VETERINARSKI ARHIV 85 (6), 609-620, 2015

Pasture mass and pasture allowance influence on sward quality, pasture intake and milk performance

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ROCA-FERNÁNDEZ, A. I., M. A. O'DONOVAN, J. CURRAN, A. J. GONZÁLEZ-RODRÍGUEZ: Pasture mass and pasture allowance influence on sward quality, pasture intake and milk performance. Vet. arhiv 85, 609-620, 2015.

ABSTRACT

Sixty-four Holstein-Friesian cows were randomly assigned to one of four treatments (M15, M20, H15 and H20) in a 2x2 factorial design, by considering: two pre-grazing pasture mass levels (PM, kg DM/ha): medium (M-1,600) *vs.* high (H-2,400); and two pasture allowance levels (PA, kg DM/cow/day): low (15) *vs.* high (20). Two periods (PI *vs.* PII) were studied. Sward density and pre-grazing sward height were higher in high compared to medium pre-grazing PM swards in PI (P<0.001, 255 *vs.* 235 kg DM/cm/ha and P<0.001, 14.8 *vs.* 10.9 cm, respectively) and PII (P<0.001, 216 *vs.* 196 kg DM/cm/ha and P<0.001, 14.3 *vs.* 13.0 cm, respectively). Lower post-grazing sward height and higher pasture utilization were obtained in low compared to high PA swards in PI (P<0.001, 4.1 *vs.* 4.9 cm and P<0.001, 98.8 *vs.* 89.9 %, respectively) and PII (P<0.001, 4.3 *vs.* 5.0 cm and P<0.001, 97.1 *vs.* 89.9 %, respectively). Pasture crude protein content and pasture organic matter digestibility were higher in medium compared to high pre-grazing PM swards in PI (P<0.001, 210 *vs.* 176 g/kg DM and P<0.05, 846 *vs.* 836 g/kg DM, respectively) and PII (P<0.05, 212 *vs.* 192 g/kg DM and P<0.05, 828 *vs.* 821 g/kg DM, respectively). This was due to higher leaf and lower dead proportions in medium than in high pre-grazing PM swards. Pasture dry matter intake (PDMI) (P<0.001, 16.5 *vs.* 14.7 kg DM/cow/day), milk yield (MY) (P<0.01, 23.8 *vs.* 22.7 kg/day) and milk solids yield (MSY) (P<0.05, 1.69 *vs.* 1.61 kg/cow) were higher in high compared to low PA swards in PI. Higher PDMI (P<0.001, 15.7 *vs.* 14.1 kg DM/cow/day), MY (P<0.001, 15.4 *vs.* 13.6 kg/day) and MSY (P<0.01, 1.19 *vs.* 1.08 kg/cow) were also found in high than in low PA swards in PII. The highest (P<0.001) milk output per ha (16,983 kg/ha) and milk solids per ha (1,268 kg/ha) were found in the group of dairy cows grazing in the M20 swards.

Key words: grass intake, herbage allowance, herbage on offer, milk yield, pasture quality

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ISSN 0372-5480
Printed in Croatia

Introduction

Pre-grazing pasture mass (PM, kg DM/ha) and pasture allowance (PA, kg DM/cow/day) are important factors of grazing management that govern pasture-based milk production systems (McEVOY et al., 2009). They may influence sward quality (to modify pasture organic matter digestibility, crude protein, fibre and carbohydrates content) and act on sward structural characteristics (to change the proportions of leaf, stem and dead material in the swards). Moreover, they may condition pasture dry matter intake (PDMI, kg DM/cow/day, to adjust the quantity of pasture to be ingested by each cow daily) and regulate milk performance of cows (to alter the quantity and the quality of the milk produced). McEVOY et al. (2009) found that maintaining pastures at medium *vs.* high pre-grazing PM level (1,700 *vs.* 2200 kg DM/ha) and offering them to cows at high *vs.* low PA level (20 *vs.* 16 kg DM/cow/day) increases milk output per ha and per cow, with a minimal decrease in sward quality, while maintaining low post-grazing residuals. The aim of this trial was to investigate how treatments, two levels of pre-grazing PM (1,600 *vs.* 2,400 kg DM/ha) and two levels of PA (15 *vs.* 20 kg DM/cow/day), similar to those used by McEVOY et al. (2009) would influence sward quality, PDMI and milk performance of Holstein-Friesian cows at grazing.

