290

Herd parameters in organic and conventional dairy farms and their role in greenhouse gas emissions from milk production

BRITTA BLANK[1], DAGMAR SCHAUB[1], HANS MARTEN PAULSEN[1], GEROLD RAHMANN[1]

Thuenen-Institute of Organic Farming, Westerau, Germany, www.oel-vti.de, britta.blank@vti.bund.de

Abstract

In the study on „Climate effects and sustainability of organic and conventional farming systems" 44 paired organic and conventional dairy farms in Germany were compared. Over three years, data on performance, management and feeding were collected on the farms and feed samples were collected and analyzed. First analyses show that on average the organic farms have a significantly higher longevity (39 month) and grazing time (2510 $h*a^{-1}$) than the conventional farms. On the other hand, mean milk yields (6478 $kg*cow^{-1}*a^{-1}$) and lifetime efficiency (10.3 $kg*cow^{-1}*d^{-1}$) are significantly lower on the organic farms. In both farming systems lifetime efficiency significantly decreases with increasing age at first calving ($p<0.05$). Further analyses shall highlight influences of farm management on the GHG balance of dairy farms and illustrate optimisation potential.

Key words: performance parameters, greenhouse gas, dairy cattle, conventional, organic

Introduction

Several factors affect the greenhouse gas (GHG) emissions in dairy farming. One important measure for reduction of the GHG-emissions is an improved milk yield, since for the same amount of milk produced the number of cows can be reduced (Zehetmeier et al., 2011). However, the increased milk yield should not induce an increased input of concentrates in the feeding ration, which enhances the GHG-emissions upstream the production chain (Reenberg and Fenger, 2011). Further alternatives for a reduction of GHG-emissions are variations of the feeding regime: Methane emissions from enteric fermentation can be reduced by an improved digestibility of the roughage or by a higher fat percentage in the ration (Flachowsky and Brade, 2007; Sejium et al., 2011). An increased productive life-span of the cows can decrease product-related emissions as well (Bell et al., 2011). But possible interactions of these factors and their effects on GHG-emissions in different farming systems are only partly known.

Material and methodology

In a joint project (www.pilotbetriebe.de) 44 dairy farms (22 pairs of neighbouring organic and conventional farms) in Germany were studied in the years 2009 to 2011. Data on herd parameters and feeding regime were collected. Feed samples were collected and analyzed with the Weender method according to the guidelines of VDLUFA (1995). Results include dry matter, crude ash, crude protein, crude fibre and crude fat. The nutrient content (metabolizable energy, net energy lactation und usable crude protein) was calculated (single feedstuffs according to the GfE, 2001; compound feedstuff according to Menke und Steingaß, 1987). For statistical analyses means and range of data were determined and means were compared using t-test ($p<0.05$). Possible correlations between data sets were determined by regression analysis.

Results

A short description of the 22 studied farm pairs is given in table 1. Figure 1 shows correlations between several performance parameters of the farms.

Table 1. Overview of selected parameters of the organic and conventional dairy farms (mean and range (min-max) of the years 2009/2010/2011)

	n	organic	n	conventional
number of farms		22		22
farm area (hectare)	22	249 (30-1299)	22	312 (35-1959)
herd size	22	71 (18-257)	22	113 (26-450)
milk yield (kg*cow^{-1} year^{-1})	21	6478** (4307-9289)	21	8571** (6130-10588)
milk protein (%)	21	3.28** (3.03-3.66)	21	3.42** (3.18-3.55)
milk fat (%)	21	4.06 (3.68-4.43)	21	4.10 (3.38-4.39)
age at first calving (months)	19	31** (26-35)	17	28** (25-33)
productive life-span (months)	19	39** (25-59)	16	27** (18-37)
lifetime efficiency (kg*cow^{-1} day^{-1})	19	10.3** (6.1-14.8)	17	12.0** (7.6-15.4)
calving interval (days)	21	409 (364-502)	19	406 (365-433)
NEL (MJ*kg^{-1} in DM) in roughage	22	6.0 (3.94-7.32)	22	5.95 (3.86-8.46)
NEL (MJ*kg^{-1} in DM) in concentrate	22	8.11 (6.64-8.99)	22	7.88 (5.04-8.96)
grazing time (h*year^{-1})	16	2510 (1008-5856)	13	774 (0-3048)

