The effects of "mob grazing" on soil organic matter and dairy cow performance – a case study.

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Abstract. Mob grazing is a management grazing strategy that is characterized by high stocking densities of livestock, which are moved frequently to a new paddock with the aid of electric fences, trampling forage into the soil as they graze. The pasture land is then left, ungrazed until it is fully recovered, allowing the whole host of plant species to establish in the sward. In this respect, mob grazing tries to simulate the grazing behaviour of vast herds of wild herbivores found on the American plains, or in the African savannah. This study investigated the effect of "mob grazing" on soil organic matter and on performance of dairy cows in a case-study farm in the UK. The results show that high stocking grazing of bio-diverse pastures has a remarkable effect on the build-up of the soil organic matter and that bio-diverse pastures serve as a viable alternative to conventional pastures as they can maintain animal productivity at high levels.

Keywords: mob grazing, dairy cows, organic milk, diverse swards, soil organic matter.

1 Introduction

Farmers are interested in increasing soil organic matter (SOM) because it serves as a reservoir of nutrients for crops, provides soil aggregation, increases nutrient exchange, retains moisture, reduces compaction, reduces surface crusting, and increases water infiltration into soil, which in turn can benefit animal productivity and maintain good herd health. The build-up of SOM can be influenced by the way in which the sward is managed in terms of grazing (e.g. increasing the return of vegetation to the soil). In this respect, the concept of "mob grazing" as a grazing management strategy has attracted great interest amongst dairy farmers over the last few years, particularly in the UK.

Under the concept of mob grazing, animals spend a short time in a small area before moving on from paddock to paddock, trampling forage into the soil as they graze. It is regarded that mod grazing has its basis on the grazing patterns of some species of wild herbivores roaming unrestricted over large rangelands, leaving behind manure concentrated on a small area, and considerable plant residues, above and

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below ground, both of which contribute to SOM and to soil nutrients (Savory and Butterfield, 1999). Mob grazing is usually applied in diverse swards as these leys are postulated to promote microbial activity resulting in increased soil carbon levels and building humus. It has been suggested that trampling of significant quantities of mixed forage onto the soil surface provides a better environment for microorganisms and other soil life and increases the soil organic matter (Savory, 2013). Plants with more above ground canopy are able to grow larger root systems than those that are grazed more severely; the long recovery time between grazing allows plants to establish a healthy root system, contributing the increased SOM (Chapman 2012; Richmond 2011).

The claimed benefits of mob grazing on soil organic matter have not been studied in scientifically robust experiments/studies and this gap in scientific knowledge is reflected in the literature. This study investigated the effect of "mob grazing" on soil organic matter and on performance of dairy cows in a case-study farm in the UK.

2 Methodology and Data Collection

In order to evaluate the effect of mod grazing on SOM and animal performance, this study gathered soil, forage and animal production data from a case-farm in which mob grazing on diverse swards is being used since 2007 as a method to increase the organic matter of soil. The farm is located in the Cotswolds, near Gloucestershire, UK and converted to organic production in 2005. The herd consists of Friesian-Shorthorn cross dairy cows that are spring calving, with a lactation period of 300 – 310 days. Full-time housing of the cows is limited to two months (i.e. December and January). The farmer introduced a mob grazing approach on diverse swards that are consisted of ten different grass, six legumes and five herb species.

Forage samples and feed intake estimation. Herbage yield of the ungrazed and grazed paddocks were assessed on a monthly basis in the same field (Big Aero) which was representative of the type and the age of the swards across the farm by the the square-metre quadrat method (Harmoney et. al., 1997). This allowed for estimation of the average DM intake of the cows. Sub-samples of the forage were separated as grass, clover, other legumes and broadleaves and senescent material in order to determine forage composition in the grazing plots. Additional herbage samples were analysed by wet chemistry for metabolisable energy (ME) and Crude Protein (CP) content.

Monitoring of farm records and additional calculations. At the end of the monitoring period the farmer provided data and information regarding milk production and composition, grazing records (i.e. area and livestock numbers grazed daily) as well as supplementary feeding records regarding forage and concentrate supplementation, amounts and periods fed. These data in addition to chemical analysis data were used to estimate the ME intake of the cows over each season from the given field. Data from the sampled field were extrapolated to provide an estimate for the whole farm for each year.

Soil Samples. Historic data on the organic matter content of soil from three different fields are available from 2007, and 2012. At the end of the two years'

monitoring, soil samples were taken again in spring 2015 from these fields to assess the change in soil organic matter (changes in SOM are likely to be slow, so maximising the time will increase the likelihood of detecting a change).

3 Results and Discussion

Pasture productivity and herbage composition. The productivity of the grazed sward during the monitoring period (i.e. April to September 2014) averaged 10.3 tonnes per hectare. Herbage production increased from April to August while the composition of the herbage in summer months remained relatively constant (Figure 1). Clover production accounted for about 24% while grass production accounted for 71% of the total herbage production. The productivity of other legumes and "broad leaves" represented 6% of the total production. The sward had an average of 19.1% DM, 10.8 MJ of ME, 21.3% of CP and 376 g of NDF indicating a good quality forage. The average ME content was marginal as normal values for this type of forage are 11 to 13 MJ of ME per kg DM, but CP content was high and NDF within the expected levels.