Materials and methods

Location. The trial was carried out at Moorepark Dairy Production Research Centre (Co. Cork, Ireland) from April 4 to October 31 in 2008. The experimental area was under permanent pasture with five year-old perennial ryegrass (*Lolium perenne* L.) swards. Three late-heading diploid cultivars (Twystar, Cornwall and Gilford) were the sown varieties.

Experimental design and treatments. The effect of offering two pre-grazing PM levels (kg DM/ha): medium (M-1,600) *vs.* high (H-2,400); and two PA levels (kg DM/cow/day): low (15) *vs.* high (20) was studied on sward quality, PDMI and milk performance of Holstein-Friesian cows grazing in perennial ryegrass swards. A randomized block design was applied, with a 2x2 factorial arrangement of four treatments: M15, M20, H15 and H20.

Grazing management. The experimental area (21.3 ha) was divided into ten paddocks (with five paddocks per each pre-grazing PM treatment). Each paddock was further divided into two sub-paddocks (randomly assigned to one of the two PA treatments). The entire area was rotationally grazed once during the pre-experimental period to a post-grazing sward height of 4.0 ± 0.07 cm. Nitrogen fertilizer was applied after each paddock had been grazed from April to August, with a total amount of 250 kg N/ha applied to each farmlet (60-50-50-50-40 kg N/ha). Sward and animal data were analysed by considering two consecutive grazing periods in dairy cows: PI (from April 9 to July 20) and PII (from July 21 to October 31).

Sward measurements. Pre-grazing PM (>4.0 cm) was determined twice weekly by harvesting two strips per treatment (1.2 m wide × 10 m long) with an Agria machine (Etesia UK Ltd., Warwick, UK). Ten sward height measurements were recorded, before and after harvesting on each cut strip, by an electronic plate meter (URBAN and CAUDAL, 1990) with a plastic plate (30 cm × 30 cm and 4.5 kg/m; Agrosystèmes, Choiselle, France). All pasture harvested from each strip was collected, weighed and sampled. A bulk sub-sample of 100 g was taken from each harvested strip and then was oven dried for 48 h at 40ºC until chemical analysis. Pre-grazing PM (<4.0 cm) was measured within the harvested strip by cutting the remaining pasture with a scythe to ground level using a 0.5 × 0.2 m quadrant. The pasture sample was then weighed and oven dried for 24 h at 80ºC to determine DM content. Daily PA (kg DM/cow/day) was calculated by dividing the pre-grazing PM (kg DM/ha) x total area to be grazed (ha) by the number of animals (cows) x number of days (days). Tiller density was calculated by JEWISS' method (1993). One hundred tillers were randomly selected, weighed and dried for 24 h at 80 °C to determine DM content. Pre- and post-grazing sward heights were determined throughout the experiment by taking 30 measurements across the two diagonals of each paddock for each treatment, using the electronic plate meter. Pasture utilization (> 4.0 cm) was calculated using the method reported by DELABY and PEYRAUD (1998).

Sward quality. Sward samples were analysed for dry matter (DM) content, crude protein (CP) (Leco FP-428; Leco Australia Pty Ltd.), acid (ADF) and neutral (NDF) detergent fibre (AOAC, 1995; method 973.18) using the sodium sulphate method (ANKOM™ technology, Macedon, NY, USA) and for organic matter digestibility (OMD) using the MORGAN et al. (1989) method (Fibertec™ Systems, FOSS, Ballymount, Dublin 12, Ireland).

Sward structural characteristics. The proportion and relative vertical distribution of leaf, stem and dead material in the swards were weekly determined. For that, approximately twenty pasture samples were taken at random by cutting with a scythe at ground level in the area to be grazed the following day. A bulk 150 g sub-sample of pasture was cut into two fractions (<4.0 cm and >4.0 cm). Each fraction was manually separated into leaf, stem and dead material and weighed. Each sward constituent was then oven dried for 24 h at 80 ºC for DM determination.

Pasture intake. Individual PDMI was estimated four times during this trial using the n-alkane technique (MAYES et al., 1986), modified by DILLON and STAKELUM (1989). The n-alkane concentration was determined as reported by DILLON (1993).

