological Organic Agriculture among Children and Youths in Smallholder Farming Communities

Julius T. Mwine,
Marius F. Murongo
and Joseph Ssemakula

Uganda Martyrs University, Uganda

Corresponding author:
mwinetj@gmail.com

Keywords:
12 EOA cartoon books, children, farming, youths

Abstract

This paper aims to showcase the functionality of a cartoon in promoting ecological organic agricultural knowledge among youths in smallholder farming communities. A pretest and post test quasi experimental design was used on a group of urban, peri-urban and rural primary school children of age 5-12 years between 2015 and 2016. The 12 EOA cartoon Book topics upon which the tests were made on the school children were developed in a participatory manner involving scientists, farmers, cartoonists, youths and animators. Observations indicate that using a cartoon in teaching EOA knowledge provided a relaxed learning mode, while the learners are entertained. The interactive and entertaining environment enhances the retention of the ecological organic agriculture principles and practices embedded in the cartoon images, sounds and symbols, hence a conclusion that cartoons in whatever format, are important tools in promoting EOA practices through increasing youth academic achievement and the level of knowledge retention in ecological organic agriculture.

Introduction

There are diverging definitions of what a cartoon is really about, with some lexicologists defining a cartoon as a form of expression and communication that takes several arrangements of art, together with humorous captioned illustrations, ironic political drawings, and animated films. It is believed that in the mid-19th century, the cartoon acquired the meaning of a pictorial imitation, entertaining, jokey and often satirical in its portrayal of social and political events. Cartoons have been instrumental in monitoring and impacting the social and political lives of those in positions of power and influence. Lively cartoons cater more to younger audiences, entertaining children with the adventures of sentimentalized animals, champions, superheroes, and child characters but also for teaching and learning (Girija, 2016). If the cartoon has been instrumental in checking and impacting the socio-political influence, one may wonder then, why the same cartoon cannot be used to impact on the practices in ecological organic agriculture across the generational divide!

Biblical wisdom writings were explicit on the importance of training young people especially children. In the book of proverbs 22: 6, is written, "Train up a child in the way we should go, and when he is old, he will never depart from it" The verse is out rightly open on the outcomes of training the child, but it is rather silent on the training methods. The cartoon could be marvelous methodical approach to teaching young people the concepts that seem to be neglected and or abused by the society . One of such concepts could be ecological organic agriculture.

Ecological organic agriculture is a farming system that sustains the health of the soils, ecosystems and people (Lammerts van Beuren *et al.* (2002). This practice relies on natural processes and respects specific principles of ecology, ecological health, eco-fairness, ecological care and ensures equity and integrity of the ecosystem practices. In the current era, where the above principle practices have been abused, ecological organic agriculture is increasingly becoming the solution to problems resulting from this dilemma. The best solution should lay its ground from the young generations so that the concept of ecological organic agriculture is enkindled among young people at a tender but exploratory age.

In the rest past, Agriculture was used as a punishment for something done wrongly at home, in school or both. Parents would deny food to erratic children. School teachers would give agricultural related punishments to errant children, while the non-errant ones observed. These kinds of activities developed a trajectory that culminated into hatred for agricultural practices. The children never look at Agriculture as a cool practice. The whole idea seems unlikeable to them and therefore never a preferred occupation but a last resort. Agriculture in general has therefore of late turned out to be a trade of the 'academically unable' and the elderly (Karega, L.N. 2017; FAO 2014) yet some agricultural forms like EOA requires scientific knowledge the former do not possess. There is therefore need to make Agriculture in general and EOA in particular such an appealing business that can attract youth at an early age (Leavy, J. and Smith, S. 2010). The early introduction of EOA through Cartoons is meant to do this.

Uganda Martyrs University cartoon series

The rationale

The background laid out in this paper forms part of the rationale for Uganda Martyrs University launching into developing the cartoon series. Besides, the university, particularly through the initiative of ecological organic agriculture is cognizant of the fact the largest population in Africa and Uganda in particular is basically agrarian and therefore, youths and children should be initiated into the best practices that characterize ecological organic agriculture. Once the youths and children are properly oriented, it would pave way for sustainable agriculture in the future. There is awareness that ecological organic agriculture has become a major analytical and strategic platform for promoting better practices in agriculture. The practices that are socially acceptable, economically friendly, and locally appropriate are the basis for providing solutions for climate change challenges.

The methods

The current hand book is a collection of 12 subtopics. Each subtopic was designed to introduce a peculiar ecological organic agricultural practice. Each subtopic will be animated into a cartoon series and later on released to the media; most preferably those that target children.

