Comparison of Swiss breeds with New Zealand Holstein-Friesian in pasture-based, seasonal-calving systems

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Abstact

The objective of the study was to compare, within pasture-based seasonal calving systems, the production and reproduction performances of Swiss Holstein-Friesian (CH HF), Fleckvieh (CH FV) and Brown Swiss (CH BS) dairy cows with New Zealand Holstein-Friesian (NZ HF) dairy cows, taken as reference for such systems. NZ HF cows were paired with Swiss cows on 15 Swiss farms. Over 3 years, 259 lactations were analysed. The two Holstein-Friesian strains had the highest milk efficiency (52.1 and 50.2 kg ECM per kg liveweight$^{0.75}$ *vs.* 44.3 and 43.6 kg for CH FV and CH BS; $P < 0.05$). The CH FV cows had the best reproductive performance, with more pregnant cows within 6 weeks of breeding (81% *vs.* 66, 63 and 46% for NZ HF, CH BS and CH HF; $P < 0.10$). Although CH HF cows are efficient milk producers, their poor reproductive performance compromised their suitability for pasture-based seasonal-calving systems. Conversely, CH FV seems promising for such systems owing to good reproductive performance.

Keywords: pasture, seasonal calving, dairy breeds, milk production, reproduction

Introduction

In Switzerland, nearly 60% of agricultural land is permanent pasture and the implementation of systems and cow genetics capable of optimal utilization of the natural resources is a priority. The full-pasture, seasonal-calving milk production system was introduced in Switzerland in the early 2000s. In such systems, cows must calve each year at the same fixed period to match herd feed demand curve and the pasture growth curve. Thus, cows with high fertility are necessary in order to maintain the calving pattern and we investigated if the main Swiss breeds are adapted to those systems. The present experiment aimed to compare, within pasture-based seasonal-calving systems, the productive and reproductive performance of Swiss Holstein (CH HF), Swiss Fleckvieh (CH FV) and Swiss Brown Swiss (CH BS) cows with New Zealand Holstein-Friesian (NZ HF) cows, taken as reference owing to their high milk production efficiency and fertility.

Materials and methods

The present study was carried out on 14, 13 and 10 dairy farms in years 2007, 2008 and 2009 respectively, involving 259 lactations of 134 cows in the four breeds NZ HF (n = 131 lactations, 58 cows), CH HF (40, 24), CH FV (crosses between Simmental and Red Holstein; 43, 27), and CH BS (45, 25). Experimental cows were representative of their population of origin (based on pedigree breeding worth). On each farm, each NZ HF cow was paired with a Swiss

breed cow according to calving date and age. Management policies were similar between herds (low-input, pasture-based, spring-calving system).
Milk volume and composition, as well as body condition score (BCS, 1-5 scale with 0.25 increment) were assessed monthly. The lactation body weight was averaged over three values (at 38, 124 and 281 post-partum) and used to calculate milk production efficiency (milk yield per metabolic body weight). Continuous and binomial variables were analysed by linear mixed models and mixed logistic regressions respectively, including breed as fixed effect, year, farm within year and cow as random effects (R statistical software). Multiple testing biases were accounted for.

Results

There were significant differences between breeds for all the production parameters (Table 1). The CH FV achieved a higher submission rate in the first three weeks of the breeding season than the NZ HF (86 *vs.* 53%, $P < 0.01$); CH BS and CH HF were intermediate (58 and 70%). These CH FV also had a higher 1st and 2nd service conception rate than CH HF (89 *vs.* 59%, $P < 0.05$); NZ HF and CH BS were intermediate (76 and 72%). Consequently, CH FV became pregnant earlier than other breeds (Figure 1).

Table 1. Milk production, bodyweight and body condition of New Zealand Holstein Friesian (NZ HF; n = 131 lactations), Swiss Holstein (CH HF; n = 40), Swiss Fleckvieh (CH FV; n = 43) and Swiss Brown Swiss (CH BS; n = 45) dairy cows managed in seasonal-calving pasture-based systems.

