OWC 2020 Paper Submission - Science Forum

Topic 1 - Ecologial approaches to systems' health

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PERFORMANCE AND HEALTH OF HOLSTEIN AND MONTBÉLIARDE DAIRY COWS IN ORGANIC SYSTEMS

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Abstract: The aim of this study was to compare the performance of Holstein and Montbeliarde dairy cows in a mixed crop dairy system and in a more restricted one, a 100% grazing system and. The total dataset contained data from 970 lactations of cows living in an experimental farm (Mirecourt, France) from 2004 to 2015. Over 44 weeks of lactation, Holstein cows produced more milk (+ 531 kg) and fat and proteins (+ 46 kg) than Montbeliarde cows, which represents a higher milk yield per body weight (+1.04 kg / kg of body weight). However, Holstein cows had poorer reproduction performances mainly in the grazing system (- 25 % of gestation rate) and they decreased to a larger extent their body weight and condition in early lactation. Holstein cows had more reproductive disorders, but Montbeliarde cows faced more lameness. On the whole, cows had more health disorders in the grazing system. Longevity between the two breed was not different because of the choice to keep more frequently Holstein cows in a prolonged lactation. Four profiles of cows were identified in terms of lactation, reproduction, body condition and health, but this classification couldn't be predicted by their breed, their parity or their feeding constrains.

Introduction: The choice of the type of dairy cows and their ability to adapt in terms of production, reproduction and health is a preoccupation of the organic dairy farmers. This question is particularly relevant in systems where the feed resources are limited and cannot meet the requirements of animals with high genetic potential. The objective of this study was to compare the performance of cows of Holstein (Ho) and Montbeliarde (Mo) breeds in two low input dairy systems.

Material and methods: Two different farming systems were compared for 11 years on the INRA organic experimental farm of Mirecourt (Coquil et al., 2011). The grassland system (GS) was based exclusively on the use of permanent grassland (80 ha) for milk production. In this GS system, 40 Mo and Ho cows calved from January to April when they were fed with hay alone, and then spent 8 months on pasture. The mixed crop and dairy system (MCDS) was based on 55 ha of permanent grassland and 105 ha of crops allowing a high self-sufficiency in roughage, grains and straw for animals. In this MCDS system, 60 Mo and Ho cows calved from August to January. During an indoor period of 5 months, the cows were fed with hay and a mixture of cereals and legumes.

The total dataset contained data from 970 lactations from 2004 to 2015; it was used for the description of health disorders. Due to culling before 305 days in milk, 788 lactations only were used to study the milk performance (milk yield and milk

composition), changes in body condition score and reproduction performance (conception rate). Longevity analyses were performed on lactations from 380 primiparous and 227 cows in parity 2. Milk production data were analysed using a linear model with year, breed, system, parity, and their interactions as explanatory variables. The qualitative variables related to reproductive and health events were analysed by logistic regression with the explanatory variables used previously. Another statistical approach was implemented in order to characterise the global robustness of the cows in these organic low inputs systems whatever the breed (Ollion et al., 2016). To do so, a principal component analysis followed by an agglomerative Hierarchical Clustering were performed with the main indicators of milk performance, body condition score, reproductive performance and health (see table 2) from 891 lactations.

Results: The effects of the breed and the production system on cow performance are displayed on table 1. Over 44 weeks of lactation, Ho cows produced more milk (+ 797 kg) and fat & protein (+ 46 kg) than Mo cows. This difference between breeds was higher in the MCDS (+1000 kg) than in the GS (+590 kg). This significant interaction between the breed and the farming system, with the MCDS providing better feeding conditions to the cows, reflects the greater milk responsiveness of Ho cows to improved nutrient ressources (Delaby and Fiorelli, 2014). Ho cows also had a higher production per kg of live weight (+ 1.04 kg/kg) especially in the MCDS. On the other hand, the reproductive performance of Ho cows was poor, especially in the GS (-12 points of percentage of the conception rate and +8 days of interval between calvings) which may be due to a lower minimum body condition score (1.45 versus 1.72 for Mo) and higher reproductive disorders at the beginning of lactation (22.8% versus 11.6% for Mo). In the GS, cows, whatever the breed, had less clinical mastitis but much more lameness that cows in the MCDS. The longevity of both breeds was not different. However, in order to keep the target of 25% of culling rate and the number of lactating cows each year, 15% of the cows were kept in the herd had a prolonged lactation (lasting more than 600 days). This proportion was higher for the Ho cows compared to Mo cows (23% versus 7%) and in GS compared to MCDS (21% versus 11%).

The profiles of cows identified in terms of lactation, reproduction, body condition and health are displayed on table 2. Profile 1 was composed of 294 lactations from cows that had maintain their body condition score and succeeded to be bred (98% of pregnancy rate) thanks to a moderate milk production. This group included a majority of young Mo cows from the MCDS system. Profile 2 was composed of 256 lactations from cows that had maintain their reproductive ability and health status, to the detriment of the maintenance of their body condition in early lactation (-0.4 point of body condition score after calving). This group included a majority of cows from the MCDS system. Profile 3 was composed of 125 lactations with poor performance on all traits, in particular on health (reproductive disorders and lameness). This group included a majority of Ho cows from both systems. Profile 4 was composed of 216 lactations of cows with poor reproductive performance (40% of conception rate at first AI) associated with satisfying performance in terms of milk production, body condition and health. This group included a majority of adult cows from the MCDS system. Altogether, the 4 profiles were expressed, in both systems despite their differences in terms of calving season and feed availability and in both breeds.

