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Review Article

Lifetime Dairy Performance as Breeding Aim

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Abstract

If the breeding toward higher yield performance (milk or meat) is not to have a detrimental effect on fertility and vitality (fitness), then only characteristics that do not interfere with the metabolic processes of other characteristics, or which are even beneficial to each other if possible, should be included in selection. For dairy cattle, this is clearly the lifetime performance of the cow as according to her body weight.

Keywords: Breeding Goal; Lifetime Dairy Performance; Justifiable Performance Limits

Introduction

The issue of breeding separate seed stock for use in organic agriculture has been in discussion for some time, not just since the initial proposals to release genetically modified plant varieties were presented. In animal breeding however, with a few exceptions, the debate has just begun. On the one hand for economic reasons (that is, falling milk prices as a result of globalization), and on the other hand because of the rapidly rising performance levels evident in the conventional dairy industry, which have reached 10,000 kilo here in Europe and over 15,000 kilo in North America. Performance levels like these, however, are only possible through the use of an unnaturally high level of concentrated feeds, the routine usage of growth promoting hormones such as bST, and other forms of special treatment.

From an ecological point of view, ruminants occupy an important position among the different types of livestock, since they are able to make efficient use of grasses, legumes and herbs, as well as many of the waste products of crop farming. On an organic farm, legumes are invaluable as nitrogen collectors, and make excellent feedstuffs for cattle. As opposed to pigs and poultry, cattle are also able to utilize high-fiber feeds that are unsuitable for human consumption, and therefore would not be in competition with humans for food sources in times of need. Cattle, either as dairy or beef cattle, also play an important role in the maintenance of the landscape in grassland regions.

Justifiable performance breeding

From an economic point of view, performance breeding is a very effective way of saving on feed, labor and animal housing expenses. A comparison of the figures on this table makes that obvious. The information consists of the average from 14 different feeding trials and the standard energy requirements for milk production. According to this, the energy requirements per kilo of milk are reduced as performance increases, since the constant maintenance requirements are distributed over an increased number of kilograms of milk. However, as the performance continues to increase, this reduction drops. A cow with a lactation performance of 5,000 kg requires 38% less energy per kilogram of milk than a cow with 2,000 kg, since the constant maintenance requirements are distributed over a higher number of kilograms of milk. But when the lactation performance level goes up another 3,000 kg to 8,000 kg, the energy requirement per kilogram of milk is only reduced by a further 10%, as seen in the chart.

Milk performance		Energy requirement[1]		M	Energy requirement		Feed intake[2]		
Lactation	Day	Maintenance	Production	M+P	per kg m.	Reduction in %	DM	%	Conc.
kg	kg	MJ	NEL	%	MJ	NEL	kg	BW	%
2.000	6,5	37,7	20,6	65	8,9		11,4	1,8	0
3.000	9,8	37,7	31,1	55	7,0	-21	13,2	2,0	3
4.000	13,1	37,7	41,5	48	6,1	-10	14,9	2,3	9
5.000	16,4	37,7	52,0	42	5,5	-7 -38	16,3	2,5	15
6.000	19,7	37,7	62,4	38	5,1	-5	17,6	2,7	22
7.000	23,0	37,7	72,9	34	4,8	-3	18,7	2,9	29
8.000	26,2	37,7	83,1	31	4,6	-2 -10	19,7	3,0	36
9.000	29,5	37,7	93,5	28	4,4	-2	20,6	3,2	44
10.000	32,8	37,7	104,0	26	4,3	-1	21,3	3,3	51

Table 1: Performance Level, Feed Intake, Energy Savings and Concentrate Usage in Milk Production.
(1) Calculation of energy requirements in MJ NEL: Maintenance requirements for a 650 kg cow = 37.7;
Lactation requirements for 1 kg milk with 4% fat = 3.17
(eg. 6.5 kg × 3.17 → 20.6 + 37.7 → 58.3 : 6.5 → 8.9).
(2) DM = dry matter,
BW = body weight,
Conc. = concentrate

But in order to obtain a higher performance level, it is absolutely necessary to attain a higher feed intake capacity, which, given an increase in performance from 2,000 to 10,000 kg, must practically double. The cited limits of 11.4 or 21.3 kg of feed dry matter intake amount to 1.8 or 3.3% of a live weight of 650 kg, respectively. In spite of the distinctly higher "feeding performance", the percentage of concentrates increases, and the percentage of forages goes down. Just taking into consideration the amount of fossil fuel needed for the manufacture of the synthetic fertilizers necessary for high-yielding grain production, it seems obvious that the use of concentrated feeds over and above the animals' nutrient requirements makes no sense.

