HerbValo – a method for calculating annual pasture utilisation by dairy cows at paddock level

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Abstract

Better knowledge of pasture utilised by grazing dairy cows (in t DM ha^{-1} year $(y)^{-1}$) would help farmers to analyse and improve their grazing management. This is the aim of HerbValo, a generic method designed to be used on commercial farms. This method combines recording grazing or cutting events at paddock level all year round and a spreadsheet for calculating pasture grazed or harvested per rotation and year. For the grazing events, the calculation takes into account the number of grazing days (herd size × residence time) at each rotation and the average daily intake per animal, estimated from a simple description of herd characteristics, supplements, pasture type and quality, and grazing severity. No pasture measurements, such as pre- or post-grazing pasture heights, are required. A large 19-year experimental database (Le Pin-au-Haras) was used to calculate the intra- and inter-annual variability of pasture utilisation, according to weather conditions or management practices. Pasture utilisation averaged 9.4 ± 1.32 t DM ha^{-1} y^{-1} and ranged from 6.7 to 12.5 t DM ha^{-1} y^{-1} depending on paddock, year and management. Using this tool on a number of commercial farms will enable the provision of regional references on pasture utilisation by grazing livestock.

Keywords: grazing, dairy cow, pasture utilisation, methodology

Introduction

In grazing systems of Western Europe, high pasture utilisation rate is a key point for increasing milk or milk solids production and profit per hectare, through reduction of feeding costs (Ramsbottom *et al.*, 2015). It is always difficult to estimate the quantity of pasture used annually by grazing herds, particularly on commercial farms where no field measurements are made, making the comparison with other harvested forage resources difficult. Moreover, at grazing, farmers decisions, and particularly stocking rate or grazing severity, have a large effect on pasture utilisation and milk production per hectare (McCarthy *et al.*, 2011). A collaborative project between research and extension services within the French network Réseau Mixte de Technologie (RMT) Prairies Demain led to the development of a simple and robust method called HerbValo, to be used by farmers themselves, on selected paddocks, for estimating pasture utilisation rate on an annual basis. Specific versions have been developed for dairy cows, suckling cows, and dairy goats (Delagarde *et al.*, 2017). The development of versions for sheep and equine is ongoing. The aim of this work is to describe the HerbValo method for dairy cows, and to analyse a large multi-year dataset from the INRA experimental farm of Le Pin-au-Haras (Normandy, France) to determine the sources and range of variation in pasture utilisation rate according to year, season, and grazing management.

Materials and methods

HerbValo description

Pasture utilisation (t DM ha^{-1}) is calculated per paddock, at each event (grazing or cutting), and then summed to calculate seasonal or annual pasture utilisation. At each grazing rotation the calculation is based on the product between the number of grazing days per ha (herd size × residence time per paddock area) and the pasture intake of the average cow in the herd (kg DM d^{-1}). Pasture intake is calculated according

to the principles of the INRA feed unit system adapted to grazing situations (INRA, 2010), taking account of cows, pasture and supplement characteristics, grazing severity and daily access time to pasture. Except for the quantity of each supplement eaten and the pasture yield at each cutting event, no 'numeric' data are required. Animal (breed, milk production, body size), pasture (type and quality, characterised by color, from green to yellow), and grazing severity (from lax to very severe) are characterised by selecting a value from a list of three to four predefined classes. Classes were defined to be easily selected by a farmer or an advisor, and to provide approximately a 5% difference in intake between two consecutive classes. Cows may receive any quantity and number of supplements, substitution rates being calculated according to supplement type and grazing severity. More details about principles, equations, parameters and accuracy of the method by comparing with the predictions from the GrazeIn model are provided by Delagarde *et al.* (2017). Paddocks and herd are described once a year, and events are described at each rotation, on paper sheets. Calculations are made from recorded data on a spreadsheet.

INRA Le Pin database

A database merging experimental data from three large paddocks of permanent pasture was built, with data from 1992 to 2010 (19 consecutive years). During this period, paddocks were mainly grazed by dairy cows, from early April to November, with a maximum of one silage cut per year. Grazing and feeding management (nitrogen fertilisation level, grazing severity or stocking rate, and cow supplementation strategy) were variable between years according to experimental programs, but strictly similar within year between the three paddocks, enabling comparison of between-paddock pasture utilisation. The grazing system was a simplified rotational grazing system, with an average of ten days residence time per paddock without using electric fences, and a change of paddock being decided from the lactation curve within each paddock (Hoden *et al.*, 1991). The HerbValo tool was used with this database, enabling the between-year and the between-paddock variability of annual and seasonal pasture utilisation, as well as the relationship between pasture utilisation and climate, to be examined over a 19-year period.