** significant at p<0.01
DM: dry matter, kg: kilogram, n: number

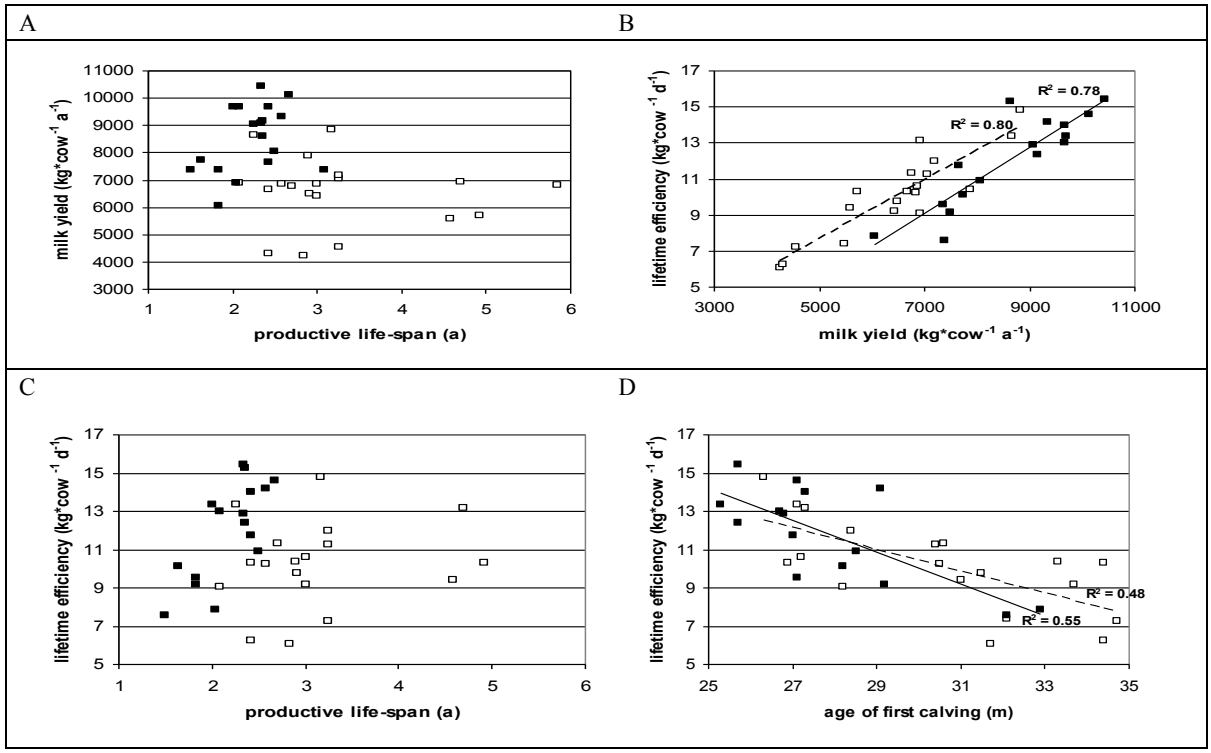

Figure 1. Correlation between milk yield and productive life-span (A, n=37), lifetime efficiency and milk yield (B, n=35), lifetime efficiency and productive life-span (C,

n=34), lifetime efficiency and age at first calving (D, n=34) of organic and conventional dairy farms in Germany, means of 2009/2010/2011

No significant correlation between milk yield and productive life-span was found (figure 1 A). But organic farms have overall lower milk yields (on average 24 % lower) than conventional farms (table 1). The productive life of cows on organic farms (on average 3.3 years) was one year longer than on conventional farms (table 1). Figure 1 B shows the positive correlation between lifetime efficiency and milk yield in both farming systems ($p<0.001$). No significant correlation between productive life-span and lifetime efficiency (figure 1 C) was observed, but a negative correlation between age at first calving and lifetime efficiency ($p<0.001$, figure 1 D). In both farming systems herds with high lifetime efficiency exist. The highest values of age at first calving (figure 1 D) and productive life-span (figure 1 C) can be found on organic farms.

Discussion

In the present study the mean milk yield on organic farms is considerably lower than on conventional farms. From numerous other studies similar results are known (Wangler and Harms, 2006; Benbrook et al., 2010).

The longer productive life-span of the animals in organic farms also agrees with the results of other studies (Benbrook et al., 2010). A short productive life-span implies that GHG-emissions from the rearing of replacement animals are spread over a lower number of productive months (Bell et al., 2011). A negative correlation between productive life-span and milk yields, as Klug et al. (2002) found in their study, could not be proved with the own or other studies (Fürst and Fürst-Waltl, 2006). Due to their higher milk yield the lifetime efficiency of conventional herds is higher than of organic farms, although cows on conventional farms have on average a shorter productive life-span. But also dairy herds on organic farms reach high lifetime efficiencies of more than 13 $kg*cow^{-1}$ day^{-1}.