Almost all nutritionists and practitioners claim that cattle with a high genetic potential can only remain healthy and fertile when they are fed to capacity, which requires appropriately high doses of concentrates in addition to forages. From a long term point of view however, it makes no ecological sense to breed cattle that are unable to survive without grain, and which therefore, in times of energy shortage (i.e. grain shortage) would have to be in direct competition with humans for food. This is particularly absurd in a country like ours, with close to 60% grassland regions.

For this reason we researched the question of how much high-performance cows can produce and the effects of a feeding regimen without concentrates on fertility and longevity over a trial period of 10 years [1]. In terms of animal health (veterinary expenses), fertility (insemination index) and longevity, no significant differences were apparent between the groups with and those without concentrates, as long as forages (hay, silage and pasture) were provided in sufficient amounts and enough time was allowed for feeding. Taking into account the almost 30% higher performance of dairy breeds (Holstein Friesian and Brown Swiss) as compared to dual-purpose breeds (Simmental and European Brown Cattle), it can be assumed that the former would produce milk more economically even in times of grain shortage.

Conventional definition of breeding aim

The breeding aim determines all of the important steps in the breeding process: performance testing, estimation of breeding value and selection. Fewson's [2,3] standard definition of a breeding aim as generally recognized in market economics is as follows:

- The breeding of (vigorous) animals which, under the current production conditions, ensure the highest possible profit.
- This classic definition of the breeding aim, intended strictly to maximize profit, is found by many breeders, justifiably, to be somewhat too abstract, and needs to be more closely defined. Essl [4] has concerned himself very intensely with this question. It is interesting to note that the addition "vigorous" was not included until 1993, and that environmental aspects in the sense of an ecological and social market economy are lacking entirely. Of course, it would be quite difficult to determine "future production conditions" as opposed to current ones.
- The so-called optimal selection index can be used to estimate the total breeding value of an animal according to the breeding aims. However, in order to use the optimal selection index correctly, reliable information about the economical importance and genetic soundness of all of the chosen traits must be available, which can sometimes lead to considerable difficulties in practical application [4].

Natural breeding principles

- Domestic animals are descended from wild ancestors, which evolved over a period of millions of years through a strict process of natural selection. Every organism is characterized by countless metabolic processes, finely tuned to each other and regulated by a system of circuits involving the body's own enzymes and hormones in combination with influences in the organism's environment. The outwardly visible characteristics of an animal, such as physical appearance, performance and behavioral traits, can therefore be considered to be a reflection of its genetic background as well as prevalent environmental conditions. The various metabolic processes that take place in a healthy organism do not occur randomly, but according to a strictly ordered system known as a hierarchy, dependent on time and space, and predetermined by the organism's genetic structure. Therefore it is impossible to change any important, highly ranked trait without affecting other characteristics at the same time. The following basic principles of breeding can be inferred from this conclusion.
- Growth is a central life process and is very highly ranked in the hierarchy of bodily functions. If one attempts to change the natural growth rhythms or bodily proportions through breeding, other important capacities will be indirectly affected as well. In the 30s, most European cattle breeds were bred to be small in size, the so-called economical type. Today's tendency to breed with an emphasis towards large size (elephant type) is just as mistaken as it was to breed for smaller animals (chubby or plump type). It generally makes no sense to try to affect body size through breeding, since it will adjust itself according to production capacity, and because a certain variation is perfectly natural.
- Inherent contradictions make it impossible to combine high milk yield with outstanding meat production in fertile and long-lived cows (as in dual-purpose dairy or beef breeds). A few show cows, chosen from among thousands, are not sufficient proof of the possibility of this venture, but should be viewed as exceptions from the rule. The scientific foundation for this conclusion has been presented in many publications [5-7]. This idea has been around for a long time, because a textbook for cattle breeding published in 1852 states, "Cattle breeders have not yet been successful in combining high milk production with meat yield: The more milk, the less meat" [8]. However, a comprehensive American/Scandinavian study [9] has recently confirmed that systematic selection away from meat yield in order to achieve a dairy type is not recommendable either.
- In the early 1900s the milk from most European cattle breeds had a fat content between 2.5 and 3.5 percent. The Dutch were the first cattle breeders to select for fat content. In 1981, the average milk fat content of all Holstein cows in the Netherlands was 4.1 percent. In comparison, the 17 living cows with a lifetime performance of more than 100,000 kg of milk yielded an average of only 3.8 percent milk fat. Those cows in the US Holstein Friesian herdbook which are of pure Dutch descent have been selected for milk yield rather than for fat content. From 1950 to 1980 the milk fat content was stable between 3.6 and 3.7 percent, although in the same period the fat quantity increased from 190 kg to 300 kg per lactation. This same population also has the most animals with a superior lifetime production. "Breeding for fat content of the milk leads to disturbances in metabolism implying higher health cost, a lower lifetime production and therefore economic disadvantages in milk production" [10]. Similar things may be said about selection for milk protein content and the ratio of fat to protein.
- If fitness (fertility and vitality) is therefore not to suffer un-

