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Grazing management for Nordic organic dairy farming

Eeva Kuusela

Department of Biology, University of Joensuu, P.O.Box 111, FIN-80101 Joensuu, Finland

Abstract

The aims of this study were to identify limiting factors and to develop adjusted grazing management for Nordic organic dairy farming conditions. The focus was to combine the aspects of plant, animal and organic production, as they are all involved in organic dairy pastures. This pioneer work provides a characterisation of Nordic organic pastures, suggests novel legume species for Nordic conditions, considers the advantages of manure compost fertilisation, proposes tools to improve grazing efficiency and assesses the benefits of supplementary feeding.

Keywords: Nordic organic dairy farming, pasture species, compost fertilisation, grazing system

Introduction

Grazing dairy cows form part of a complex ecosystem involving their interaction with the pasture plants, soil micro-organisms and climatic conditions (Figure 1). In Nordic organic dairy farming, grazing represents a challenge with the short grazing season and limited number of winter-hardy plant species combined with restrictions on the use of fertilisers and supplementary feeding and with nutritional demands of high-yielding milk cows. Grazing management based on conventional farming practice does not fit into the Nordic organic farming system, where mineral fertilisers are not permitted. Neither natural pastures, nor extensive grazing systems can supply adequate herbage (quantity and quality) for lactating dairy cows. Hence, grazing management needs to be specially adjusted for organic dairy farming.

Table 1. Description of seven experiments contributing data to this study (Kuusela, 2004).

Subject of experiment	Treatments	Measurements
Sward renovation	Compost application or no fert. Reseeding or no reseeding	Sward measurements
Clover species for perennial swards	Five seed mixtures	Sward measurements
Birdsfoot trefoil and white clover	Three seed mixtures	Sward measurements
Grazing method and supplementary feeding	Strip or paddock grazing Four supplementary feedings	Sward measurements Animal measurements
Herbage allowance and supplementary feeding	Two levels of herbage allowances Two levels of supplementary feeding	Sward measurements Animal measurements
Compost fertilisation and legumes for annual swards	Compost fertilisation Four seed mixtures	Sward measurements
Legumes for annual swards and concentrate feeding regimen	Two seed mixtures Two concentrate feeding regimens	Sward measurements Animal measurements

