Combining robotic milking and grazing

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Abstract

In 2013 in France, nearly 3000 milk producers use an automatic milking system (AMS). It often leads to reduced grazing, for fear of a drop in milking frequency. A national project was set up to bring technical solutions to breeders who wish to combine AMS with grazing. During 5 years, the experimental farm of Derval tested several traffic options and herd management opportunities while grazing. The maize-silage silo was closed for 34 days (in 2012) and 56 days (2013). Holstein cows on a 100% grazed diet produced, on average, 27.5 kg of milk with 2.8 kg of concentrates. The feeding cost was one-third the winter ration. Each cow ingested up to 1.5 t of grazed grass per year. During the same programme, 20 French robotic farms were surveyed with various saturation levels, grass growth potential and traffic. This programme shows that grazing with an AMS remains possible as long as the farmer keeps motivation, a sufficient grazeable area, and implements the right traffic options.

Keywords: AMS, grazing, milking frequency, dairy cows

Introduction

In France, the massive introduction after 2000 of AMS often led to reduced use of grazed grass in the diet of dairy cows (Jégou *et al*., 2007; Billon, 2009). The possible decrease in milking frequency which is often presented as an important factor for individual productivity often threatens the breeders. As they are also seeking to reduce working time, grazing does not always appear as a solution to reach this target, but keeping grazed grass in cow diets is advocated for its positive impacts on nutrition and health (Burow, 2011). It is also an efficient solution to the need to reduce production costs thanks to the low cost of per energy unit to produce milk from grazed grass compared with other feeds. The experimental farm of Derval (western France) tested different solutions to graze dairy cows milked with an AMS. The research programme had associated experiments in stations as well as pilot farms in order to broaden the list of solutions that can be used to reconcile AMS and grazing.

Materials and methods

The experiments lasted from 2009 to 2013. The following aimed at studying the impact of the share of grazed grass in the daily diet ("day grazing only", or "day and night grazing") on the performances of the cows and the robot, compared to the performances during the winter period when the cows are kept inside. The average number of cows (Holstein) milked by the robot (a Delaval one-stall VMS 2007) reached 72. The yearly production is ca. 9000 kg of milk /cow and there are ca. 150 milkings every day. The cow traffic is guided: the cowshed equipped with cubicles has a drafting gate only usable from the feeding area. After the robot, a second gate directs the cow towards grazing or towards an isolation box. Derval is located in a dry area (mean 600 mm rainfall /year). The grazable area reaches 28 ha of temporary grasslands of ryegrass-white clover. One large track (3.5 m) leads to the 3 paddocks of 10, 10 and 8 hectares. Grass management is a simplified rotational system. The maximal walking distance for the cows to reach the end of the furthest paddock is 800 m. One water trough is located at the entrance of the shed and a second just before the exit. No water is available in the fields. The buffer feed (maize silage) is adjusted to the amount of grass outside and the growth forecasts to maintain 10 days of grass ahead. It is delivered in the morning. When the cows get 8 kg DM per day, they do not have access to the trough as long as the whole herd is not inside the shed,

to ensure all the cows have the same access time to the buffer feed. The amounts of grass grazed were estimated through the difference between the calculated Intake capacity of the cows (INRA 2007, R Delagarde, pers. comm.) and the intakes of supplements. SAS ® software was used to analyse data with PROC MEANS, GLM and MIXED. For weather data, classification methods (PCA and HAC) were used. A number was dedicated to each feeding period: P1 (100% shed period), P2 (transition period) and P3 (100% grazing period.) Statistical analyses are based on 2011, 2012 and 2013. The international production cost method (IFCN) was used to assess the feeding cost and the margin over feeding cost.

Results

The access time to grazing allowed by the traffic management led to the valorization of more than 1 ton of grazed grass per cow per grazing season. In 2013 the maize clamp was closed for 56 days. The individual dairy production remained around 27.5 kg during the 100% grazed grass diet both in 2012 and 2013 (Table 1).

