TECHNICAL NOTE

SusCatt - Increasing productivity, resource efficiency and product quality to increase the economic competitiveness of forage and grazing based cattle production systems

Assessing diverse forages to reduce the environmental impact of grazing dairy cows

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About

Grazing dairy systems are the most cost-effective form of ruminant production, however, enteric methane produced by the cows is a major source of agricultural greenhouse gases.

We asked ourselves if diverse pastures, particularly when including tannin rich forages, could reduce methane emissions while maintaining productivity. Thus, we compared the performance and methane emissions of grazing dairy cows on two forage mixtures with contrasting sward diversity.

Jersey cow with SF_6 equipment grazing on diverse pasture.
Photo: Carsten Malisch

Challenge and objectives

Although the benefits of grazing dairy systems have been widely proven and customer preference for pasture-based milk and dairy products is increasing, information on methane emissions from cows grazing mixed swards, including tannin-rich herbs, is scarce. The existing predisposition was, that due to poorer efficiency, methane emissions per litre of milk would increase if cows graze rather than being housed. On the other hand, several herbs have been hypothesized to reduce rumen methane production, while simultaneously providing ecosystem services - by enhancing carbon sequestration and biodiversity.

Our goal at CAU Kiel was to find out if we could create herb-rich, diverse pastures for intensive grazing by dairy cows, that might combine all these benefits to produce environmentally friendly, high quality milk with lower methane emissions.

What did we do?

In the experiment, we measured enteric methane and milk yield from 24 mature, spring-calving Jersey cows grazing two perennial mixed swards with contrasting degree of diversity at peak (May) and late lactation (September). The swards were: i) a relatively simple mix of perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*) and ii) a diverse mixture with eight sown species, which also included: red clover (*Trifolium pratense*), birdsfoot trefoil (*Lotus corniculatus*), salad burnet (*Sanguisorba minor*), chicory (*Cichorium intybus*); narrow leafed plantain (*Plantago lanceolata*) and caraway (*Carum carvi*).

Throughout the study, cows were milked twice a day (0600 and 1600 h) and individual milk yield was recorded automatically, with subsamples analysed for quality. Enteric methane collection was measured using the sulphur hexafluoride (SF_6) tracer technique, adapted

for a 4-day collection period. Forage uptake was estimated from pre- and post-grazing herbage height, measured by an electronic raising platemeter (Grasshopper, True North Technologies, Shannon, Ireland), and by cutting ten randomly chosen 0.25 m² quadrats per plot to a height of 4 cm, which were subsequently sorted for botanic composition.

Diverse pastures can provide comparable energy yields to binary mixtures

The nutritional quality of both herbage mixtures was very good throughout, with energy concentrations of 7.7 and 6.9 MJ NEL / kg DM for the simple mixture and 7.5 and 6.7 MJ NEL / kg DM for the diverse mixtures, for late spring and late summer, respectively. Herbs accounted for up to 24% of the diverse mixture in late spring, while in autumn particularly red clover boosted its share to 41%. The proportion of ryegrass was always twice as high in simple compared to diverse mixtures with 90% in spring and 55% in autumn. Unfortunately, the proportion of tannin rich herbs (birdsfoot trefoil and salad burnet) in the mixed swards were generally low.

Milk yields and methane emissions are excellent throughout

Milk yield (and calculated energy corrected milk yields or ECM) were very high for both systems, reaching 30 kg ECM in late spring and 23 kg ECM per cow per day in autumn. On average, cows grazing diverse pasture gave more milk - an extra 1kg ECM per cow and day in both early and late lactation, compared with cows grazing the ryegrass/clover swards.

Compared to published figures for grazing jersey cows, daily methane emissions here were low for both systems, although slightly higher from the diverse mixtures compared to the simple mixed swards (on average 221 g for binary vs 260 g CH_4/cow/day for the diverse mixtures). Methane intensity relative to milk yield in this experiment (between 8.3 to 10.4 g CH_4/kg ECM) was also much lower than the average of 17g / kg ECM, previously reported for grazing Jersey cows. This can largely be explained by unusually high milk yields in this study as a consequence of intensive use of excellent quality forages.

Conclusion

Well managed, efficient organic dairying appears to have very low methane emissions. Adding a low level of forbs to swards provides little additional benefits as these herbs are not competitive under intensive grazing management, although might be appropriate for mixtures with lower use intensity.

Binary (top) and diverse (bottom) mixtures constituting the two treatments. Lindhof experimental farm, Kiel University. Photo: Cecilia Loza

Imprint

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