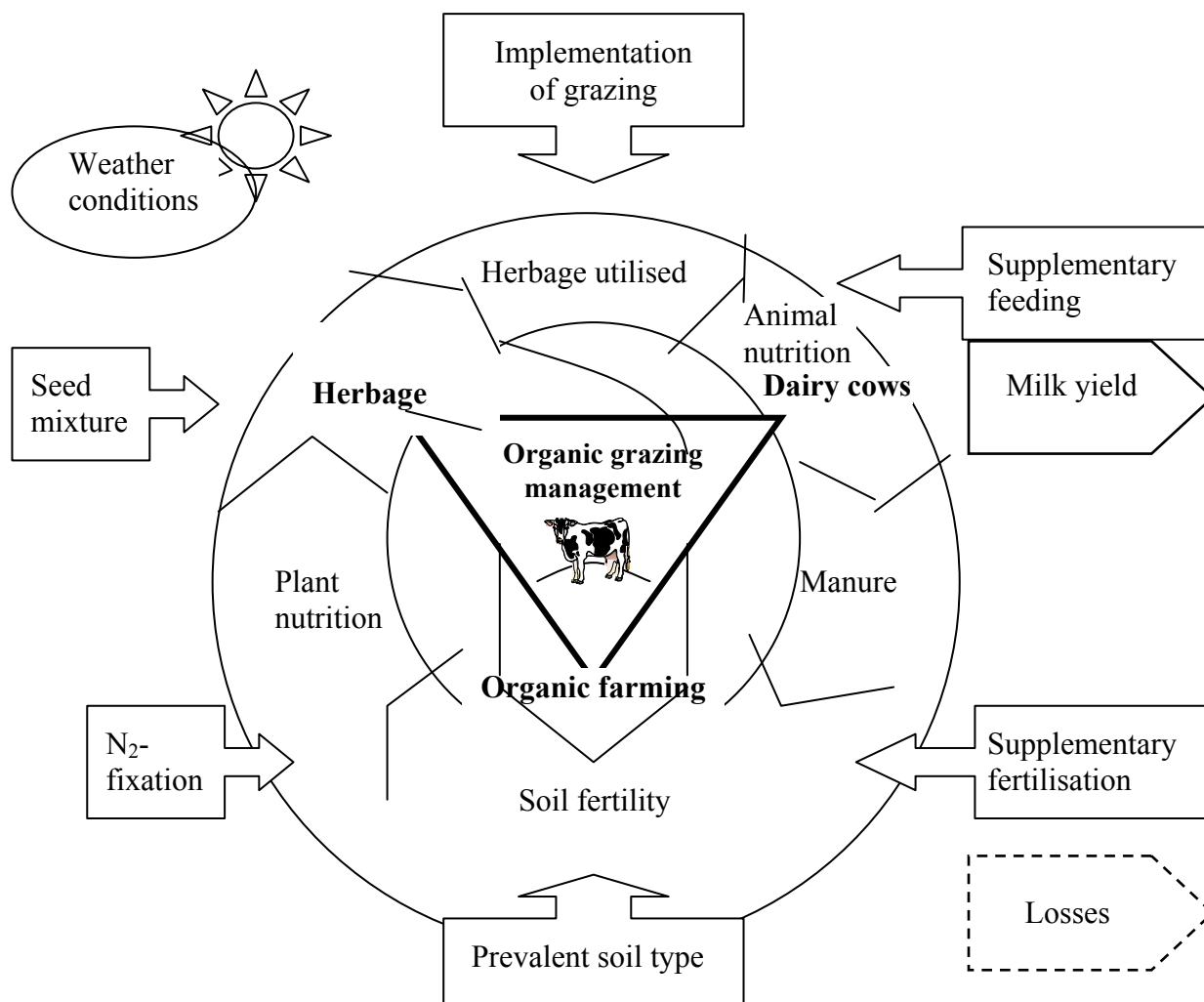


Figure 1. Elements influencing the grazing management under development for Nordic organic dairy farming (Kuusela, 2004).

Material and methods

The study, including seven field or feeding experiments (Table 1), was conducted on the Siikasalmi research farm of the University of Joensuu (62°30'N, 29°30'E) in Eastern Finland in 1994 – 1999 (Kuusela, 2004).

Results and discussion

This study showed that intensively managed organic pastures could support at least moderate herbage production with good nutritive value. Mean pre-grazing herbage mass (above 3 cm) varied between experiments from 1265 to 1985 kg dry matter (DM) per hectare, when approximately 3 weeks rotation cycle was applied in order to obtain adequate herbage quality. Mean crude protein content between experiments varied from 165 to 217 g/kg DM and *in vitro* digestibility of organic matter from 0.75 to 0.76. Organic pastures were heterogeneous mixtures of three botanical components, grasses, legumes and weeds, which were clearly divergent regarding dependence on soil nitrogen availability and herbage nutritive value. The botanical proportions and seasonal changes affected the nutritive value and growth of the herbage.

The choice of legume species for the grazed mixture is of key importance, since red clover (*Trifolium pratense*), the basal legume for organic silage, is known to suffer from frequent grazing. In the present study white clover (*Trifolium repens*) was the most suitable perennial pasture clover for Nordic conditions, but the additional inclusion of beneficial birdsfoot trefoil (*Lotus corniculatus*) in perennial clover-grass mixtures is suggested. Hairy vetch (*Vicia villosa*) was best suited for grazed annual legume-grass-cereal mixtures and could support extended grazing in the autumn. At the farm level, including both annual and perennial swards is recommended to balance the temporal variation of the herbage mass and extend the grazing season in the autumn.

In organic farming systems, the proportion of legumes and their ability to accumulate N₂ determine the potential productivity of the whole system and farm yard manure is a practical tool to circulate nutrients and improve the fertility of low-fertility areas. Grazing supports soil fertility intrinsically because most of grazed nutrients and nutrients from supplementary feeding are directly recycled to pasture. In the present study, application of soil-deposited manure compost increased the amount of pre-grazing herbage mass by 18 %, but increased also the amount of post-grazing herbage mass by 27% and had no effect on the amount of utilised herbage. The reduction in intake was attributed to smell, since the differences in the chemical composition between unfertilised and compost fertilised herbage were minor. Hence, manure compost fertilisation, when necessary, is recommended to be used for cereals included in pasture-crop rotation rather than for grazed swards.