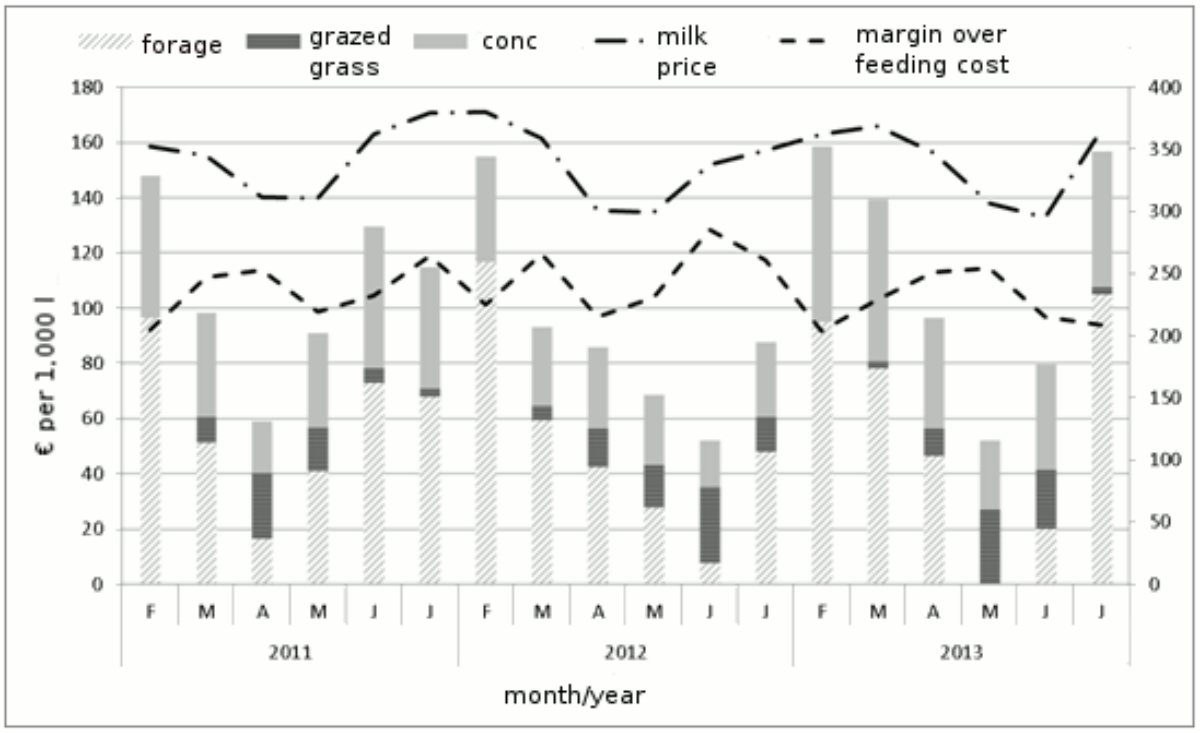
Table 1. Dairy production, milking frequencies and concentrates per period.

	2011			2012			2013		
	P1 61d	P2 44d	P3 11d	P1 60d	P2 74 d	P3 32d	P1 60 d	P2 33d	P3 56d
Cow number	68	74	74	73	74	74	69	71	67
Lactation stage (d)	206	178	178	192	189	185	226	229	232
Milk kg d^{-1} c^{-1}	27.6	30.4	28.3	29.4	31.6	27.6	30.1	30.7	27.5
Diff to P1	/	+2.8	+0.7	/	+2.2	-1.8	/	+0.6	-2.6
Concentrates kg c^{-1} d^{-1}	4.8	3.9	2.7	3.9	3.9	2.3	5.6	4.6	3.3
Diff to P1	/	-0.9	-2.1	/	0	-1.6	/	-1.0	-2.3
Milk kg per AMS d^{-1}	1876	2253	2097	2130	2323	2044	2074	2182	1842
Milking frequency c^{-1} d^{-1}	2.15	1.86	1.97	2.06	1.92	1.86	2.12	2.08	2.12
Diff to P1	/	-0.3	-0.2	/	-0.14	-0.2	/	-0.04	0