Animal measurements. Sixty-four spring calving, primiparous (n = 24) and multiparous (n = 40) Holstein-Friesian cows were selected from the Moorepark herd.

The cows were balanced according to calving date (February 11 ± 23.9 days), lactation number (2.6 ± 1.74), pre-experimental milk yield (29.3 ± 4.8 kg/cow), milk fat content (43.9 ± 0.88 g/kg), milk protein content (33.4 ± 0.286 g/kg), body weight (BW) (513 ± 74.4 kg) and body condition score (BCS) (2.96 ± 0.55). The cows were then blocked into four groups (n = 16) and each group was randomly assigned to one of the four grazing treatments (M15, M20, H15 and H20). The cows were on average 53 days in milk when the experiment started. No concentrate was offered at all during both periods. Milking took place at 07.00 h and 16.00 h daily. Milk yield (MY) (kg) was recorded from each cow at each milking (Dairymaster, Causeway, Co. Kerry, Ireland). Milk protein, fat and lactose content were determined by MilkoScan 203 (DK-3400, Foss Electric, Hillerød, Denmark). Solids-corrected MYs were calculated using the equation of TYRRELL and REID (1965). Body weight (BW) was measured weekly, and body condition score (BCS) was registered weekly by an experienced observer using a 1 to 5 scale (LOWMAN et al., 1976).

Statistical analysis. All statistical analyses were made using SAS (2005). Milk production, PDMI and sward parameters were analysed considering two individual periods: PI and PII.

All sward measurements were analysed using analysis of variance. Pasture data were analysed applying the following model: $Y_{jkl} = \mu + H_j + P_k + R_l + H_j \times P_k + e_{jkl}$.

Cow variables were analysed by covariate analysis. Daily MY, milk composition, milk constituent yields, BW, BCS and PDMI data were analysed for each period by using the following model: $Y_{ijk} = \mu + Pr_i + H_j + P_k + H_j \times P_k + b_1 X_{ijk} + b_2 DIM_{ijk} + e_{ijk}$.

Results

Grazing management. On average, the medium pre-grazing PM swards had three more (P<0.001) rotations, with lower (P<0.001) length of rotation (-10 days), than the high pre-grazing PM swards (6 rotations and 32 days, respectively). The medium pre-grazing PM swards were allocated a greater (P<0.001, +34 m^2/cow/day) mean grazing area per day than the high pre-grazing PM swards (74 m^2/cow/day). Offering the high PA swards increased mean grazing area (P<0.001, +19 m^2/cow/day) over the low PA swards (82 m^2/cow/day). Pasture growth rate was 9.5 kg DM/ha/day lower (P<0.001) in the low compared to the high PA swards (75.5 kg DM/ha/day). Milk output per ha and milk solids per ha were higher (P<0.001) in the medium (16,020 and 1,202 kg/ha, respectively) than in the high pre-grazing PM swards (14,658 and 1,115 kg/ha, respectively). Cows grazing in the M20 swards showed the highest (P<0.001) milk output per ha (16,983 kg/ha) and milk solids per ha (1,268 kg/ha).

Sward measurements. Mean pre-grazing PM was lower in the medium than in the high PM swards in PI (P<0.001, 1552 *vs.* 2679 kg DM/ha, respectively) and PII (P<0.001,

