An agro-ecological dairy cattle system to allow all year round grazing

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Abstract

In order to face the new challenges of dairy farming in north-west Europe, an innovative dairy system (90 ha, 72 cows, Lusignan, France) was redesigned to be resilient to climate change, while saving water and fossil fuel resources and contributing to sustainable agriculture. This system relies on the grazing of diversified forage resources and on an adapted cattle breeding system. The herd reproduction is based on two calving periods centred on spring and autumn. The age of heifers at first calving is reduced to 24 months, and the lactation length is extended to 16 months. A three-way crossing of dairy breeds (Holstein, Scandinavian Red, Jersey) was implemented to have more robust cows, with good reproduction capacity and well adapted to grazing. Grazed forage did not yet succeed in reaching 100% of the dairy herd feed in spring and 25% in winter, but was close or higher than the objective of 50% in summer and autumn, thanks to the grazing of various forage resources.

Keywords: mixed crop-dairy system, grazing, diversity, climate change, agroecology

Introduction

Dairy farming in north-west Europe has new issues to face: it has to be resilient to climate change, while saving water and fossil fuel resources and contributing to sustainable agriculture. To address these challenges, an innovative dairy cattle system (90 ha, 72 cows), called OasYs, was redesigned with an agroecological approach, by giving priority to grazing. Agroecology is grounded in the stimulation and valorisation of natural processes to reduce inputs and pollution in agroecosystems (Dumont *et al.*, 2014). Grazing is an energy- and water- saving management mode, which could reconcile economic and environmental performances (Peyraud *et al.*, 2010). It is also generally beneficial to animal welfare (Arnott *et al.*, 2017). However, the quantity and quality of grazed forage are highly dependent on climatic conditions. Climate change will enhance the frequency of extreme weather events, such as drought (IPCC, 2013), and will increase the overall variability of grassland production and availability (Dumont *et al.*, 2014). We hypothesise that a greater diversity of the dairy system's components and of their functions will both improve the resilience of the overall system against climatic hazards and permit high production levels and environmental performance. This paper presents the first results of the livestock breeding strategy and the forage resources used to allow all year round grazing.

Materials and methods

An agroecological dairy system has been implemented since June 2013 on an INRA facility located in Lusignan (Vienne, France), south of Brittany, in an area already affected by summer droughts. The herd reproduction is based on two calving periods centred on spring and autumn, to better link cattle needs with the growth of grasslands and also to overcome climatic hazards which could occur at one period. The age of heifers at first calving is reduced to 24 months, and the lactation length is extended to 16 months, to limit the non-productive period during cow lifetime and the associated negative environmental impacts. A three-breed rotational crossing of dairy breeds (Holstein, Scandinavian Red, and Jersey) is implemented to have robust cows with good reproduction capacity, which are well adapted to grazing and to forage resources of contrasting quality.

Cattle feeding relies on the grazing of diversified forage resources, with the objective to allow grazed forage resources to meet 100% of the dairy herd feed requirements in spring (meteorological season), 50% in summer and autumn and 25% in winter. Five-year grazed grasslands represent the heart of the forage system (36 ha of the 48 ha potentially grazable). They are diversified regarding their species, cultivars and age to provide grazeable forage resources in a wide range of climatic conditions (Novak *et al.*, 2016a). Short duration (six months to two years) grasslands provide fast- growing grass but of lower persistence (e.g. Italian ryegrass, Crimson clover, chicory). Annual crops (millet-forage sorghum with clovers, rape, fodder radish, fodder beet) are implemented to address the shortage of grass generally observed in summer, autumn and winter. We also use dual purpose crops (grain sorghum or cereal-legume mixtures) which can either be grazed or harvested (or both), depending on the amount of grass and conserved forage stores, to better adapt to climatic conditions. Legume-rich pastures may also be stockpiled from late spring to be grazed in summer. Finally, trees and shrubs have been planted in 2014 to provide browsed fodder in summer and autumn but also to shelter cattle and to improve the efficient use of natural resources (Novak *et al.*, 2016b).