The cartoons were developed in a participatory manner involving the scientists, children educators and Cartoonists engaged at local, national, and international forums. The product was tested with children educators and the children of age 5-12 years old, both from urban and rural primary schools.

Preliminary results and discussion

Preliminary results show that 94% of the children between the ages 5 – 12 years keep alert and focused when viewing a cartoon compared to 62% alert ratio when learning agriculture related material in normal pupil- teacher narrative session. It was also observed that 96% of the pupils showed interest to read the EOA cartoon book again compared 52% who showed interest to revise class notes given by the teacher.

Agro ecological information embedded within the cartoon can be easily detected by the young children. It was observed that in the process of denotation of the cartoons, children first focused on the lines in the cartoon, thought over every detail, and established connections and comments in contrast with the cartoon objects. This approach is believed to facilitates agro ecological critical thinking at an early age.

Children have a very short attention span. Their ability to concentrate is quickly distracted, and they get bored very fast, . A clear observation was that presentation of ecological agriculture knowledge in form of cartoons disallowed this boredom. The children, both from the rural and urban schools remained focused for a long time as the cartoon presenters went through the topics. Concentrated attention is a requisite factor in liking the content within the subject being promoted.

During the pre-tests and in tests of the cartoon, it was observed that a cartoon is a powerful tool that enables children of different ages to learn in a "relaxed mode" This mode enables a positive contribution to the development of the thinking and comprehension skills of ecological agriculture concepts by young people.

It should be noted that this is still work in progress and final findings will be released after testing with animated cartoons.

The cartoon is a tool that provides an "impeccable edutainment" where children (and adults) learn in an entertaining atmosphere (Normaliza *et al.* 2014). Cartoon pictorials enabled the children to realize the events in different topical aspects while they were made to smile. The children entertainment during agro ecological lessons and the Cartoon has the power to achieve this through the language of humor that enables young people to learn. A positive classroom environment created in the course of teaching and demonstration by smiling is far more beneficial than the lesson taught by narration.

The above observations connote that cartoon makes it easier for the children and [adult learners] to memorize the agro ecological messages related with the target objectives. It can be concluded that the humor approach is attractive while communicating with the learners. Communicating with the cartoon is an easy way that is not complex, with a side kept in mind. The cartoon discourages memorizing, instead, the different interesting images, sounds and symbols remain in the minds of children along time. As a result, it is easy to remember the knowledge learned when they have become old .

Conclusion

The relaxing mode, and the entertaining environment are important aspects in delivering ecological organic agriculture information among the children and the youths. It can further be concluded that EOA knowledge provided in a relaxed learning mode, while the learners are entertained is retained for a long period of time when it is embedded in the cartoon images, sounds, and symbols. Adoption of cartoons as a teaching method for the young in learning Agriculture and EOA in particular should be recommended.

References

Alaba, S., 2007. The Use of Educational Cartoons and Comics in Enhancing Creativity in Primary School Pupils in Ile-ife. Osun State, Nigeria. *Journal of Applied Sciences Research*, 3(10), pp.913–920.

Chen, W.C., H., K.C. & Ho, Y.C., 2009. Applying the strategy of concept cartoon argument instruction to enpower the children's argumentation ability in a remote elementary science classroom. In *13th European Conference for Research on Learning and Instruction*. pp. 201–256.

Eker, C., 2014. The Effects of Educational Practice with Cartoons on Learning Outcomes. *International Journal of Humanities and Social Science*, 4(14), pp.223–234.

FAO (2014). Youth and Agriculture: Key challenges and concrete solutions. A publication of the Food and Agriculte organization. http://www.fao.org/3/a-i3947e.pdf ; Retrieved on 27 June 2018.

Girija, N. Srinivasalu, 2016. Using Cartoons as effective tools in teaching learning process of social science. *Scholarly Research Journal for Interdisciplinary studies,* 3(23) pp.1893 - 1905.

Karega, L. N. 2017. Youth in Agriculture; Perceptions and Challenges for Enhanced Participation in Kajiado North Sub-County, Kenya. *Greener Journal of Agricultural Sciences,* 7 (8) pp 207.

Lammerts van Bueren, E.T; Struik, E.P; Jacobeson, E. 2002.

Ecological concepts in organic farming and their consequences for an organic crop ideotype. *Wageningen Journal of Life Sciences* 50(1) pp. 1-26J

Leavy, J. & Smith, S. 2010. Future farmers? Exploring youth aspirations for African agriculture. Future Agricultures, *Policy Brief,* No. 037.

