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Comparison of two different dairy cow types in an organic, low input milk production system under Alpine conditions

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Abstract

The core task of sustainable milk production is the conversion of forage into milk, dairy products and, as a by-product, into meat. In Europe and North America, for decades dairy cows were selected for a high genetic merit for milk production under high input farming conditions. It is therefore questionable whether these "high input genotypes" are suitable for forage-based, organic farming systems. The objective of this study was to compare two cow types concerning their suitability for an Alpine organic, low input dairy production system. The cow types used were conventional Brown Swiss (BS) on the one hand and a specific strain of Holstein Friesian (HFL), selected for lifetime performance, on the other. Both cow types were managed within one herd in an organic, pasture-based system with seasonal calving. Data from 89 lactations showed that BS animals were heavier and superior in milk production. HFL cows lost less body weight during lactation and showed a higher reproductive performance, which may indicate a greater suitability for low-input dairy production systems.

Introduction

Alpine dairy farming suffered severe changes during the last fifty years from traditional, small scale, forage based dairying towards larger and more specialised non seasonal dairy systems with strongly reduced pasture reliance and a marked increase of concentrate supplementation. To reduce costs of production and to meet consumers´ expectations, the implementation of a seasonal, site adapted, pasture based milk production system similar to those applied in New Zealand and North Western Europe might be an alternative for the near future in Alpine regions also (Thomet et al. 2011; Steinwidder et al. 2011). It is questionable whether animals selected under high-input conditions are most suitable for low input systems, in which fertility and reproductive performance rather than individual milk yield are of key importance (Veerkamp et al. 2002; Dillon et al. 2003). Therefore the objective of this study was to compare two cow types concerning their suitability for an Alpine organic, low input dairy production system.

Material and methodology

Data was recorded during a four year period from 2008 to 2011 at the organic dairy farm of the Agricultural Research and Education Centre Raumberg-Gumpenstein, Trautenfels, Austria (680 m altitude, 7°C average temperature, 2000 mm precipitation year^{-1}; latitude: 47° 31‘ 03‘‘ N; longitude:

14° 04‘ 26‘‘). The dairy herd was managed in a pasture based, low input system with block calving and consisted of conventional Brown Swiss (BS) and a specific strain of Holstein Friesian (HFL). While the BS cows represented the average breeding goal of the Austrian BS population, the HFL animals were selected for superior lifetime performance and fertility for more than 30 years. In total, data from 89 lactations were collected (40 lactations from 19 individual BS and 49 lactations from 23 individual HFL cows). Average lactation numbers were 3.3, 3.0, 2.3 and 2.6 in experimental years one, two, three and four, respectively. For BS and HFL mean numbers of parities were 2.5 and 2.9, respectively. Calvings were aspired between November and March and breeding started after 30 days in milk (DIM). Animals which did not conceive until June 30 were culled after 305 DIM or were newly inseminated after January 15 of the following year. Mean calving date was balanced between years and breeds. Individual rations were calculated throughout the experimental period, taking into account individual milk yield, milk composition and body weight. Detailed ration composition during dry period and lactation, as well as during barn and pasture feeding period was reported previously by Steinwidder et al. (2011). During the barn feeding period, the diet consisted of 5 kg of hay and grass silage ad libitum. Concentrate supplementation was increased until 21 DIM and depended on milk yield afterwards. Grazing period lasted from the beginning of April until the end of October (± 15 d). Cows had free access to a continuously grazed sward (height Ø 4.0-5.5 cm, estimated with Filip´s Folding Plate Pasture Meter). Pasture yield and botanical composition has been reported previously by Starz et al. (2010). At the beginning of grazing, a gradual transition from barn to pasture feeding was done. At the beginning of day and night grazing (end of April), silage feeding in the barn was stopped. During the grazing period cows received 1.5 kg hay per day and only cows yielding more than 28 kg per day received concentrate supplementation. At the end of October daily grazing time was constantly reduced and the grazing period was terminated at the beginning of November. In parallel, the quantity of hay and grass silage offered in the barn was increased. Individual milk yield was recorded twice daily. Milk samples were taken three times per week for determination of milk fat, protein, lactose and urea content as well as somatic cell count. Cows were weighted weekly after morning milking. Rations were provided in Calan gates and daily feed intake was recorded during the barn period. During the grazing period, herbage intake was estimated taking into account hay and concentrate intake, milk yield and composition, live weight and live weight change. The dataset was analysed using the MIXED procedure of SAS 9.2. The model contained breed, year, parity and barn feeding regime within year as fixed effects and days in milk at the beginning of the grazing period as a covariate. Animal within breed was included as a random effect. P-Values <0.05 were considered to be significant.

