Organic versus conventional dairy farming – studies from the Öjebyn Project

Sara Byström, Simon Jonsson, Kjell Martinsson
Department of Agricultural Research for Northern Sweden, Swedish University of Agricultural Sciences, Patrons Allé 10, S-943 31 Öjebyn, Sweden

ABSTRACT

A study (the Öjebyn Project) was conducted to determine differences between organic and conventional dairy farming systems. Comparisons of feed intake, milk production, live weight (LW), feed efficiency and animal health were conducted, based on records from 145 dairy cows (238 parities). A lower daily metabolisable energy (ME) intake, lower milk yield and a higher protein content were recorded in the organic herd during the first ten weeks of lactation. No differences were recorded between the systems in either average total DM intake or efficiency of feed conversion, calculated as MJ of feed/kg of energy-corrected milk (ECM). There were a trend to lower LW change and better health in the organic herd. Most differences between the systems were recorded during the early lactation period.

Keywords: Organic dairy farming, feed intake, milk production, feed efficiency

INTRODUCTION

In conventional agriculture the negative environmental impact of many intensive production systems has increased the importance of more sustainable and environmentally friendly systems. In addition to environmental benefits, standards for organic livestock production provide several pre-conditions that are required to achieve good living conditions for farm animals (Sundrum, 2001) and today more farmers are converting to organic farming. The aim of this investigation was to examine whether there were any differences between organic and conventional systems in relation to feed-intake, milk production, live weight (LW), feed efficiency and health.

MATERIAL AND METHODS

Animals and experimental design

Data was collected from a study at a research station in the north of Sweden (the Öjebyn project) to compare organic and conventional dairy farming systems. In 1990, the farmland and buildings were divided into separate organic and conventional systems, with the manure and urine collected and returned separately in each system. Data from 69 organic cows (110 parities) and 76 conventional cows (128 parities) of the Holstein-Friesian and Swedish Polled breeds was collected during three indoor-periods from September 1995 to June 1998 and included in the study.

Feed, feeding and management procedure

The forage consisted of silage (ley), green forage (oat/pea mixture), and some hay (Table 1). Timothy, meadow fescue and red clover were the main species in the silage and hay (with the inclusion of some white clover in the organic system). Harvest date depended on the protein content in the leys with organic leys always harvested after the conventional leys.

Organic cows were fed according to the rules of KRAV (1995) and offered *ad libitum* forage while the conventional cows were offered 1.5kg DM of forage/100kg LW. All cows received concentrate, minerals and vitamins in relation to the expected nutritional needs for milk yield (Feed Tables for Ruminants, 1995). For the organic cows the requirements were calculated from a predicted forage intake (2.0-2.25kg DM/100kg LW) and predicted milk yield. The concentrate mixture consisted of barley, commercial concentrate and protein compounds. The cows were kept in tied stalls. Cows were milked twice a day and milk yields recorded on two days in every 14-day period. Feed refusals were collected daily. Feed samples were collected daily with chemical analyses were made on pooled samples (two and four-week periods). The LW was recorded every eight weeks and also after calving.

All traits studied were calculated for the whole lactation (44 weeks) and for three different parts of the lactation. The effects of treatment (organic or conventional), parity (1, 2, =3), year, season of calving, individual cow and some interactions were tested and statistically analysed with the SAS mixed model procedure (SAS, 2000). The number of veterinary treatments/cow, the percentage of treated cows, and the distribution of culling reasons were calculated as separate frequency studies, without statistical analyses.

RESULTS AND DISCUSSION

Feed composition and feed intake

The chemical composition of the feeds (Table 1) showed that the metabolisable energy (ME) was higher in the conventional forage. Differences in total DM and total DM intake/100kg LW were only found in weeks 11-34, with the organic cows recording a higher intake/100kg LW (Table 2). However, for the separate forage and concentrate intakes the groups differed in all parts of the lactation (Figure 1). The average daily ME intake (Table 2) was higher during the trial in the conventional group, but in the sub-periods the herds only differed during the first period.

The lower level of ME in the organic forage, was probably a result of the high proportion of lower energy green forage. It may also have been influenced by the delayed harvest date which can lead to a lower energy and protein content, together with an increased fibre content and lower intake (Buxton, 1996).

The average intake of forage by the organic cows did not exceed the assumed intake of 2.0-2.25kg DM/100kg LW and especially during early lactation intakes were lower than predicted. Consequently, the level of concentrate in the total feed ration exceeded 50% during that part of lactation, which is against the rules of KRAV (1995). In addition to the possibly higher fibre contents in the forage the high levels of NH_4 may also have contributed to the low intake.

Table 1. Chemical composition and calculated metabolisable energy range.

