Breeding Strategies for Organic Dairy Producers

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In all production systems, it is important for milk producers to choose breeds and crosses that are most suited to their systems and the markets that their milk is sold into. This is especially true for organic milk producers since they have particular difficulties to address e.g. the need to minimise the use of drugs to treat or prevent disease. This is important as the prophylactic use of antibiotics and some other drugs on a herd basis is prohibited in organic systems. There has been little research on disease resistance in organic systems, but it has been shown that crossbred animals generally show greater disease resistance and overall fitness than their purebred counterparts due to hybrid vigour for these traits. This suggests that crossbred animals may be better suited to organic systems than purebred animals.

Survey of breeding goals

Which traits do organic farmers consider important in their breeding goal? To answer this question, organic dairy farmers were asked to give a score of 0 to 5, with 0 being of little importance and 5 being of great importance, to 28 potential goal traits. These traits included milk production, resistance to general and to specific diseases, fertility and feet and leg disorders. The top 10 traits from that survey, together with their ranking, are in the following table:

Rank	**Trait**
1	General disease resistance
2	Mastitis resistance
3	Longevity
4	Somatic cell count (sub-clinical mastitis resistance)
5	Female fertility
6	Feed characteristics (e.g. forage intake capacity)
7	Feet and Legs
8	Lameness
9	Resistance to parasite infection
10	Robustness/hardiness

Milk yield, as a goal trait for the organic dairy farmer, was the highest ranking of the yield traits. It achieved a ranking of 17, and was closely followed by protein content (18) and fat content (22). Bottom ranking traits were ketosis (27) and colour of animal (28).

Estimating hybrid vigour in crossbred animals

Hybrid vigour, or heterosis, is the difference between crossbred and purebred performance and is the reverse of inbreeding depression. It is exploited regularly in crop production and also in pig and poultry production. It is associated with better fertility and overall fitness, and so is of potential benefit to the organic dairy sector in particular. Useful hybrid vigour is found when the mean of the crossbred animals is more advantageous then either of the purebred parent means e.g. when the crossbred mean for milk yield is higher than either of the purebred means, or the crossbred mean for somatic cell count (a predictor of mastitis) is lower than either of the purebred means. The word 'useful' is used because if the crossbred mean is not higher than both the purebred means, there is no advantage in using the crossbred rather than the purebred.

Using UK national milk recording data, no useful hybrid vigour was identified for the production traits (milk, fat, protein, fat % and protein %), although a significant amount of hybrid vigour was found for fat % in Ayrshire-Jerseys and Jersey-Guernsey. Useful hybrid vigour was found for somatic cell count in all first cross animals. Similar genes control both somatic cell count and mastitis, making somatic cell count a useful predictor of mastitis. Mastitis is an important disease for the dairy cattle industry as it is a major reason for culling (in conventional herds approximately 10% of culling in each lactation is due to mastitis) and treatment costs are high. By crossbreeding, advantage can be taken of useful hybrid vigour for somatic cell count, so reducing the incidence of mastitis in the herd. This is particularly useful to organic producers who are prevented from using antibiotics on a regular basis.

Evidence of hybrid vigour for survival from 1st lactation to 2nd lactation was found in the Ayrshire-Jerseys and the Ayrshire-Shorthorns, and the presence of hybrid vigour for calving interval in the Ayrshire-Jersey cross indicates that fertility is better in this cross than in either purebred Ayrshires or purebred Jerseys.

Economic Values

In most countries, estimates of bull and cow genetic merit (predicted transmitting abilities, PTAs) for individual traits are combined into an overall index. In the UK, this is a profit index (£PLI) and is calculated by multiplying PTAs for milk, fat, protein, lifespan, somatic cell count (to predict mastitis) and locomotion (to predict lameness) by their respective economic values. These economic values are expressed in £s per unit of the trait, e.g. £/Kg of milk yield, and are based on many fixed assumptions including milk price, yield level and concentrate use. These assumptions are appropriate for conventional farming systems but may not be appropriate for organic systems. Calculating economic values under organic farming assumptions allows us to compare profitability across the systems.

