Assessment of Site-related Breeding of Dairy Cattle on Organic Farms in a Swiss Mountain Region

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Abstract

On organic farms animals (in particular ruminants) should be nourished from farm own forage. Ruminants on organic farms in Switzerland have to feed on 90% roughage. It is essential that ruminants fit well to forage growing on their organic farm. Therefore organic dairy cow breeding has to be site-related. In 2006 *FiBL* developed an estimation tool for site-related dairy cow breeding for farmers and consultants (Spengler Neff *et al.*, 2007). In 2008 the tool was amended by livestock consultants of the agricultural school *LBBZ Plantahof*. From 2008 to 2010 *FiBL*, *LBBZ Plantahof* and the organic farmers' organization "*Bio Grischun*" carried out a corporate research- and consulting project on 99 organic dairy farms. It was investigated whether animal demands (resulting from their production level) fit well to feed supply on their organic farm. Additionally the relation between animal health and site-relatedness was examined. Each farm was visited by one consultant. Farmers and consultants examined together feed stocks, livestock, and the barn. They used all available animal data to fill in the questionnaires of the estimation tool. This tool estimated the relation between farm conditions and animal demands calculating a "site-relatedness-score". If site-relatedness was assessed deficient, farmers got advice on how to ameliorate the situation.

Results: Site-relatedness was assessed as good on 50% of the 99 farms. 12 % of the farms did not exploit their potential. On 38% of the farms site-relatedness was not sufficient: animal demands were higher than farm potential. Consultants proposed several measures to improve the situation on those farms: better feed harvesting and stocking and optimized feeding and breeding management. On farms with a good estimation for site-relatedness longevity was better and less veterinary treatments were necessary. Calving interval was lower in herds with higher body condition scores.

Introduction

In Swiss mountain regions dairy cow breeding and milk production are most important branches. Many organic farms in Switzerland are located in mountain regions. In the Grisons (a canton in the Swiss alpine region) 56% of all farms are organic; around 15% or 500 farms are organic dairy farms. They keep around 8'700 dairy cows (Rudmann *et al.*, 2005; BFS, 2007). After conversion most farms went on breeding their often high yielding *Brown Swiss* cow type, called *Braunvieh*. But they were no more allowed to feed more than 10% concentrates (*Bio Suisse* rules) or to buy any conventional components (Swiss and EU organic rules). Therefore farm own feed and feed production conditions were suddenly playing a greater role than before conversion. Organic farms in mountain areas often experience limited conditions for feed production. If they are keeping high producing animals anyway, risks of undersupply and animal diseases are increasing.

Therefore site-related dairy cow breeding is important on organic farms: Daily milk yield should never exceed the milk production potential of farm own feed (+10% concentrates). The organic farmers' organization in the Grisons, *Bio Grischun*, wanted to know about the situation on organic farms in their canton and to improve it, if necessary. Therefore *Bio Grischun* and the agricultural school of the Grisons, *LBBZ Plantahof* as well as *FiBL* started this corporate project. The aim of the project was to examine 100 organic dairy farms in the Grisons for their site-relatedness and to provide advice concerning feed production and site-related breeding, if necessary. Additionally the hypothesis that site-related breeding is correlated to animal health had to be proven.

Material and methods

99 organic farms participated voluntarily in the project. Three consultants from *LBBZ Plantahof* and one consultant from *FiBL* visited the farms during winter seasons between January 2008 and May 2009. Each farm was visited once by one consultant. Farms were assessed with the "*FiBL-estimation-tool for site-related breeding"* (on www.biorindviehzucht.ch: free download in German and French). It consists of two questionnaires (*excel*-sheets) and a report. The first questionnaire covers all important farm factors influencing the environment of dairy cows (table1). The second one covers overall herd data influencing the demands of cows (table 2). For each answer scores from 1 to 4 are given. Answers applying best to the farm and to the animals had to be ticked. After both questionnaires were filled in the program calculated an overall farm score and an overall herd score, expressing the ratios of the possible maximum scores, respectively. In addition it calculated a site-relatedness-score expressing the difference between the overall farm score and the overall herd score. If the herd score exceeded the farm score by more than five points (difference was <-5), animals' demands were assessed to be too high for the possibilities of the farm and breeding was interpreted as not site-related. If the farm score exceeded the herd score by more than four points (difference was ≥+5) points, the potential of the farm was interpreted as not exploited.