During P3, concentrate (wheat) delivered is limited to 2.8 kg c^{-1} d^{-1} versus 4.8 average during P1. Adjusted means of the productions are 28.9 kg d^{-1} c^{-1} for P1, 30.3 for P2 and 27.5 for P3. An increase of 1.4 kg c^{-1} d^{-1} occurred during P2 ($P< 0.0001$). During P3, there was a decrease of 1.4 kg compared to the average production during the winter period P1 ($P< 0.0001$), partly due to a decrease by 1.6 to 2.3 kg c^{-1} d^{-1} of concentrates in 2012 and 2013. The average milking frequency ranges from 1.86 to 2.15 milkings c^{-1} d^{-1} in relation to the saturation level of the robot, though variation between P1 and P3 is only a decrease by -0.3 to -0.04 milkings c^{-1} d^{-1}. The adjusted mean for milking frequency is 2.11 milkings c^{-1} d^{-1} in P1. This frequency decreases in P2 (1.96 milkings c^{-1} d^{-1}) then reaches 1.99 milkings c^{-1} d^{-1} in P3. Thus, the effect of grazing leads to a decrease by 0.15 milkings c^{-1} d^{-1} ($P<0.0001$) in P2 and only by 0.11 milkings c^{-1} d^{-1} ($P<0.0001$) in P3.

The weather influences the return of the cows from pasture (Lozach, 2011). Days with the lowest milking frequency (1.79 milkings c^{-1} d^{-1}) are characterized by high wind speed with high humidity, with no effect of rainfall. In terms of working time, during P2, sorting cows takes ca. 5 min to check milking times on computer, and 10 min to sort cows inside the shed. This is done daily at ca. 8 am after delivering maize silage, so cows are brought to feed racks. During P2 and P3, the cows are fetched by the herdsman at ca.6 pm, 20-40 min. are required. In terms of economic impact, the feeding cost for 1000 L delivered decreases from 148 € in P1, to 43 € in P3. Thanks to grazing, the monthly margin over feeding cost (Figure 1, curve with dots) remains over 200 € per 1000 L whatever the seasonal effect of the milk prices.

Figure 1: feeding cost and margin over feeding cost.



Discussion

The results show the same tendencies as on the 20 pilot farms followed during 3 years within the CASDAR research programme (Carles, 2013). On those farms the milking frequency decreased by 0.24 milkings c^{-1} d^{-1} with a drop by 1.7 kg of milk d^{-1} during the grazing period. The amount of grazed grass in Derval reaches the same level as on the 20 pilot farms (average of 1500 kg DM c^{-1} y^{-1}; range 750 to 2600), and 1500 kg DM is exactly the average grazed grass intake by the average French dairy cow (Brunschwig, 2011).

In terms of working time, two tasks are directly related to grazing: at 8 am the cows milked between midnight and 6 am are sorted out, and in the evening the herd has to be fetched from the field. Using two paddocks per 24 hours (day and night paddocks) could facilitate the separation by the farmer of cows already milked from those not milked (Oudshoorn, 2008) but this requires two daily interventions to empty the night- and day-paddocks. To avoid fetching the cows, a system with 3 paddocks per 24 h like in Ireland or New-Zealand (Fitzgerald, 2012, and Woolford, 2004) could also be implemented.

Conclusion

The Derval experiment with a robot at full capacity, together with results from pilot farms, clearly show that grazing (even 100% grazing with no silage) can be combined with robotic milking. The feeding cost was reduced to one third: this limited the negative effect of the fluctuations of the milk price in spring. The same tendency was shown in the pilot farms. The success of the system lies in the trust of the cows in terms of traffic. Cows have a strong capacity to adapt to any traffic solution as long as we give them enough time to do it.

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