CAP reforms adopted in January 2003 by the European commission propose a single farm payment, independent of production. This payment will provide incentives to respect environmental, animal welfare and health standards, as well as a requirement to keep farmland in good agricultural condition. To address this, additional economic values, called environmental values, were calculated. These values are taken as a true measure of the economic worth of natural resource assets, of which the most important is land, and take account of soil quality and composition. Environmental values include an estimate of what it would cost to return the land to its value (condition) prior to farming it in this particular way. In an organic system, land quality is maintained by recycling nutrients but in conventional farming fertiliser needs to be bought in to replace lost nutrients and this represents an additional cost.

Organic assumptions for a selection of breeds and crosses are given below:

Breed	P	CR	305 day Milk yield	Fat g/kg	Protein g/kg	C.I.	Weight	Birth Weight	Herd Size
Holstein	0.74	0.5	8055	41	33.5	385	600	40	100
Ayshire	0.87	0.56	5974	42.1	33.5	397	545	35	126
Guernsey	0.89	0.57	5216	49.5	35.7	394	500	33	135
Jersey	0.89	0.57	4922	55.7	38.2	395	450	26	142
Shorthorn	0.82	0.53	5476	38.4	32.7	401	550	33	129
Ayrshire X Jersey	0.90	0.58	5798	44.7	34.2	395	497	30.5	133
Ayrshire X Shorthorn	0.86	0.55	5944	39.2	32.9	399	547	34	127
Jersey X Guernsey	0.93	0.6	5096	55.7	38.6	396	475	29.5	136
Holstein X Friesian	0.82	0.53	7120	40.4	32.5	390	600	40	100

CR: conception rate; C.I.: calving interval ; P:proportion surviving from 1st lactation to 2nd lactation

Milk prices were based on the average litre payments paid by buyers, reflecting the oversupply in the market whilst considering the quality of the milk. The overall average milk price was assumed to be 20.06 ppl. Milk quota assumptions were that farmers own 500,000 litres and that quota at a price of 1.12ppl could be leased to cover excess milk production. Quota requirements were further adjusted for increases/decreases in butterfat content.

Combining all the above assumptions allows us to replicate as closely as possible an organic dairy farm, inclusive of the costs and benefits of home-produced forage.

Comparing breeds and systems

A comparative analysis employing risk measurement techniques allows us to gain an insight into differences between conventional and organic systems and between breeds. Based on variation in income and costs, the amount of financial risk involved in stocking a farm with a particular breed or cross can be calculated under both organic and conventional farming systems. Given that the presence of risk is a major factor in the agricultural sector and will play a major role in managerial input, the appropriateness of this approach becomes apparent.

From a comparative analysis, breeds were ordered from 1 (least financial risk) to 9 (most financial risk). Scores are given in the following table:

	Organic		Conventional	
	Acc.	Environ.	Acc.	Environ.
Holstein	1	1	1	1
Ayrshire	3	3	3	5
Ayrshire – Jersey	4	5	4	4
Ayrshire – Shorthorn	5	4	5	8
Guernsey	7	7	7	7
Holstein – Friesian	2	2	2	2
Jersey	8	8	8	6
Jersey – Guernsey	6	6	6	3
Shorthorn	9	9	9	9

An initial observation is that Holsteins outperform all other breeds in both systems, for both accounting and environmental values, while at the same time, Shorthorns are consistently ranked last. For the other breeds, the ranking is broadly identical across systems with the exception of environmental values in conventional systems. Another moderate exception is the ranking of Ayrshire-Jersey and Ayrshire-Shorthorn - in an organic system the former outperforms the latter with respect to accounting values while the reverse occurs in terms of environmental values. This is due to differences in milk yields and therefore energy requirements. If energy requirement is high, the intensity of land tillage increases, affecting the environmental value.