In organic grazing systems herbage production is often lower than in heavily fertilised conventional systems when normal rotation cycles are used in order to obtain herbage with adequate nutritive value. In organic farming systems the length of the rotation cycle is a compromise between digestibility and the amount of herbage mass, where nitrogen deficiency often depresses the production of herbage mass from grasses. The pre-grazing herbage mass affects the stocking rate, grazing area requirement, milk yield per animal and milk yield per hectare. It should be noted that grazed herbage mass is the only DM harvested from pasture and generally pasture productivity is limited due failure in grazing management. However, efficiency of grazing can often be improved. In the present study, the milk yield per hectare was clearly (36 %) increased by applying daily strip grazing instead of paddock grazing, because of the benefits of short animal occupation. An excessive herbage allowance in connection with a low herbage mass is an inefficient combination, because they both increase the grazing area requirement while large incremental increase in herbage allowance are known to have only minor effects on the milk production of individual animals per day. In the present study, moderate decreases in the daily herbage allowance (24 vs 18 kg DM, above 3 cm) decreased slightly (8.8%) grazing area requirement, but resulted in lower post-grazing sward height, depressed sward growth and had no significant effect on the milk yield per hectare. The herbage allowance should not go below the level which the system can tolerate. In Nordic organic dairy farming, an adequate daily herbage allowance for mid-lactating cows might be 20-26 kg DM per cow, depending on the milk yield, supplementary feeding and growing conditions. Based on the current data a target post-grazing, a sward height of 10-12 cm is suggested for Nordic organic legume-grass pastures.

The intake of herbage and the nutritive value supply from the herbage for grazing cows is determined by the nutritive value of the herbage and herbage allowance, but also herbage mass and sward structure are affecting. On grass-based diets, a maximum milk yield of 20 kg per day has often been assumed to be the highest level of production that can be achieved at pasture, but recent studies have shown that milk yield of 30 kg per day can be achieved on grass under excellent grazing conditions. In the present study a grass-only diet resulted in a daily milk yield of 16.8 kg per mid-lactation cow, indicating some deficiencies on herbage mass or its nutritive value. Both energy (barley + oats) and protein (rape seed meal) supplementation (4 and 1.25 kg per day, respectively) resulted in increased daily milk production (19.1 and 18.2 kg milk, respectively). Increasing the amount (2.5 vs 5 kg per day) of concentrate supplementation (barley + oats + rape

seed meal) resulted in relatively high milk response (0.68). Based on current study, a moderate level of concentrate (4 kg per day) could be offered once instead of twice daily to simplify feeding.

Calcium, Mg, P, K and Na concentrations of pre-grazing herbage samples collected in 1997 and 1998 averaged 6.20, 2.08, 4.05, 32.94 and 0.09 g/kg DM, respectively. The main differences between seed mixtures were connected to the proportion of legume in the sward, which affected Ca and Mg contents of the herbage. The temporal changes in mineral contents and mineral ratios were significant. The organic pasture herbage did not fully satisfy the mineral requirements of grazing dairy cows. Low concentration of Na and moderate Mg in herbage, especially the latter associated with high K in early summer, require mineral supplementation. Because of temporal variation, measured values of herbage mineral content are needed to control the risk of disorders in grazing animals and for planning adequate mineral feeding.

Conclusions

Heterogeneity in herbage production, species and herbage chemical content both spatially and temporally was characteristic for organic pastures. However, intensively managed organic pastures could support at least moderate herbage production with good nutritive value. A sufficient legume proportion was essential for the nutritive value of herbage and current and future growth. In Nordic conditions white clover was the most suitable legume for perennial pastures and hairy vetch for grazed annual legume-grass-cereal mixtures. At the farm level, including both annual and perennial swards will help to balance the temporal variation of the herbage mass and extend the grazing season in the autumn. Manure compost fertilisation, if necessary to improve the soil fertility of a given area, is recommended to be used for harvested cereals included in pasture crop rotation rather than for grazed swards.

Efforts to improve grazing efficiency are essential in organic systems, where herbage production is often lower than in heavily fertilised conventional systems. In the present study the milk yield per hectare was clearly increased by applying daily strip grazing instead of paddock grazing. In organic dairy farming, excessive herbage allowances are rarely useful because of the limited pre-grazing herbage mass. On the other hand, the herbage allowance should not go below the level which the system can tolerate. Post-grazing sward height is a good indicator for the implementation of adequate allowances and for continuous monitoring to prevent inefficient under-grazing and detrimental over-grazing also for organic pastures.

In the present study, the milk yield response to concentrate feeding was relatively high for mid-lactating cows grazing on organic cultivated swards. This was mainly because the herbage intake was limited on a herbage mass basis. Both energy and protein supplementation resulted in increases in milk production. A concentrate supplement including additional protein adjusted according to the state of lactation is recommended for early-mid lactating cows grazing clover-grass swards grown under the conditions of Nordic organic farming. Organic pasture herbage did not fully satisfy the mineral requirements of grazing dairy cows. Low concentrations of Na and relatively low Mg in the herbage, the latter especially in connection with high K, require mineral supplementation.

References

Kuusela, E. (2004) Grazing management for Nordic organic dairy farming – University of Joensuu, 2004, 154 pp. University of Joensuu, PhD Dissertations in Biology, n:o 32, ISSN 1457-2486 ISBN 952-458-586-3