Normaliza Abd Rahim, Hazlina Abdul Halim & Roslina Mamat . 2014. Learning via Television Cartoon. *Asian Social Science;* 10, 15.

Content Analysis of Publications on Ecological Organic Agriculture (EOA) Research Literature on Crops

[1]Felicitas C. Ratanya,
[2]Martin Njoroge Kimani,
[3]Rhoda Jerop Birech, and
[3]Joseph Kinyoro Macharia

[1]Department of Information Science Egerton University

[2]Department of Environmental Science Egerton University

[3]Department of Crops Horticulture and Soils, Egerton University

Corresponding author:
fratanya@gmail.com

Introduction

The purpose of this document is to assess the trend of research conducted in crops from publications cross-examined in support of Ecological Organic Agriculture (EOA) research conducted at Egerton University. In total 57 research based documents were assessed guided by various parameters such as research topic, authorship pattern, type of information resources accessed, methodology used, region of study, keywords, thus forming the bases for the content analysis. It was found out that majority of publications were co- authored by more than six authors whereas others were authored by one author. Patterns on the date of publication indicated a majority of documents were published between 2014 to 2016(28%). , Field experiments was the most popular methodology in most documents evaluated. An assessment of the study regions, found out that research was common in Nigeria, Kenya, Uganda and the coastal region of Kenya.

The questions addressed in this analysis included;

i. What is the authorship pattern of research publications related to crops?
ii. What is the methodology applied in most research publications related to crops?
iii. What are the most common keywords used in crop research?
iv. What is the year of publication of the documents on crops?
v. Which study regions conduct the most research on crops?

Methodology

Documents related to research conducted in crops were retrieved and accessed. Through the help of Research Assistants and Data entry Clerks, the documents were accessed from the Egerton University Library and online searches from relevant e-journals. Documents with abstracts only were excluded for cross examination and a total of 57 documents were selected for reference. Data from documents was collected, organized in a database. Using MS EXCEL, data was coded and analyzed.

Analysis and Interpretation

Collected data was organized based on various aspects such as;

subject areas, authorship patterns, methodology applied, source of information, year of publication and the study region.Guided by the objectives of the content analysis, Data was therafter analyzed and findings presented in tabulated summaries and graphs .

Results

Trend of authorship of research publications.

The trend of authorship reveals the pattern in which documents are distributed among authors and showing any existing collaborative efforts in a specific subject area. Publications were categorized from one author to more than five authors. The analysis revealed that majority of publications were co-authored by more than six authors(25%) whereas 12% were authored by one author. Twenty One percent (21%) were authored by five authors, followed by those authored by four authors at 19%. Publications authored by three authors scored 12. Few publications crops-11% were co authored by two authors.

Sources of information

The source of information for publications on crop research was derived from a variety of documents that included; Journal articles, Technical reports, MSc Thesis, PhD Thesis, books and conference proceedings.

Journal articles were the most popular sources of information for research (57%), followed by Technical reports (30%). Msc Thesis were more popular than the PhD thesis a clear indication that research on crops at masters level was rampant. The least sources of information was seen from both books (2%) and conference proceedings (4%).

Keywords used on Research in crops

Keywords serve to increase the content representation and information retrieval in any field of study. Figure 1 clearly show the various keywords that were used in the publications that were cross-examined in research on crops.