Conclusions

There exist general differences between organic and conventional dairy farms in several performance and feeding parameters. However, the parameters, which affect the GHG-emissions in dairy farming, depend strongly on the management on the individual farms. High milk yields and lifetime efficiency can be found in both systems. The effects of different performance and feeding parameters and their interactions on GHG-emissions have to be analysed on the basis of individual farms.

Acknowledgements

This research is funded by the Federal Ministry of Food, Agriculture and Consumer Protection based on a decision of the German Bundestag within the Federal Organic Farming Scheme and other forms of sustainable agriculture.

References

Bell MJ, Wall E, Russell G, Simm G & Scott AW (2011): The effect of improving cow productivity, fertility, and longevity on the global warming potential of dairy systems. J. Dairy Sci. 94, 3662-3678.

Benbrook C, Carman C, Clark E, Daley C, Fulwider W, Hansen M, Leifert C, Martens K, Paine L, Petkewitz L, Jodarski G, Thicke F, Velez J & Wegner G (2010): A Dairy Farm's Footprint: Evaluating the Impacts of Conventional and Organic Farming Systems. The Organic Center, Critical Issue Report, 1-35.

Flachowsky G & Brade W (2007): Potentiale zur Reduzierung der Methan-Emissionen bei Wiederkäuern. Züchtungskunde 76,6, 417-465.

Fürst C & Fürst-Waltl B (2006): Züchterische Aspekte zu Kalbeverlauf, Totgeburtenrate und Nutzungsdauer in der Milchviehzucht. Züchtungskunde 78 (5), 365-383.

GfE (Ausschuss für Bedarfsnormen der Gesellschaft für Ernährungsphysiologie) (2001): Empfehlungen zur Energie- und Nährstoffversorgung der Milchkühe und Aufzuchtrinder 2001. DLG-Verlag, Frankfurt/Main, Germany.

Klug F, Rebock F & Wangler A (2002): Die Nutzungsdauer beim weiblichen Milchrind (Teil 1). Großtierpraxis 3: 12, 5-12.

Menke K-H & Steingaß H (1987): Schätzung des energetischen Futterwertes aus der in vitro mit Pansensaft bestimmten Gasbildung und der chemischen Analyse. II: Regressionsgleichungen. Übers. Tierernährg. 15, 59-94.

Reenberg A & Fenger N-A (2011): Globalizing land use transitions: the soybean acceleration. Geografisk Tidsskrift-Danish Journal of Geography 111, 1, 85-92.

Sejian V, Lakritz J, Ezeji T & Lal R (2011): Forage and Flax Seed Impact on Enteric Methane Emission in Dairy Cows. Research J Vet Sci, 4, 1-8.

Wangler A & Harms J (2006): Verlängerung der Nutzungsdauer der Milchkühe durch eine gute Tiergesundheit bei gleichzeitig hoher Lebensleistung zur Erhöhung der Effizienz des Tiereinsatzes. Forschungsbericht der Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg Vorpommern, Institut für Tierproduktion, Fo.-Nr.: 2/22, 1-74.

Zehetmeier M, Gandorfer M & Heißenhuber A (2011): Diskussion der Leistungssteigerung in der Milchviehhaltung als mögliche Strategie zur Reduktion von Treibhausgasemissionen, Tagung, boku.ac.at., 7-8.

Johann Heinrich
von Thünen-Institut

Sonderheft 362
Special Issue

Tackling the Future Challenges of Organic Animal Husbandry

2nd Organic Animal Husbandry Conference Hamburg, Trenthorst, 12-14 September, 2012

Gerold Rahmann and Denise Godinho (Eds.)

Bundesministerium für
Ernährung, Landwirtschaft
und Verbraucherschutz

Bibliographic information published by the German National Library

The German National Library lists this publication in the German National Bibliography; detailed bibliographic data are available in the internet at http://www.d-nb.de/

Bibliografische Information der Deutschen Bibliothek

Die Deutsche Bibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://www.d-nb.de/ abrufbar.

2012

Landbauforschung
vTI Agriculture and Forestry Research

Johann Heinrich von Thünen-Institut
Federal Research Institute for Rural Areas, Forestry and Fisheries,

Johann Heinrich von Thünen-Institut
Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei (vTI)

Bundesallee 50, D-38116 Braunschweig, Germany

landbauforschung@vti.bund.de
www.vti.bund.de

Preis / Price 18 €

ISSN 0376-0723
ISBN 978-3-86576-094-4