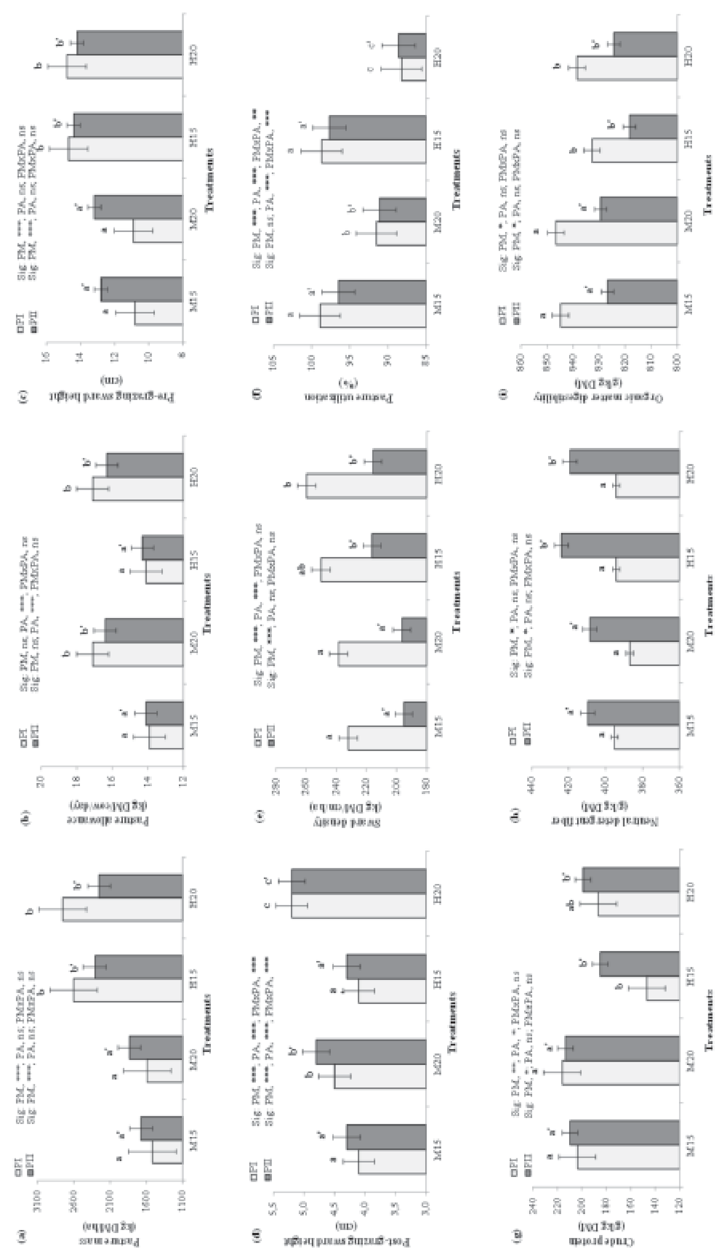

Fig. 1. (a-i) Effect of (a) pre-grazing pasture mass (PM; M-1,600 or H-2,400 kg DM/ha) and (b) pasture allowance (PA; 15 or 20 kg DM/cow/day) on (c) pre- and (d) post-grazing sward heights, (e) sward density, (f) pasture utilization and (g-i) swards quality in two periods. [a-c] Values in the same period not sharing a common superscript are different ($P<0.05$). ns: not significant ($P\geq0.05$); ***, $P<0.001$; **, $P<0.01$; *, $P<0.05$.

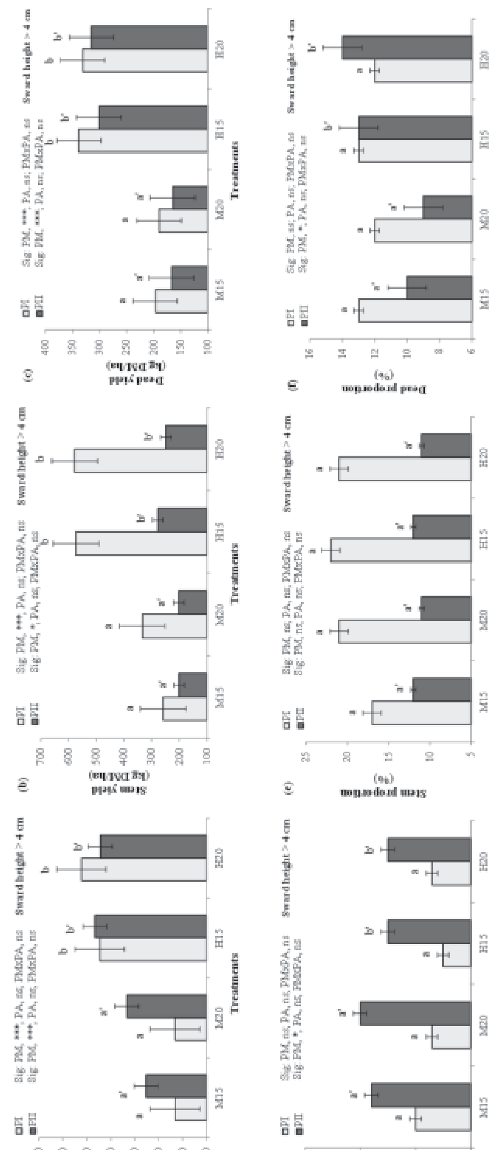

Fig. 2. (a-f) Effect of pre-grazing pasture mass (PM; M-1,600 or H-2,400 kg DM/ha) and pasture allowance (PA; 15 or 20 kg DM/cow/day) on (a-c) leaf, stem and dead yields and (d-f) leaf, stem and dead proportions of perennial ryegrass swards rotationally grazed by mixed parity Holstein-Friesian dairy cows to greater than 4.0 cm of sward height in two periods. [1]See Fig.1.