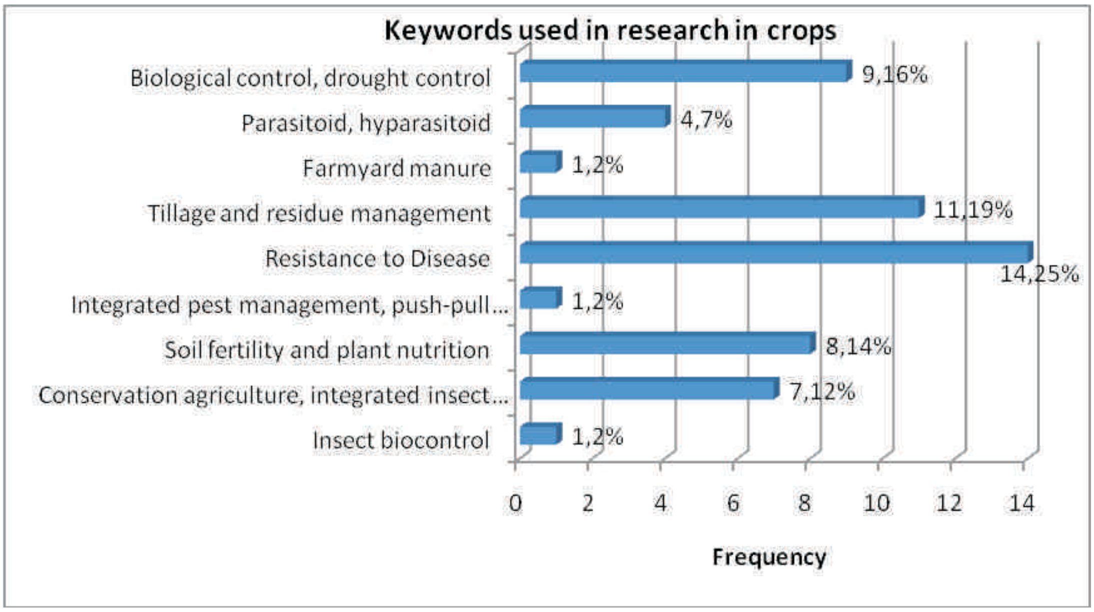


Figure 1. **Keywords used in research in crops**

The most common keywords used was resistance to crops (25%), tillage and residue management (19%), biological control, drought control (16%), soil fertility and plant nutrition (14%) and conservation agriculture, integrated insect management(12%). It was however noted that the least keywords used in research in crops was parasitoid, hyperparasitoid (7%), farmyard manure (2%), integrated pest management, push-pull technology (2%) and insect biocontrol (2%).

Year of Publication

In order to assess the growth of publications in a certain subject area, it is important to examine the year of publication with an aim of finding out the most productive publication and how up to date the publication is. From the documents examined, it was revealed that the year of publication varied from one publication to another.

Majority of publications were published between 2014 to 2016 (21%), followed by documents published in between 2010 and 2012(18%). Such an observation implies that the publications were up-to-date and contained the most recent research findings. However it is worth noting that lesser documents were published between 2002 and 2004 (4%), 1998 and 2000(1%).

Study Region of Research

Study region from which research is conducted influences the growth of a subject area that in turn contributes to the development of the affiliated region. Table 1 shows the study regions where research was conducted in crops.

Table 1. **Study Region of Research conducted on Crops**

Study regions			
1.	Egerton University Njoro, Kenya	12.	Nyabenda, Western Kenya
2.	Koibatek and Egerton Njoro, Kenya	13.	Meru, Tharaka Nithi and Embu counties Kenya
3.	East Africa	14.	Makueni, Kenya
4.	Kibos and Kisii Kenya	15.	Embu and Meru, Kenya
5.	Kericho Kenya	16.	Nyabenda, Western Kenya
6.	Embu, Kenya	17.	Laikipia, Kenya
7.	Mbeere, Kenya	18.	Nakuru, Kenya
8.	Meru South, Kenya	19.	Kakamega, Kenya
9.	Kiambu, Kenya	20.	Kanduyi and Alupe, Kenya
10.	Naivasha, Kenya	21.	Western Kenya
11.	Laikipia and Siaya, Kenya	22.	Nyabenda, Western Kenya

Methodology applied in Crop Research

Research methodologies applied may vary in different publications. Different methodological designs were applied in the research on crops as shown in figure 2.

