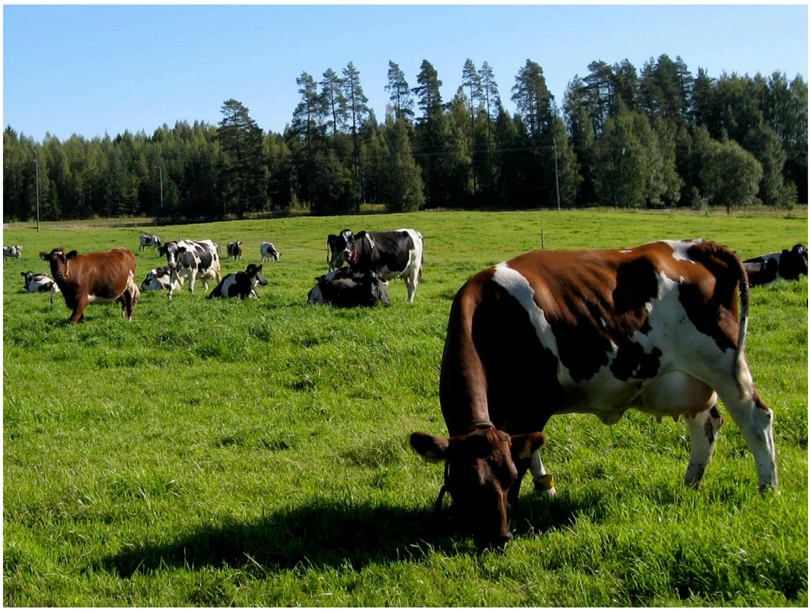
SOLID Sustainable Organic and Low Input Dairying

Breeding cows suitable for low-input and organic dairy systems

Introduction

Most low-input dairy systems seek to maximise the utilisation of 'home grown' forage, especially pasture, and to operate with low inputs of supplementary concentrates. These principles are reflected in the EU regulations for organic milk production systems, namely basing the system on a maximum use of grazing pasturage and restrictions on the proportion of concentrates in the diet. Thus, a key requirement of an efficient low-input forage-based milk production system is a cow that can consume large quantities of forage per unit bodyweight, efficiently convert this forage into high value milk or milk solids, become pregnant within a defined breeding season, and have a high health status.

Until relatively recently selection programmes within the Holstein-Friesian breed focused primarily on milk yield, resulting in a breed with high milk production potential and high efficiency for milk production. This has led to the dominance of the Holstein breed in many parts of the world. However, these selection programmes largely ignored functional traits, and were often implemented in high concentrate input environments where (grazed) forages were considered relatively unimportant. This, together with the excessive mobilisation of body tissue reserves which is common with high-performing cows, resulted in a decline in fertility, health (metabolic disorders) and longevity within the Holstein population. This has motivated many dairy producers to consider alternative breeds of dairy cattle.

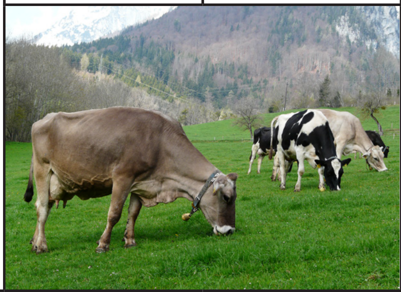


Which cow for which system?

A diverse range of low-input and organic milk production systems exist across Europe. These diverse systems generally require livestock which are adapted to specific conditions within countries and regions, and this means that different breeding approaches may be required to secure appropriate livestock. Farmers, breeding companies and researchers have therefore adopted a number of alternative strategies to overcome the limitations of conventional genotypes within low input or organic systems. These include crossbreeding and selection for robustness and lifetime performance.

A key objective within the SOLID project was to compare the performance of a number of breeds which are commonly used within three diverse dairying regions (Austria, Northern Ireland and Finland) with breeds/genotypes which were perceived as being 'better adapted' to the local systems (Table 1). Each comparison took place at two different concentrate levels. While the results across the different regions and breeds were inconsistent, in general there were no clear overall advantages for the alternative breeds examined. Nevertheless, there was evidence of improved fertility and health traits with some 'adapted' breeds, while the different breeds had different metabolic responses to concentrate feeding. This suggests that it is possible to select breeds which are adapted to the specific low input and organic dairy systems.