	ME (MJ/kg DM)	DM (%)	CP (3) (g/kg DM)	AAT (3) (g/kg DM)	PBV (3) (g/kg DM)	NH3 (%)	pH
Organic forage (1)							
95/96-97/98	9.7-10.4	29.9-32.1	141-157	68-70	21-37	6-14	4.2-4.4
Conventional forage (1)							
95/96-97/98	10.5-10.7	27.4-31.4	166-175	70-71	4-49	7-16	4.1-4.4
Organic concentrate (2)							
95/96-97/98	13.3-13.5	89.0-90.5	190-257	99-112	3-81	-	-
Conventional concentrate (2)							
95/96-97/98	13.2-13.4	88.6-89.3	171-175	109-113	(-11) - (+4)	-	-

(1) Forage includes both silage (organic 30% clover, conventional 12% clover) and green forage. Forage in the organic system in 95/96 included some hay (<2%). The content of green forage was, in the organic system, 95/96:32%; 96/97:25%; 97/98:34%, and in the conventional system it was 95/96:13%; 96/97:18%; 97/98:34%.

(2) Concentrate includes all concentrates used, both grain, commercial concentrate and protein compounds.

(3) CP=crude protein, AAT=amino acids absorbed in the small intestine, PBV=protein balance in the rumen

The lower intake of ME with the organic cows during early lactation was probably due to the higher amount of roughage in the ration. Results from Kristensen & Kristensen (1998) showed that even though a higher amount of roughage in the feed ration reduced intake in early lactation, organic herds had a more persistent intake during lactation. The authors found only a marginal difference in total feed intake between the farming systems. Our results suggest that meeting the nutritional requirements of the dairy cow in early lactation is more difficult in organic herds. This emphasises the importance of forage quality on organic dairy farms.

Milk yield and milk composition

The organic cows had significantly lower daily milk yields (lactation average), but in the sub-periods the herds only differed during early lactation (Table 2). No differences in milk composition were found, except for a small but significantly higher protein content during the first ten weeks in the organic herd.

The lower milk yield of the organic cows in early lactation was attributed to the low ME intake. High milk production during early lactation may result in increased stress leading to an increase in health and reproductive problems (Collard *et al*., 2000). From that point of view a lower yield in the organic system during early lactation could be beneficial. However, a lower yield during early lactation that is due to an inadequate energy supply may increase the incidence of post-calving problems. Reksen *et al*. (1999) and Kristensen & Kristensen (1998) also found a tendency for lower milk production in organic herds. However, Kristensen & Kristensen, (1998)

also reported improved persistency of milk production when an even feed intake was recorded during lactation. A higher intake of high quality forage in early lactation and consequently a higher ME intake may lead to similar milk yields for the two systems presented.

Table 2. Daily feed intake, milk yield and milk composition, intensity parameters (least-square means).

	Whole lactation		Week 1-10		Week 11-34		Week 35-44	
	Organic	Convent -ional	Organic	Convent -ional	Organic	Convent -ional	Organic	Convent -ional
Feed intake								
Forage (kg)	1.8 a	1.4 a	1.6 a	1.3 a	2.0 a	1.4 a	2.0 a	1.4 a
Conc. (kg)	1.3 a	1.8 a	1.7 a	2.1 a	1.3 a	1.7 a	0.7 a	1.1 a
Total (kg)	3.1	3.1	3.3	3.4	3.3 c	3.1 c	2.6	2.4
Total ME(MJ)	205 b	222 b	223 a	240 a	217	223	168	171
Total AAT(g)	1507 a	1705 a	1640 a	1863 a	1602 c	1714 c	1190	1271
Total PBV (g)	575 a	326 a	654 a	253 a	602 a	343 a	484 a	326 a
Total CP (g)	3080	3108	3362	3286	3268	3143	2493	2438
Milk yield & composition								
Milk (kg)	23.8 b	25.9 b	28.5 c	30.7 c	24.5	24.9	17.7	17.9
ECM (kg)	25.6 c	27.5 c	29.9 c	31.9 c	26.2	26.7	20.2	20.5
Fat (%)	4.5	4.5	4.3	4.3	4.5	4.5	4.9	4.9
Protein (%)	3.5	3.5	3.4 c	3.3 c	3.5	3.5	3.8	3.8
Lactose(%)	4.7	4.7	4.8	4.8	4.7	4.7	4.7	4.7
Feed efficiency								
ME (MJ)	6.0	6.0	5.5	5.8	6.0	6.0	6.2	5.9
AAT (g)	46 b	49 b	43 a	48 a	47	49	47	47
CP (g)	79 a	72 a	74 a	66 a	80 b	73 b	84 b	76 b

Means with a, b, or c are significantly different when comparing groups within the same period (a = p<0.001, b = p<0.01, c = p<0.05)
Forage, concentrate and total intake measured as kg in DM per 100 kg LW
Feed efficiency parameters measured per kg ECM

Live weight and feed efficiency

There was a lower average LW in the organic herd (significantly lower during weeks 11-34; 581 vs. 613 kg), and also a lower LW change (kg/day) in all periods. During the early part of lactation the LW change was negative in the organic herd (-0.07 kg/day). There were no overall differences between the herds in efficiency of feed conversion expressed as MJ/kg ECM.