Farmers and consultants examined together feed stocks, livestock, and the barn. Additionally they used herd and animal based data from the breeding companies to fill in the questionnaires. They filled them in together, discussing each point. If site-relatedness was found to be deficient, farmers and consultants searched for solutions, checking farm factors with the lowest points first. Breeding strategies were always discussed as well. The consultants wrote a report with the conclusions of the discussions for the farmers.

Table 1: Farm factors and categories in the questionnaire

farm factors	**units / categories**
agricultural surface	ha
livestock units dairy cows and other roughage feeding animals	LU
dairy cow livestock units on all roughage feeding livestock units	% =LU dairy cows / (LU dairy cows + LU other roughage feeding animals)
feed purchase	none; ≥ 5% of yearly ration; ≥ 10%; ≥ 15%
cadastral zone	mountain zone II-IV; mountain zone I; hill zone; valley zone
frequency of use of main forage area	1 to 2; 2 to 3; 3 to 4; > 4
precipitation per year	>2100mm; 1800-2100mm; 1400-1790mm; 1000-1390mm; 700-990mm; <700mm; <700mm+irrigation <30%; <700mm+irrigation ≥30%; <700mm+irrigation 100%
percentage of ley in crop rotation	0-9%; 10-39%; 40-79%; 80-100%
hay conservation	ground drying; ground drying and ventilation; 100% ventilation; hot air ventilation
protein based roughage (winter)	≤10%; >10% medium-quality; 10-40% high-quality; >40% high-quality
energy based roughage	none; partly / little; in winter; all year
feeding Management	all cows alike (roughage); dry cows separate; concentrate individually; roughage and concentrate individually
concentrate per cow and year	none; <150 kg; 151-400 kg; >400 kg
housing	dark and narrow spacing; light and narrow spacing; dark and partially generous spacing; light and partially generous spacing; light and generous spacing
spring and autumn grazing system	continuous grazing 100%; continuous grazing 50-75%; continuous grazing 25%; rotational grazing 100%; rotational grazing 50-75%;; rotational grazing 25%; strip grazing 100%; strip grazing 50-75%
summer grazing system	continuous grazing 100%; continuous grazing 50-75%; continuous grazing 25%; rotational grazing 100%; rotational grazing 50-75%;; rotational grazing 25%; strip grazing 100%; strip grazing 50-75%
labor units per 25 lifestock units	<0.7 or frequent changes; 0.7-1.0; 0.7-1.0 and great interest in cows; 1.1 - 1.5; 1.1-1.5 and great interest in cows; 1.6 – 2.0
Interest in dairy cow breeding	not much interested; interested; very interested; dairy breeding is most important
feed purchase	none; 5%; 10%; 15%; 20% (on dairy cow forage for one year)

Table 2: Herd factors and categories in the questionnaire

herd factors (averages)	units / categories
height at withers	< 135 cm; 135-140 cm;140-145 cm; >145 cm
weight	≤ 500 kg; 501-600 kg; 601-700 kg; >700 kg
feet and legs	big-boned; rather big-boned, rather fine-boned; fine-boned
muscling	heavy; rather heavy, rather light; light
temperament	calm; rather calm, rather spirited; excitable
milk yield per year	kg (from breeding company database)
milk per day	kg (from breeding company database)
milk per kg live weight	<8.5 kg; 8.5-9.5 kg; 9.6-10.5 kg; >10.5 kg (calculated by consutant)
mean BCS of all lactating cows	>3.0; 3.0; 2.75; ≤ 2.5 (assessed by consultant)
age at first calving	>34 months; 30-34 months; 25-29 months; <25 months
original brown cattle (OB) blood	% (farmers' declarations)