Table 1: Dairy systems and breeds examined in the SOLID-project

Country	Austria		UK (Northern Ireland)		Finland	
Region	Alpine Grassland		Western European Grassland		North European Grassland	
Systems studied	Low (320 kg) vs. moderate (710 kg) concentrate input		Low (850 kg) vs. moderate (2110 kg) concentrate input		Moderate (1440 kg) vs. high (3470 kg) concentrate input	
Milk output from systems	5,600 kg vs. 6,200 kg		6,300 kg vs. 8,000 kg		8,300 kg vs. 9,400 kg	
Breeds studied	Conventional	Adapted	Conventional	Adapted	Conventional	Adapted
	Brown Swiss	Local Holstein (selected for longevity)	Holstein-Friesian	Swedish Red x Jersey x Holstein	Holstein-Friesian	Nordic Red (selected for robustness)
						
Results	The local Holstein cows had: • A lower production response to concentrate supplementation • Higher milk fat and lower milk protein content • Lower body weight • Earlier minimum body condition score		The crossbred cows had: • Lower milk yields • Higher fat and protein content • Improved energy status in early lactation • Lower body weight but higher body condition score • Later minimum body weight • Fewer health disorders		The Nordic Red cows had: • Slightly lower milk yields • Higher milk solids content • Less fat mobilization in early lactation • Tendency towards less metabolic disorders	

Selecting animals for low-input and organic dairy systems

Breeding decisions have a cumulative impact, meaning that the effects of breeding choices (both good and bad!) can build up over many generations.

For this reason, a clear set of breeding objectives should be established on each farm. While specific objectives may vary greatly from farm to farm, the overall objective on most farms is likely to be improving profitability in the long term. As a first step farmers need to identify the specific strengths and weaknesses of their herd, and indeed individual cows in the herd. Sires which will help overcome these ‘weaknesses’ and further add to ‘strengths’ should then be selected.

Traits which are particularly important within organic and low input systems include fitness traits (such as fertility, lifespan and disease resistance), functional type traits (legs and udder) and specific performance traits (such as persistence and lifetime performance). Increasing milk yield is unlikely to be a core selection criterion on most low-input and organic dairy farms. Sire selection decisions are then made by matching the information available from performance testing schemes and breeding indexes (genetic merit) to individual breeding goals.

Genetic Indexes and selection decisions

The overall genetic merit of an individual animal is usually calculated from 10 to 20 individual traits (e.g. milk yield, milk fat, milk protein, somatic cell count, fertility, mastitis, lameness etc.) plus a number of auxiliary traits. Each trait is given an economic value, and these traits are then weighted to give the overall genetic merit of the animal. This is normally expressed as a monetary value relative to the breed average. Animals within a breed can then be ranked in terms of their genetic indexes. Most countries publish specific selection indexes which follow very similar concepts, but which do not allow direct comparisons between countries.

The decision on which cow to select and which bull to use for insemination should not be based on the overall genetic merit only, as this value only expresses the overall financial improvement that a breeding animal is, on average, expected to transmit into the next generation. If the offspring shall be managed in a system which is substantially different from the average system, the overall genetic merit may not represent the true breeding value of the animal for that specific production environment. In order to better address the needs of breeders operating within organic and low-input dairy systems, specific indexes (e.g. 'Ecological Total Merit Index' and 'Spring Calving Index') have been designed in a number of countries.

When selecting sires, the overall genetic index provides a first overview of the sires to choose from. The farmer then needs to identify the traits which are most important within the herd, and which need to be improved, and then select sires with a high genetic merit in these traits. As all bulls have strengths and weaknesses, it is important to select a sire which is strong in the traits to be improved but yet not weak in any of the traits of particular importance for the specific herd.