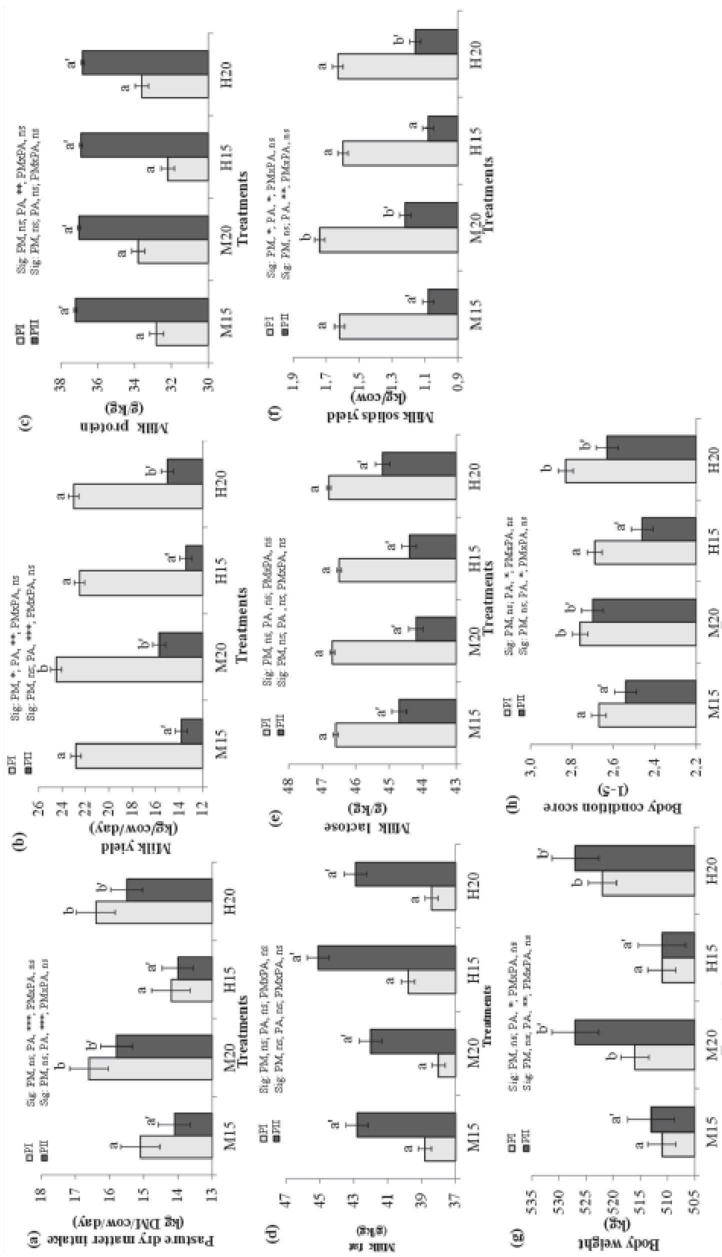

Fig. 3. Effect of pre-grazing pasture mass (PM; M-1,600 or H-2,400 kg DM/ha) and pasture allowance (PA; L-15 or H-20 kg DM/cow/day) and their interaction on (a) pasture dry matter intake, (b) milk yield, (c) milk protein content, (d) milk fat content, (e) milk lactose content, (f) milk soids yield, (g) body weight and (h) body condition score of mixed parity Holstein-Friesian dairy cows in two periods. [1]See Fig. 1.