Results and discussion

In the 19-year database from Le Pin-au-Haras, the pasture utilisation rate averaged 9.3 ± 1.48 t DM ha^{-1} year $(y)^{-1}$ and ranged from 6.5 to 14.2 t DM ha^{-1} y^{-1} depending on paddock, year and management (Figure 1a). Pasture utilisation rate ranged from 8.8 to 9.6 t DM ha^{-1} y^{-1} between paddocks (average of all years), and from 6.7 to 12.5 t DM ha^{-1} y^{-1} between years (average of all paddocks), showing a larger year effect than a paddock effect. This may be related mainly to the fact that the three paddocks were relatively homogeneous (adjacent permanent pastures of close botanical composition, and deep soils).

Pasture utilisation rate was greatest in spring (late March to end of June), and lowest in summer (July and August) and autumn (September to November), with, on average, 5.3 ± 0.77, 2.0 ± 0.37 and 2.1 ± 0.77 t DM ha^{-1} $season^{-1}$, respectively. The between-year variability of pasture utilisation was thus greater in spring and autumn than in summer in absolute values, but greater in autumn than in spring and summer in relative values (coefficient of variation of 14, 18 and 37% for spring, summer and autumn, respectively). There was no apparent carry-over effect of a high or low pasture utilisation rate in spring on the subsequent pasture utilisation rates in summer or autumn (Figure 1b), showing that seasonal pasture utilisation rates are fairly independent, probably related to specific weather conditions and pasture growth rates. Between years, pasture utilisation rate was positively related to mean temperature during the growing season (+0.8 t DM ha^{-1} y^{-1} per °C) but not to rainfall (infrequent rain deficit in summer in this region).

The feedback from 30 dairy farmers who used the tool in 2016 is positive, but farmer motivation is required to record events all year round (only 5 minutes per rotation per paddock is required). Improvements to the dairy cow version of HerbValo were made in 2017 from the farmer feedback to increase the usability of the method. Ongoing projects aim to develop web applications of the HerbValo method for all herbivore

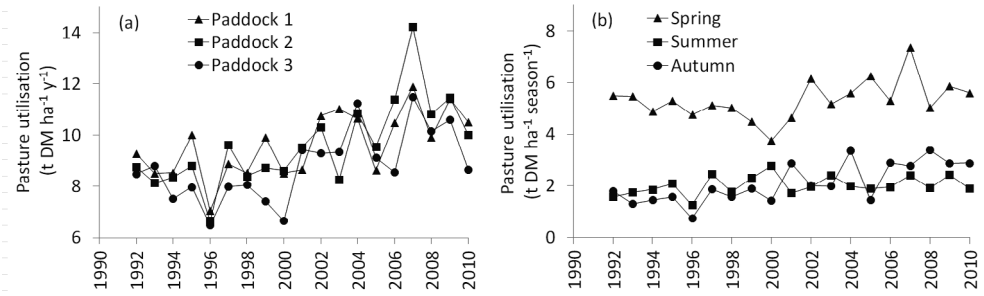


Figure 1. Interannual variation of pasture utilisation by grazing dairy cows: (a) per paddock, with same management, at year level, or (b) per season, on averaged data of three paddocks.

species (bovines, ovines, caprines and equines) to study the relationships between pasture growth and pasture utilisation, and to highlight grazing management practices that can improve pasture utilisation rate through using HerbValo on a large network of farms and paddocks at country level.

Conclusion

The HerbValo method has been collaboratively developed by research and extension services, to calculate simply but accurately pasture utilisation rate at paddock level on farm. Using a large database from an experimental farm clearly showed that HerbValo makes it possible to analyse the between-year, between-paddock or between-management variations in pasture utilisation rate.

Acknowledgements

The RMT Prairies Demain (www.afpf-asso.fr/index/action/page/id/95/title/rmt-prairies) and the staff of the INRA farm of Le Pin-au-Haras are gratefully acknowledged.

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