Some traits which may be particularly relevant in low-input and organic systems were mentioned above; it is recommended that a limited number of traits (three to four) should be focused on at any one time. The primary traits for selection should have at least moderate heritability (i.e. the degree to which a trait is passed down to the next generation). If milk production is already at the optimum for the production environment, this offers the opportunity to improve other traits, such as reproduction performance, longevity, somatic cell count, type traits (including optimum cow size), etc.

Crossbreeding: a quick fix?

Crossbreeding is frequently suggested as providing a rapid solution to the problems of declining fertility and health in dairy cows, with the New Zealand dairy industry frequently used as proof that crossbreeding is particularly appropriate for low-input or organic dairy production systems.

There are two main reasons for the adoption of a crossbreeding programme:

- Introduction of desirable genes from another breed, which may be absent or very rare in the recipient breed. Examples are crossbreeding with Jersey in order to improve milk composition and with Scandinavian breeds in order to improve fertility and health.
- Benefiting from hybrid vigour; i.e. the additional performance benefit which can be achieved by crossbreeding, over and above the average of the two parent breeds. The magnitude of this effect varies, depending on the trait and on the degree of genetic differences between the parent breeds; e.g. hybrid vigour may be around 3 to 6 % for milk yield and milk composition, and 6 to 15 % for fertility, health and longevity. Within low-input systems there is clear evidence that crossbred cows may have similar levels of performance as the high-performing parent breed, while having improved fertility, health and longevity. However, hybrid vigour should not be mistaken with long term genetic improvement as it will not be passed on to the next generation.

Points to be considered

Despite the potential benefits, the decision to adopt crossbreeding needs to be made with caution. Crossbreeding will not solve problems caused by poor management or poor nutrition, and hence must not be seen as a substitute for improving poor management. It is also not a 'quick fix' due to the time taken (three years) before crossbred animals enter the milking herd. Additionally, a breeding strategy needs to be developed for the F_1-generation once they reach breeding age. A number of options are available and these need to be considered critically, including 'criss-crossing', 'rotational crossing' or use of progeny tested F_1-sires. The choice of the second (and possibly third) breed is a critical decision within any crossbreeding programme. The breed(s) to be chosen should allow for a minimum loss in milk production and at the same time substantially improve the other traits of interest. The specific requirements of the dairy system need to be carefully considered when making this choice. The chosen breed should have a robust progeny testing scheme and breeding programme in place in order to secure the future availability of high quality sires. In addition, sires used for crossbreeding should be among the top sires from the selected breed.

Experiences from existing crossbreeding programmes for grassland-based dairy systems show that, depending on the parent breeds, while the desired reduction in cow size is realised, this is often accompanied by increased variability in cow size. Herds comprising cows of different sizes create specific management challenges, including optimum cubicle sizes and fitting into milking facilities. Depending on the parent breeds used, crossbreeding may also have an impact on the value of cull cows, (male) calves and youngstock when sold, and this may affect the overall profitability of the dairy system.

Conclusions and recommendations

Low-input production systems require a cow that can consume large quantities of forage per unit body weight, efficiently convert this forage into high value milk or milk solids, become pregnant within a defined breeding season, and has a high health status. Thus, high-yielding dairy cows, which have been selected under high-concentrate input conditions, may not be suitable for low input and organic production systems. While producers are requesting alternative cow types, there is no ‘one size fits all’ solution.

Given the diversity of low input and organic systems throughout Europe, results from the SOLID-project show that within well managed herds, breeds perceived as being better adapted to low-input and organic systems did not necessarily show clear and substantial advantages over conventional breeds.

However, the ‘adapted’ breeds examined had specific strengths which may offer particular advantages in certain environments. These breeds, and the principles involved in their development, should be further developed within their breeding programmes.

The large variability in the genetic merit of breeding animals allows for the selection of animals which are suitable for individual herds or farms. A good understanding of the existing strengths and weaknesses of a herd is the first step in defining the traits which need to be improved, and for the choice of the most suitable sire.

While crossbreeding provides an alternative to selection within one breed, it requires strategic planning and should not be seen as a ‘quick fix’ for management-related problems.

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