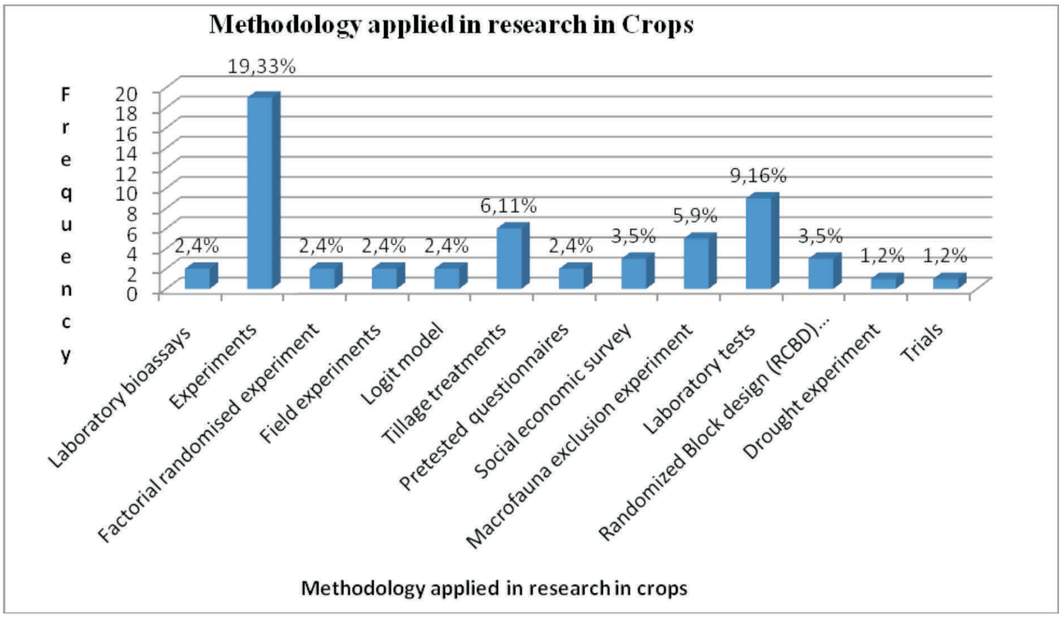


Figure 2. **Methodology applied in research in Crops**

Experiments (33%) seemed to be the most preferred methodology followed by laboratory tests(16%) and Tillage treatments(11%). Few publications however applied laboratory bioassays (4%), Factorial Randomized. Experiments (4%), Field experiments(4%), pretested questionnaire(4%), drought experiments(2%) and Trials(2%).

Findings and Discussions

On the bases of this content analysis, tit was revealed that journal articles were the most popular sources of information for crops research (57, followed by technical reports (30%). Msc Thesis were more popular than the PhD thesis. The least sources of information was seen from both books(2%) and conference proceedings(4%).

The most common keywords used in research in crops was resistance to crops (25%), followed by tillage and residue management (19%), biological control, drought control (16%), soil fertility and plant nutrition (14%) and conservation agriculture, integrated insect management(12%). It was however noted that the least keywords used in research in crops was parasitoid, hyperparasitoid(7%), followed by farmyard manure (2%), integrated pest management, push-pull technology (2%) and insect biocontrol (2%).

Majority of publications were co- authored by more than six authors(25%) whereas 12% were authored by one author. 21% were authored by five authors, followed by those authored by four authors at 19%. Publications authored by three authors scored 12%. Few publications 11% were co authored by two authors.

Documents published on research conducted on crops also indicated a pattern where a majority were published between 2014 to 2016(28%). Such an observation implies that the publications were up-to-date and contained the most recent research findings. However it is worth noting that lesser documents were published between 2002 and 2004 (4%), 1998 and 2000(1%).

Experiments(33%) seemed to be the most favored methodology in research related to crops followed by laboratory tests(16%) and Tillage treatments(11%).Few publications however applied laboratory bioassays (4%), Factorial Randomized. Experiments(4%), Field experiments(4%), pretested questionnaire(4%), drought experiments(2%) and Trials (2%).

Conclusion

The content analysis conducted in this paper specifically sought to find out the trends of documents related to research on crops. based on various aspects of the publications which comprised of the subject areas, authorship patterns, methodology applied, source of information, year of publication and the study region. Such content analysis of documents in research may therefore be significant in helping researchers in identifying their research interests and design considerations. Furthermore, the study will help researchers and scholars identify glaring research gaps for continuity in their areas of interest.

References

Ateka, E. M., Mwang'ombe, A. W. and Kimenju, J. W., (2001). Reaction of Potato cultivars to Ralstonia solanacearum in Kenya. Nyeri, Meru and Nyandarua Kenya. *African Crop Science Journal,* 9 (1): 251-256.

Ahmed, H., Hans, H., Zeyaur, R. K., John, A. P., and Christine, M. W., (n.d.) Integrated pest management: the push–pull approach for controlling insect pests and weeds of cereals, and its potential for other agricultural systems including animal husbandry. *Philosophical Transactions of the Royal Society,* 363: 611-621.

Patton, M. Q. (2002). Qualitative research and evaluation methods. Thousand Oaks, CA: Sage.

White,M. D.(2006). Content Analysis: A Flexible Methodology. *Library Trends*, Vol. 55, No. 1, edited by Lynda M. pp. 22–45. Available at: https://www.researchgate.net/publication/32957977_Content_Analysis_A_Flexible_Methodology. Accessed:13 July 2017.

ISOFAR
International Society of Organic Agriculture Research

AfrONet
African Organic Network

African Organic Network (AfrONet)
Headquarters:
Uhuru Road, MAFAOHSE, 15th Floor,
Ilala BOMA, Dar EsSalaam, Tanzania.
Phone: +255732975799,
Mobile:+255758908303
Email:info@afronet.bio;
Website: www.afronet.bio

ISBN: 978-3-86576-190-3