More details on this study are available in a French report (Robin, 2017).

Discussion: Even if the two breeds have different advantages in order to meet the challenges of highly autonomous farming systems, the poor reproductive performance of the Holstein cows impair its relevance in grassland systems with spring grouped calvings. However, within breed variability exists which could allow to select robust animals adapted to these organic low imputs systems. Our study strengthens ideas developed in previous studies: types of trade-offs between life function expressed by dairy cows cannot be predicted by their breed, their parity or their feeding constrains.

References: Coquil X., Fiorelli, J.L., Blouet A., Trommenschlager J.M., Bazard C., Mignolet C. 2011. Conception de systèmes de polyculture élevage laitiers en agriculture biologique : Synthèse de la démarche pas à pas centrée sur le dispositif expérimental INRA ASTER-Mirecourt. Renc Rech Ruminants, 18, 57-60.

Delaby L., Fiorelli J.L., 2014. Elevages laitiers à bas intrants : entre traditions et innovantion. INRA Prod. Anim., 27(2), 123-134

Ollion, E., Ingrand, S., Delaby, L., Trommenschlager, J.-M., Colette-Leurent, S., Blanc, F. (2016). Assessing the diversity of trade-offs between life functions in early lactation dairy cows. Livestock Science, 183, 98–107.

Robin M. 2017. Performances et santé de vaches laitières en agriculture biologique : Bilan de l'expérimentation-système menée à l'INRA de Mirecourt Thèse doctorat vétérinaire, Faculté médecine Nantes. ONIRIS, 60p.

Image:

Table 1: Effect of the breed (Montbeliarde *versus* Holstein) and the production system (Grassland System *versus* Mixed Crop and Dairy System) on cow performance in organic low inputs systems

| | Montbeliarde | | Holstein | | | P–value[1] | | |
	GS	MCDS	GS	MCDS	SEM	Breed	System	B*S
Milk yield over 44 weeks of lactation (kg)	4555[a]	4613[a]	5145[b]	5617[c]	676	***	***	***
Mean fat content over 44 weeks (g/kg)	42.5[a]	42.4[ab]	41.8[b]	40.7[c]	3.17	***	*	*
Mean protein content over 44 weeks (g/kg)	32.5[a]	32.9[b]	31.4[c]	31.6[c]	1.95	***	*	NS
Milk yield per day of productive life (Kg/day)	14.6[a]	14.6[a]	15.5[a]	17.0[b]	2.72	***	**	*
Minimum body condition score	1.68[a]	1.74[b]	1.35[c]	1.52[d]	0.29	***	***	**
Conception rate at first IA	43%[ab]	48%[a]	31%[b]	38%[ab]		*	NS	NS
Interval between calvings (day)	371[ab]	371[ab]	381[c]	378[ac]	31.4	**	NS	NS
% of lactations displaying lameness	49%[a]	30%[b]	40%[a]	15%[c]		NS	***	NS
% of lactations displaying reproductive disorders	14%[ab]	10%[a]	30%[c]	18%[b]		***	NS	NS
% of lactations displaying clinical mastitis	10%[a]	16%[ab]	10%[a]	23%[bc]		NS	*	NS

[1]P-value : *** : p<0.001 ; ** : p<0.01 ; * : p<0.05. SEM : standard error of the mean ; B*S : interaction breed*system. [a-d] means within rows with no common superscripts differ (p < 0.05 Tukey test).

Image 2:

Table 2: Profiles of cows in terms of lactation, reproduction, body condition and health in organic low inputs systems (Grassland System and Mixed Crop and Dairy System)

	Profile 1 (N=294)	Profile 2 (N=256)	Profile 3 (N=125)	Profile 4 (N=216)	SEM	P-value[1]
Milk yield over 44 weeks of lactation (kg)	5122[a]	5393[b]	5327[b]	5846[c]	990	***
Mean fat content over 44 weeks (g/kg)	41.8[a]	42.0[ab]	41.4[a]	42.5[b]	2.12	*
Mean protein content over 44 weeks (g/kg)	32.8[a]	32.4[a]	31.7[b]	32.5[a]	1.95	***
Body condition score at calving	2.38[a]	2.70[b]	2.57[c]	2.37[a]	0.58	***
Maximum body condition loss	0.23[a]	0.40[b]	0.36[c]	0.27[a]	0.164	***
% of pregnant cows after one year	98[a]	93[a]	29[b]	40[c]		***
% of lactations displaying lameness	11	14	20	14		*
% of lactations displaying reproductive disorders	13	8	30	22		***
% of Montbeliarde / Holstein breed	65/35	54/46	36/64	49/51		***
% of cows from the GS / MCDS systems	34/66	37/63	53/47	40/60		*

[1]P-value : *** : p<0,001 ; ** : p<0,01 ; * : p<0,05. SEM : standard error of the mean ; [a-d] means within rows with no common superscripts differ (p < 0.05 Tukey test).

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