der performance breeding, then the breeding goal may only include traits that do not interfere with the metabolic processes of other characteristics, or those which are even beneficial to each other if possible. The difficult job of creating a long-term balance between many different characteristics for the selective decision is best solved "naturally" by choosing according to the "total breeding value", which combines the most essential vital characteristics in such a manner that descendants will be above average in longevity and production – this is known as lifetime performance [11,12].

- Aside from the efficient use of forages, longevity is of key importance in the economy of dairy farming. Zeddies was able to prove in 1972 that the total economic value of a dairy cow does not reach its limit when the animal is at its peak performance level (about the fourth or fifth lactation) but continues to increase up to the ninth lactation. Besides which, a larger number of offspring makes it possible to be much more precise in selection, which is obviously desirable. Based on detailed research of economic and genetic factors, Essl (1982) recommends waiting to make a final selective decision until after the third lactation [13,14].

Results of lifetime performance breeding

Given 30 years of consistent breeding toward a high lifetime performance, the occurrence of cows with a lifetime performance of more than 50,000 kg milk yield could be increased significantly. The percentage of living cows with a lifetime performance of over 50,000 kg milk yield in the Styrian province is 3.7% for Simmental, 7.1% for Brown cattle, and 7.2% for Holsteins, over an average of 5 years. In our own line breeding program (4 farms with approximately 110 cows), the percentage is 12.4%.

4 farms were originally involved in the line breeding project [11]. After 25 years of breeding for high lifetime performance, only 1.75% of the Holstein cows in Bavaria subject to lactation controls were on these farms. However, of all cows with a lifetime performance of over 50,000 kg milk yield, 27% belonged to the lifetime performance breeding project, that's 15 times the statistical expectation. These results are then sufficient proof that breeding for a high lifetime performance can be successful, if one is really prepared to act accordingly and not just talk about it.

Conclusions

The most important function of agricultural domestic animals in the industrial age is their ability to convert feeds into human food. In the long term however, something can only be economically (financially) feasible if it is also ecologically acceptable (natural). This also applies to the breeding of dairy cows, whose economic value depends to a great degree on performance level and longevity. For a farm run on an ecological basis, then, an acceptable annual performance level, based on the feed situation and the breed would be about 5,000 to 7,000 kg (maybe 8,000 kg someday) for fully-grown animals.

Although responsible breeding requires us to think in generations, we should do our best to encourage agricultural animal breeding to work with nature instead of against it. This is particularly true in light of modern breeding techniques, such as embryo transfer, cloning, gene transfers and so on. Given our unfortunate experiences with atomic technology, we should know by now that this is not an area that should be left entirely up to scientists to do as they please, but must instead be decided by a democratic majority after thorough discussion.

A fundamental change, however, will only then be possible when the politicians start paying more attention to the ecologists than to the economists (politics that are constructive as opposed to compromising), when researchers orient themselves and their work on the laws of nature instead of those of the free market (paradigm shift), when agricultural engineers go back to being farmers (increase of humus), and when consumers (that means all of us) are prepared to use their purchasing and voting power to apply the necessary pressure (= ethics in practice).

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