Effect on profit of changing milk prices

The effect on revenue of changes in milk price was mimicked by altering the amounts paid for butterfat and protein over a range of +/–6%. This was judged to be a suitable method of modelling price changes since other components of the milk price are more pertinent to the running costs of milk buyers and are unlikely to decrease (at least by as much as 6%). For ease of comparison, accounting and environmental values were compared to each other where the no-change situation is set to be a figure of 100.

Trends were similar across breeds and crosses, and the following table gives the values for Holstein-Friesians. The no-change situation is found at 16.6ppl in conventional systems and 19.8ppl in organic systems.

Conventional			Organic		
MilkPrice (ppl)	Acc.	Env.	MilkPrice (ppl)	Acc.	Env.
15.7	81.5	95.9	19.2	76.7	91.6
15.8	84.6	96.6	19.3	80.8	93.0
16.0	87.7	97.3	19.4	84.5	94.4
16.1	90.9	98.0	19.5	88.5	95.8
16.3	94.0	98.7	19.6	92.2	97.2
16.4	97.1	99.4	19.7	96.3	98.7
16.6	100	100	19.8	100	100
16.7	103.1	100.7	19.9	103.7	101.3
16.9	106.2	101.4	20.0	107.8	102.8
17.0	109.4	102.1	20.1	111.5	104.2
17.2	112.5	102.7	20.2	115.5	105.6
17.3	115.4	103.4	20.3	119.2	107.0
17.5	118.5	104.1	20.4	123.3	108.4

From this table, and using accounting values, we can see that if the milk price in a conventional system increases from 16.6ppl to 17.5ppl, net revenue increases by 18.5%. Similarly, in an organic system an increase in milk price from 19.8 to 20.4ppl results in a 23.3% increase in net revenue.

The general trend is as expected in that a milk price decrease will simply cause revenue to decrease whilst the opposite is also true, although accounting values do not vary as much in conventional systems as they do in organic systems. This greater variation of revenues in organic systems suggests a greater importance of milk price to profitability. With respect to environmental values, these were also found to vary over a greater range in organic systems, although a smaller differential can be observed. Nevertheless, environmental values under organic systems still display a moderately larger variance.

The most consistent returns were found in the Holsteins and the Holstein-Friesians, confirming the suitability of these breeds to organic systems. Unpredictability of returns is likely to influence farmers not only in their decision as to whether to convert to an organic system, but further as to which breed to adopt in order to be profitable. It is not evident that farmers running organic systems should consider crossbreeding as a first option to improve profitability.

The future

The size of the global Holstein population means that this breed will make the greatest genetic progress in terms of milk yield. An increase in yield is associated with increasing fertility and health problems that attract hidden costs and may make a niche for other breeds or crossbreds particularly if Holstein breeders fail to respond to changing market circumstances regarding disease costs. This effect is particularly true in organic systems where the cost of disease is greater. However, producers in all systems must remain competitive, so selection in any breed or cross will still need to include milk yield.

Currently, insufficient data is recorded on dairy cattle to allow accurate statistics to be compiled for the organic sector. There is no official disease recording in the UK even though recording facilities exist in most milk recording schemes, but general disease resistance was given top priority as a breeding goal for organic farmers. We need to collect accurate information on the incidence of all major diseases, per lactation, in both conventional and organic dairy herds. This will allow us to refine our economic values for traits currently in the UK profit index, and expand the profit index to include other costly diseases. Identification of herds in the organic dairy sector and the length of time they have been fully organic would allow us to compare the profile of the average dairy cow in an organic system with the average dairy cow in a conventional farming system. How does disease incidence differ? Do organic dairy cattle live longer than their conventional counterparts when giving the same amount of milk? What, if any, difference is there in the shape of the lactation curve between these systems?

The European Union has a policy in favour of the expansion of organic farming. Their general principles of organic production require recognition of the interdependence between animals and the soil. They recommend choosing breeds of dairy cattle that are adapted to their environment and resistant to certain diseases. To promote a successful organic dairy farming sector, we need to be able to identify robust animals that meet environmental targets and are profitable to the farmer.