Data from all participating farms were analyzed to explore effects on health and reproduction indicators. Multivariate linear regression models with stepwise backwards selection were calculated. To reduce the great number of assessed variables, independent variables strongly correlating with $r_s>0.6$ or overlapping with regards to meaning were not simultaneously included in one model. Explanatory variables univariably associated with $p<0.2$ with the dependent variable were included into models as described by Dohoo et al. (1996). Dependent variables were: Calving interval (months); Somatic Cell Count (SCC; % of all samples of one year <150'000); longevity (average lactation number of the herd); veterinary treatments (average number of treatments per cow per year). Factors were checked for normal distribution by "Q-Q-plots" and, if necessary, were transformed. Statistical analyses were calculated with SPSS 20.

Results

50% of the 99 farms were estimated as site-related. 12% of the farms did not exploit their potential. On 38% of the farms herd demands exceeded the potential of the farm: the site-relatedness-score was lower than -5. The consultants gave the farmers individual advices. For 46 farms advices concerning feeding management were given, aiming at portioning farm own feed well targeted, referring to animals' production. For 12 farms they recommended more energy feed during the first months of lactation, for 44 farms they suggested not to increase milk production per cow anymore, but rather increase blood of the *Original Brown (OB)* breed in the herd. For 8 farms they recommended to increase milk production, for 18 farms they suggested a better choice of sires, considering functional traits.

Analyses of farm data showed that animal health parameters can be partly explained by the site-relatedness-score (table 3).

Table 3: Final regression models of influences on calving interval, veterinary treatments, and longevity

dependent variables	explanatory variables	standardized coefficient	p-value	adjusted R^2	F	p-value of the model
Calving interval				**0.067**	**6.611**	**<0.05**
	BCS	-0.281	<0.05			
Veterinary treatments (log10)				**0.257**	**7.824**	**<0.001**
	agricultural surface	-0.212	<0.05			
	precipitation	0.301	<0.01			
	housing	-0.304	<0.01			
	site-relatedness-score	-0.186	<0.1			
Longevity				**0.198**	**10.649**	**<0.001**
	frequency of use of main fodder area	-0.356	<0.01			
	site-relatedness-score	0.317	<0.01			

Higher calving intervals were influenced by lower body condition scores (BCS). BCS was highly and positively correlated to the site relatedness-score (r_s= 0.613; p<0.001). High amounts of veterinary treatments were influenced by small agricultural surface, high precipitation, narrow housing, and by trend by a low site-relatedness-score; high longevity (high number of lactations) was influenced by low frequency of use of main fodder area and a high site-relatedness-score. For udder health no model could be calculated.

Discussion

This study showed that it is interesting and necessary to assess site-relatedness of breeding on organic dairy farms. Animals on farms with a good balance between farm conditions and animal demands, showing a high site-relatedness-score were healthier than animals on farms with a low site-relatedness-score. Especially in mountain areas it is important to take account of those facts, since conditions for feed production are limited compared to valley regions. Ameliorations can be achieved by adjustments of the cow type, for example by breeding for robustness and dual-purpose instead of focusing on milk production. Possible adjustments of the environment are improvements of feed quality, feed stocking, and a targeted roughage feeding management, taking account of individual yields. Since changing the environment is often difficult, farmers, breeders, and farm advisors are advised to breed animals in a site-related way: using BCS, persistency and feeding behavior on the female side as traits to select good roughage feeders and high breeding values in functional traits as selection criteria for sires. Dams' and sires' breeding values for milk production have to fit to the milk production potential of farm own feed.

No economic analyses were carried out in this project, but another recent Swiss study showed that roughage based feeding of dairy cows lead to lower milk production, but also to lower veterinary costs and lower costs for buildings, man power, and mechanization leading to better incomes compared to high yielding dairy systems (Gazzarin *et al*., 2011).

For farmers and consultants the use of the estimation tool is a good opportunity to think and talk about breeding strategies. It is recommended to develop similar estimation tools in other countries.

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