The higher average LW of cows in the conventional herd may be a result of the higher ratio of Holstein-Friesian to Swedish Polled breed cows compared with the breed ratio in the organic herd. The weight loss of the organic cows during early lactation was probably due to an energy deficit. The predicted energy requirements were calculated as 5.0-5.7 MJ of feed/kg ECM (Feed Tables for Ruminants, 1995), with the actual values somewhat higher at 6.0 MJ/kg ECM in both herds. The energy efficiency was similar in both systems. Therefore, a diet with a high amount of forage can lead to efficient feed utilisation although milk production may be lower. Reksen *et al*. (1999) reported similar levels of milk production from conventional and organic

dairy herds. Although the organic herds were fed a reduced level of concentrates the efficiency of forage utilisation was higher.

Health aspects

The average number of cows requiring treatment tended to be lower in the organic herd (66 vs. 70%), as was the total number of veterinary treatments/cow (0.72 vs. 0.77), with mastitis as the main health problem and the incidence slightly higher in the organic herd (0.41 vs. 0.37). Milk fever was the second most common health problem in both herds. The mean culling percentage was similar (34 and 35%), with low yield the main reason in both herds (organic herd: 30%; conventional herd: 17%). The second most common reason for culling was infertility and the failure to conceive.

The overall lower incidence of disease problems in the organic system suggests that organic cows may be healthier than conventional ones and the results were similar to other studies (Ebbesvik, 1993; Hardeng, 1998). However, the higher frequency of mastitis found in the organic herd was similar to the results reported by Weller & Cooper (1996). The relative high level of organic cows culled due to 'infertility' could be a consequence of the negative energy balance in early lactation. Significantly lower fertility in an organic herd compared with the fertility in a conventional herd was also reported by Gruber *et al*. (2001). Sundrum (2001) suggested that the specific farm management, rather than the production method, influence the health status of a herd.

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FIGURES

Figure 1. Average DM and ME intake during the lactation for organic and conventional cows (uncorrected means).

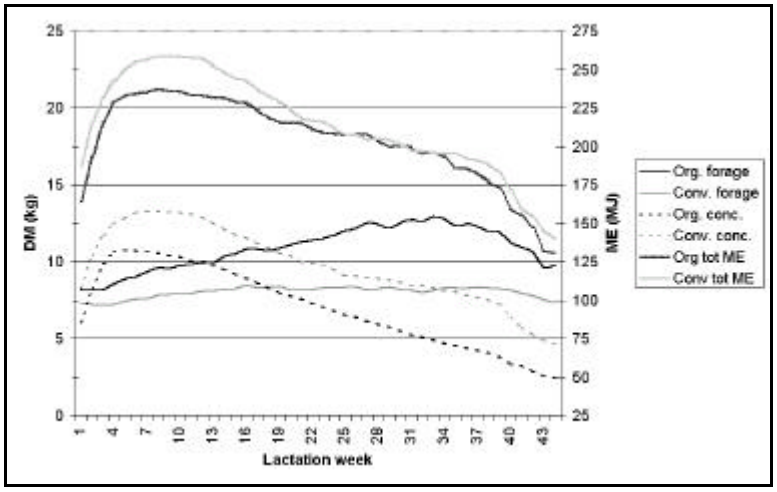
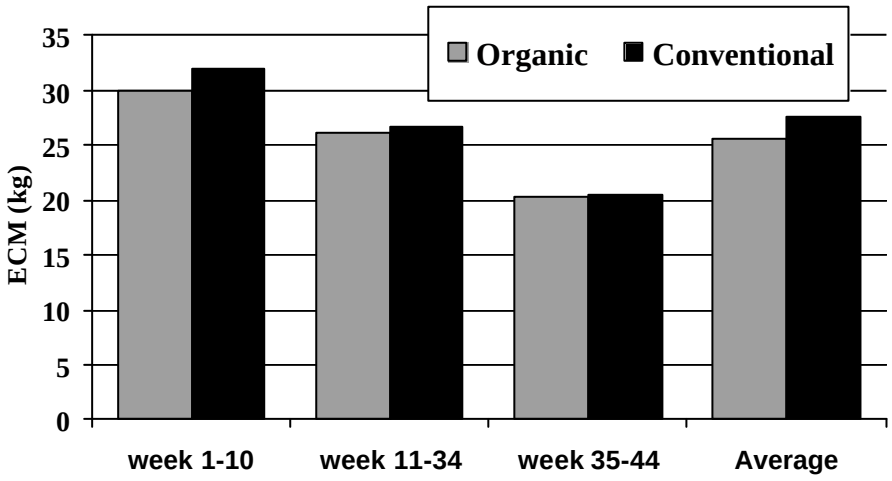


Figure 2. Average milk yield (kg ECM) during different parts of the lactation.



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