Results

Table 1 shows the least square means and the effect of dairy cow breed on milk production and composition, life weight and reproductive performance over the four experimental years. Lactation length for BS cows was significantly longer than for HFL animals (294 and 285 days, respectively). In terms of milk production, BS was superior. It produced significantly more milk, milk solids and energy corrected milk. Comparing milk yield and energy corrected milk yield differences between breeds tended to increase as HFL had lower contents of fat and protein than BS, but only the difference in protein content was statistically significant. No difference between the two breeds was found for somatic cell count and persistency. Body weight of HFL cows was about 60 kg significantly lower than that of BS. Comparing the breeds in terms of live weight development during lactation BS animals reached nadir about 50 days later than HFL animals. Conversely, HFL animals started to regain live weight significantly earlier than BS cows. Moreover, HFL animals lost significantly less weight (18 %), comparing pre calving measurements and live weight at nadir, than BS cows (23 %). HFL animals were superior for compared parameters of reproductive performance. Interval from calving to conception was about one month shorter for HFL, but not statistically significant. Calving intervals were 395 and 353 days for BS and HFL, respectively, the difference being statistically significant.

Table 1. Effect of breed on milk production and composition, life weight and reproductive performance 2008 - 2011

	Breed		SED[c]	P value
	BS[a]	HFL[b]		
Lactation length, d	294	285	16	0.029
Milk yield, kg	6,082	5,490	476	0.020
ECM[d] yield, kg	5,764	5,040	419	0.001
Fat and protein yield, kg	438	378	31	<.001
Fat content, %	3.99	3.86	0.14	0.110
Protein content, %	3.24	3.05	0.08	<.001
Somatic cell count, n	125,970	126,160	108	0.733
Persistency[e]	0.78	0.75	0.06	0.148
Average LW[f], kg	599	536	15	<.001
Day of LW[f] nadir, days in milk	178	126	64	0.002
LW[f] change from calving to nadir, %	23	18	5	0.013
Calving to conception, d	124	93	76	0.226
Calving interval, d	395	353	43	0.002

[a] Brown Swiss, [b] Holstein Friesian Longevity, [c] Standard error of difference, [d] Energy corrected milk
[e] Ratio of milk yield of 101-200 days in milk and milk yield of 1-100 days in milk, [f] Live weight

Discussion

The results illustrate the impact of the alternative breeding objectives of HFL as compared to BS and the trade off between breeding for high milk production and selection for high longevity. BS cows achieved higher milk yields, but mobilised more body reserves over a longer period of time as compared to HFL cows. This indicates that HFL animals went through a less pronounced period of negative net energy balance, which lasted not as long as for BS. Dillon et al. (2003) and Roche et al. (2007) stated the positive effect of a lower degree and shorter duration of body tissue mobilisation on reproductive performance. Animals with high genetic merits for fertility tend to partition nutrients towards reproduction and not milk production (Cummins et al. 2012). Comparing both breeds, HFL seems to be more suitable for a pasture-based dairy system, particularly if block calving is involved. It meets the goal of high reproductive performance and therefore ensures an optimal use of pasture, which is a key factor for sustainable, low-input dairying. Taking into account the topographic conditions in the Alps, the lower live weight of HFL can also be an additional advantage.

Suggestions to tackle the future challenges of organic animal husbandry

Seasonal, pasture based systems of milk production will be of crucial importance in the future of (organic) dairy farming. If managed adequately, these systems guarantee a highly efficient and environmentally friendly conversion of forage into milk, low use of concentrate supplementation, high standards of animal welfare and elevated consumers' acceptance. To achieve this aim, dairy cow breeding needs to be adapted towards an increased importance of fertility and other fitness traits, resulting in animals which are more suitable for organic, low-input systems.

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