Item	n	NZ HF	CH HF	CH FV	CH BS	P_{breed}
Milk production over 270 days						
Milk yield (kg)	259	5321^{b}	5921^{c}	5291^{ab}	4927^{a}	< 0.001
ECM yield 1 (kg)	259	5531^{b}	5840^{b}	5363^{b}	4814^{a}	< 0.001
Fat content (%)	259	4.25^{c}	4.01^{ab}	4.15^{bc}	3.86^{a}	< 0.001
Protein content (%)	259	3.46^{b}	3.20^{a}	3.31^{a}	3.27^{a}	< 0.001
ECM persistency[3]	259	0.79^{b}	0.74^{a}	0.76^{ab}	0.72^{a}	< 0.001
ECM efficiency[2] (kg. kg$^{-0.75}$)	221	52.1^{b}	50.2^{b}	44.5^{a}	43.8^{a}	< 0.001
Average body weight	221	514^{a}	592^{b}	605^{b}	523^{a}	< 0.001
Body condition (1 to 5)						
BCS at calving	251	3.25^{b}	3.05^{a}	3.52^{c}	3.38^{bc}	< 0.001
BC change from calving to 30 days	249	-0.28	-0.37	-0.24	-0.24	0.129
BC change from calving to 100 days	247	-0.40	-0.50	-0.39	-0.45	0.415
Maximum BC loss in 300 days	242	-0.55	-0.65	-0.64	-0.61	0.230

[1] Energy corrected milk (4.0% fat, 3.2% protein and 4.8% lactose content)
[2] Energy corrected milk per average lactation metabolic weight, i.e. per (average lactation BW)$^{0.75}$
[3] Thirty-eight lactations with missing weights were excluded from the analysis
Ratio of ECM yield of the days 101 to 200 to the ECM yield of the days 1 to 100
[a, b, c] values with different superscript letters are significantly different ($P < 0.05$)

The differences in production outcomes observed between NZ HF and CH HF were within the range of differences reported for Holstein-Friesian (HF) strain comparison studies in low-input pasture-based systems (Horan *et al*., 2005; Macdonald *et al*., 2008). With regard to the produced ECM yield per metabolic weight, the two HF strains were the most efficient milk producers (+14% in comparison with CH FV and CH BS). A lower milk efficiency was expected for the CH FV cows, which are dual-purpose cows, but not for the dairy-type CH BS cows. High milk production efficiency was not reached in the same way by the two HF strains, CH HF having lower fat and protein content than NZ HF, but also a lower milk persistency,

indicating a sharper lactation curve. Part of the CH HF efficiency could be attributed to body fat mobilization. Indeed, although BCS change over the first 100 days of lactation did not significantly differ, daily weighing on one farm revealed a greater body weight loss for CH HF cows (-32 *vs.* -9 kg 30 days post-partum for CH HF *vs.* NZ HF, P<0.01) and metabolites measurements performed in 2008 revealed higher non-esterified fatty acids and β-hydroxybutyrate concentrations for the CH HF cows.

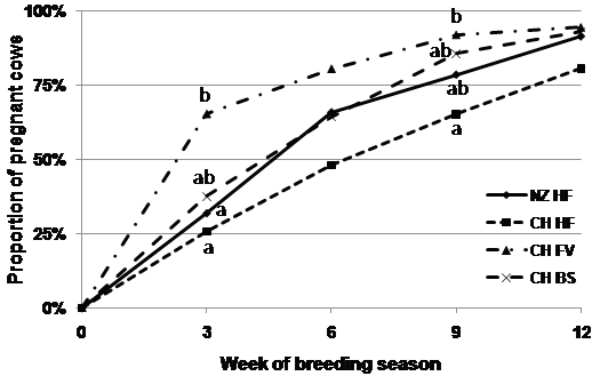

Figure 1. Proportion of pregnant cows within 3, 6, 9 and 12 weeks of the breeding season for New Zealand Holstein Friesian (NZ HF; n = 131 lactations), Swiss Holstein (CH HF; n = 40), Swiss Fleckvieh (CH FV; n = 43) and Swiss Brown Swiss (CH BS; n=45) dairy cows managed in seasonal-calving pasture-based systems.

Discussion

Only the CH FV achieved the New Zealand objectives for reproductive performance, with 65% of the cows being pregnant within three weeks of the breeding period. This excellent result could be explained by an early onset of regular ovarian activity (as suggested by progesterone profiles performed in 2008), a very good submission rate, suggesting good oestrus expression, and very good fertility. In NZ HF cows, a delayed onset of cyclicity, as suggested by progesterone profiles in 2008 (commencement of luteal activity 51 *vs.* 29 days post-partum for NZ HF *vs.* CH FV, $P < 0.01$) and by other studies (Macdonald *et al*., 2008), could explain the poor submission rate; but thanks to good fertility they could catch up later in the breeding season. Poor submission rate and fertility explained the insufficient pregnancy rates for CH HF cows.

Conclusions

Although CH HF cows are efficient milk producers even in low-input systems, their poor reproductive performance compromised their suitability for pasture-based, seasonal-calving systems. Conversely, although CH FV cows are less milk production oriented, this breed seems promising for such systems in Switzerland owing to good reproductive performance.

References

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