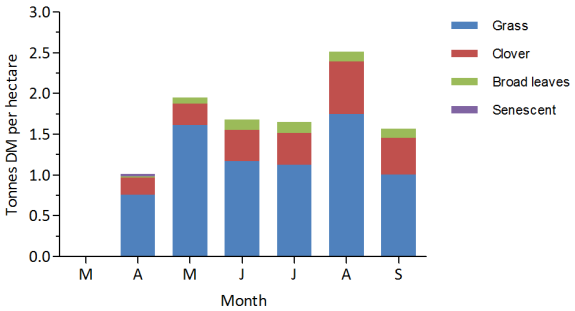

Fig. 1. Monthly pasture productivity (tonnes of DM per hectare) and herbage composition of the diverse swards.

Gazing data, feed intake and animal productivity. According to the grazing data 181 milking cows grazed a diverse sward field of total area of 12.5 ha for a total of 43 days in monthly rotation intervals over a six-month period. The average stocking density over the grazing period was 115 tonnes of livestock per hectare. The resting period between consecutive grazings averaged about 21 days with 16 and 25 days the shortest and the longest, respectively. These resting periods do not coincide with the principles of "mob grazing" where resting periods are of long duration (i.e. more than 50 days) but the stocking density was relatively high. According to the farmer, in previous years he was applying a 40 to 50 days rotation management allowing the pastures to recover for longer. The estimated grazed intake per cow per day in each month as well as the calculated ME intake are shown in Table 1.

Table 1. Estimated feed (kg DM) and energy intake (MJ) per cow per day during the grazing period from April to September 2014.

Month	Estimated grazed intake		Supplementary feed Intake*		Total ME Intake	Total ME requirements	Energy Balance
	DM intake (kg)	ME intake (MJ)	Kg DM	ME intake (MJ)			
03 œ09 April	14.0	152	4.3	56	208	204	4
05 œ12 May	22.6	244	3.0	39	283	213	70
02 œ11 June	13.9	150	3.0	39	189	210	-21
05 œ23 July	10.9	118	3.0	39	157	195	-37
09 œ19 August	23.8	257	2.2	28	285	188	96
12 œ25 September	14.8	160	2.2	28	188	178	11

**Natural Organic Green HDF 18 Nuts (BOCM PAUL LTD), 862g DM, 18% CP, 13 MJ ME.*
*** Assuming a cow LW of 550 kg*

Over the period the average daily grazed intake per cow was 17 ± 1.9 kg DM but it fluctuated from as little as 10.9 kg DM in July up to 23.8 kg DM in August. The average daily concentrate supplementation per cow was 2.9 ± 0.29 kg DM ranging from 4.3 kg DM in April to 2.2 kg DM in September.

The estimated ME intake from the forage in the monitoring field in addition to the ME Intake from the supplementary feed (i.e. Natural Organic Green HDF 18 Nuts (BOCM PAUL LTD), 862g DM, 18% CP, 13 MJ ME) covered the daily ME requirements of the cows in most months, but there was a nutritional shortfall in ME intake during the grazing periods in June and July as shown in Table 1. This is explained by the relatively low forage DM intake that is estimated in the monitoring field for these periods, which is likely attributed to the low forage availability. Nevertheless, daily milk yield during June and July averaged 25 and 22 kg per cow, respectively, indicating that productivity was not compromised by the relatively low intakes estimated for these days which suggests that subsequent grazing in the next field in rotation allowed for good DM intakes.

Effects of mob grazing on soil organic matter. Despite the fact that monitoring of the performance of the diverse swards was conducted only in one field (i.e. Big Aero) soil samples were collected in 2015 from three different fields (i.e. Big Aero, Lanes Estate, Pinchins) and compared with earlier results from 2007 or 2012. These data show that soil organic matter increased by 122.7%, 47.2% and 40.4% in Big Aero, Lanes Estate and Pinchins fields, respectively. The relative higher increase in soil organic matter in the Big Aero is attributed to the fact that samples collected in 2015 are compared with those collected in 2007 (i.e. 8 years earlier) and not in 2012, which is the case in the other fields (i.e. 3 years earlier). Yet, this is a marked improvement with more than double the levels of organic matter reserve. The build-up of the soil organic matter is also remarkable in the other fields as well. The overall soil analysis data suggest that soil improvement management through rotational high stocking grazing of bio-diverse pastures appears to have a beneficial impact on soil organic matter.

4 Conclusions

The results of this case study show that bio-diverse pastures are sufficiently productive to serve as a viable alternative to conventional pastures (i.e. grass / clover pastures) as they can maintain animal productivity at high levels. Although the farmer claims that the grazing system he applies in his farm falls within the principles of "mob grazing", the average 21-day rotation he applied in his farm during 2015 is regarded as rather short to allow plants to grow to a desired height that fulfils the expectations of mob grazing. However, it should be acknowledged that grazing rotations were longer in the previous years while stocking density always remains high. This study shows that the build-up of the soil organic matter is remarkable and suggests that soil improvement can be achieved through high stocking rotational grazing of bio-diverse pastures.

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