Increasing milk production from grassland with reduced environmental impact

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Several reports, directives, regulations and initiatives challenge dairy systems at the environmental level. At the same time, the dairy sector must face other challenges: greater volatility of milk prices, reduction in non renewable resources and the consequences of global climatic change. Today great variety exists in dairy faming systems, not only between but also within countries/regions. In this context, dairy systems maximising grassland utilisation have many opportunities to combine and maximise economic and environmental performance. From the economic point of view, comparisons made at world level show that dairy systems maximising grass utilisation appear highly competitive. On the environmental level, the various roles of grassland in providing regulating and supporting services are widely recognized although the interaction and balance between these different functions differ between regions in Europe. The objective of this paper is to review existing knowledge for developing productive, efficient and environmentally friendly dairy systems based on grassland utilisation.

Ideal forage Net energy and metabolic protein content of fresh forages are high but intake is low compared to total mixed rations. Consequently fresh grass alone prevents high genetic merit cows fully expressing their milk potential. However several trials have shown that relatively high milk production (i.e. 7000 kg/lactation) is achievable with high genetic merit cows on grass based systems. The challenge is to increase fresh forage intake at grazing. Increasing leaf blade mass by appropriate grazing management in early season plays a major role in increasing herbage intake over the entire grazing season. Using grass-legumes mixtures also increases intake compared to pure grasses, the higher the clover content the higher the difference. Because voluntary DM intake of legumes is 10 to 15% greater than that of grasses of similar digestibility, pure legume silage and legume dominated silages increase milk yield compared to pure grass silage when cows are fed indoors. From an agronomical point of view there is interest in extending herbage growth season. Many results have shown that the first N application is important to stimulate the early growth of grass. New perennial rye grass varieties look also very promising. The difficulties in maintaining well balanced grass-legumes mixtures, the difficulties of legumes silage conservation and the slow growth rate of clover in early spring remain the main reasons for the preference of pure grass swards and required further research.

Ideal cow The improvement of genetic merit for milk production no longer appears to be a priority. Cows having high longevity are required. Inflated replacement rate, that it is due to infertility or other reasons, reduces efficiency because first lactating animals produce less than adult cows and thus the number of lactating animals and heifers as well as the amount of forage required to feed the herd increase for a given amount of milk. Older cows are also more efficient in converting forage into milk because intake capacity increases with the rank of lactation. Several trials have shown that cows selected solely on milk are not well suited for seasonal grass based systems that required a 365 day calving interval. For theses systems highly fertile cows are required. Infertility problems are less acute when compact calving is not required as for example when high quality forage is available all around the year. Here, lengthening of lactations offers several advantages such as reducing non productive periods and limiting the inherent risks at the beginning of lactation but this strategy requires cows having a high persistency of lactation. The most efficient cow is that which produces the maximum per kg of forage intake or per kg of live weight. Thus Jersey cows appear to be very efficient but heavier cows generally produce more milk and it is probable that in practice the effect of the weight is not very relevant for animal effectiveness. It is also advisable to reconsider, at least in marginal zones, the interest of dual purpose breeds which make it possible to produce 6 to 7.000 kg of milk by lactation and one calf per year, primarily from grass, and to ensure a greater stability because of the double source of income (milk and meat). All the more interesting to have a system that is frugal in concentrate use.

Ideal system management With regards to food security and high land prices, maximising milk yield per unit area is more than ever a challenge for research. In low input systems this requires a need to convert the whole of forage produced into milk thus avoiding losses at grazing and during forage conservation. Given the high feeding value of fresh forages there is interest to extending the grazing season as much as possible. Several trials conducted in Northern Ireland, in Ireland and in France have shown there are considerable opportunities to extend the grazing season in early spring and/or in late autumn (at least in West Europe) thereby reducing costs associated with indoors feeding systems, increasing milk yield and consuming almost the full amount of grass that is produced. From an environmental point of view, nitrogen losses under grazed grasslands remain moderate for fertilization applications lower than 250 kg of mineral N/ha/year. However in regions with pasture-arable crop rotation the ploughing of grazed pasture is followed by rapid N mineralization. Using catch crops during winter is recommended as this contributes to reduced nitrate leaching compared to bare soil while providing forage for animals. Recent live cycle assessments indicate that forage legumes can contribute to reduced global warming potential and the consumption of non renewable energy per kg of milk compare to N-fertilized grass based systems and to conventional intensive systems using high amount of concentrates. However data in the literature are still relatively scarce and further investigation is warranted to better quantify the benefits and risks of grassland based systems relevant to their management.

In conclusion Forage legumes will undoubtedly constitute an important pillar for the development of future dairy systems with high environmental and economic performances. Selection on functional traits for more robust cows and adaptations of lactation and management systems will constitute others pillars.

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