Results and discussion

The new livestock breeding strategy initiated in June 2013 shows good progress (Table 1): four years after its start-up, calvings are nearly equally distributed between spring and autumn, and calving intervals level off at around 18 months (i.e. 548 days). As expected, three-breed crossbreeding takes more time to be effective: in 2017, the dairy herd was composed of 37% of Holstein and 63% of Holstein × Scandinavian Red or Holstein × Jersey crossbred cows. The amount of milk delivered decreased from 8,565 litres per cow in 2013 to 7,076 litres per cow in 2016, mainly as a result of the decrease in the amount of concentrates (from 127 g per litre of milk in 2013 to 74 g per litre of milk in 2016) and also as a result of crossbreeding. In the same period of time, the fat content of delivered milk increased from 39.7 to 41.7 g kg^{-1}.

From 2013 to 2016, five-year old grasslands provided 58 to 100% of the forage grazed by dairy cows, depending on the season (Figure 1). The objective to meet 100% of the dairy herd feed requirements with grazed forage in spring was not achieved, in spite of the grazing of cereal-legume mixtures and short duration grasslands. An earlier topping of grasslands could help to improve these results. On the contrary, the objective of 50% of grazing in summer was largely exceeded thanks to some grassland species (e.g. chicory, tall fescue) and annual crops (mainly cereal-legume mixtures and millet-sorghum). In autumn, grazing was close to 50% of the dairy herd feed, except in 2016, because the dry weather in summer and autumn did not allow sowing of the intended annual crops and sufficient regrowth of grasslands. Trees

Table 1. Results of the implementation of the new livestock breeding strategy which began in June 2013.

		2013	2014	2015	2016	2017
Calving distribution (% of cows)	spring	0	36	37	64	47
	autumn	100	64	63	36	53
Calving interval (days)		406	508	609	575	554
Crossbred cows in the dairy herd (%)[1]	H × R	0	0	0	10	25
	H × J	0	0	0	21	38
Age at first calving (months)		26.5	26.6	28.5	27.3	26.6

[1] H=Holstein, J=Jersey, R=Scandinavian Red.

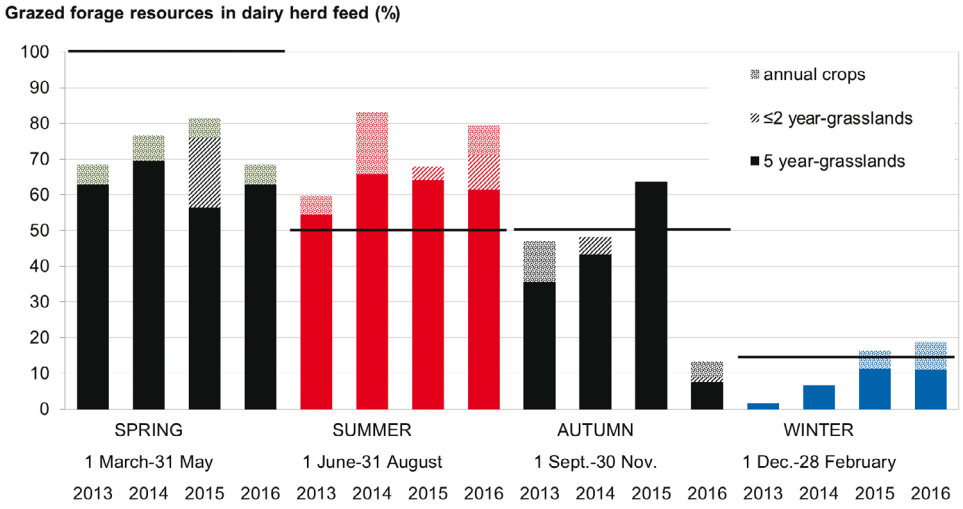

Figure 1. Part of grazed forage resources in dairy herd feed according to meteorological season, from spring 2013 to winter 2016 - 2017.The proportion of grazing in herd feed was estimated using the duration of grazing in each month. The horizontal bar indicates the target set for each season.

and shrubs were too recently planted to be browsed in summer or autumn. In winter, grazing represented less than 25% despite the use of fodder beet which represented up to 38% of the grazed forage.

Conclusion

This agroecological system experiment, through grazing, allowed the provision of most of the feed of the dairy herd in spring and summer and a large part in autumn. Grazed forage resources should increase in the following years with the full establishment of the system, leading to the browsing of fodder trees and shrubs and to crossbred cows more adapted to the system. We also intend to assess new grass and crop species and management practices so as to continue to extend the grazing period.

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