1753 *vs.* 2281 kg DM/ha, respectively) (Fig. 1a). Mean PA was lower in the low than in the high PA swards in PI (P<0.001, 14.0 *vs.* 17.1 kg DM/cow/day, respectively) and PII (P<0.001, 14.2 *vs.* 16.4 kg DM/cow/day, respectively) (Fig. 1b). Pre-grazing sward height (Fig. 1c) and sward density (Fig. 1e) were greater in the high than in the medium pre-grazing PM swards in PI (P<0.001, 14.8 *vs.* 10.9 cm; P<0.001, 255 *vs.* 235 kg DM/cm/ha, respectively) and PII (P<0.001, 14.3 *vs.* 13.0 cm; P<0.001, 216 *vs.* 196 kg DM/cm/ha, respectively). In PI, greater sward density (P<0.001) was observed in the high than in the low PA swards (249 *vs.* 241 kg DM/cm/ha, respectively). The lowest post-grazing sward height (Fig. 1d) and the highest pasture utilization (Fig. 1f) were found in the low rather than in the high PA swards in PI (P<0.001, 4.1 *vs.* 4.9 cm; P<0.001, 98.8 *vs.* 89.9 %, respectively) and PII (P<0.001, 4.3 *vs.* 5.0 cm; P<0.001, 97.1 *vs.* 89.9 %, respectively). There was interaction between pre-grazing PM and PA for post-grazing sward height (P<0.001) and pasture utilization (P<0.01) in both periods.

Sward quality. In PI, greater CP (Fig. 1g) (P<0.001; +34 g/kg DM) and OMD (Fig. 1i) (P<0.05; + 10 g/kg DM) were found in the medium than in the high pre-grazing PM swards (176 and 836 g/kg DM, respectively). In PII, lower NDF (Fig. 1h) (P<0.05; -13 g/kg DM) but higher CP (P<0.05; +20 g/kg DM) and OMD (P<0.05; +7 g/kg DM) were found in the medium than in the high pre-grazing PM swards (422; 192; 821 g/kg DM, respectively). In PI, CP was greater (P<0.05; +17 g/kg DM) in the high than in the low PA swards (184 g/kg DM).

Sward structural characteristics. In PI, leaf (Fig. 2a), stem (Fig. 2b) and dead (Fig. 2c) yields were greater (P<0.001) in the high (1769, 576 and 335 kg/DM/ha, respectively) than in the medium pre-grazing PM swards (1063, 296 and 194 kg/DM/ha, respectively). In PII, leaf (Fig. 2a) and dead (Fig. 2c) yields were also greater (P<0.001) in the high (1711 and 308 kg/DM/ha, respectively) than in the medium PM swards (1386 and 166 kg/DM/ha, respectively). There were no differences in leaf (Fig. 2d), stem (Fig. 2e) and dead (Fig. 2e) proportions for the upper sward horizon in PI. However, in PII higher (P<0.05) leaf (Fig. 2d) and lower dead (Fig. 2f) proportions were observed in the medium (79 and 10 %, respectively) than in the high pre-grazing PM swards (75 and 15 %, respectively).

Pasture intake. There was no interaction between pre-grazing PM and PA for PDMI in PI and PII (Fig. 3a). There was no effect of pre-grazing PM on PDMI in both periods. However, PA showed an effect (P<0.001) on PDMI in PI and PII. Cows offered the high PA swards had higher PDMI (Fig. 3a) (P<0.001) than those offered the low PA swards in PI (16.5 *vs.* 14.7 kg DM/cow/day, respectively) and PII (15.7 *vs.* 14.1 kg DM/cow/day, respectively).

Animal measurements. Cows offered the high PA swards showed higher MY (Fig. 3b) and milk solids yield (MSY) (Fig. 3f) than those offered the low PA swards in PI (P<0.01, 23.8 *vs.* 22.7 kg/day; P<0.05, 1.69 *vs.* 1.61 kg/cow, respectively). Similar results were found in PII in comparison of high *vs.* low PA swards for MY and MSY (P<0.001, 15.4 *vs.* 13.6 kg/day; P<0.01, 1.19 *vs.* 1.08 kg/cow, respectively). In PI, cows in the medium pre-grazing PM swards had higher MY (P<0.05, +0.9 kg/day) and MSY (P<0.05, +0.06 kg/cow) than those in the high pre-grazing PM swards (22.8 kg/day and 1.62 kg/cow, respectively). Greater milk protein content (Fig. 3c) was found in PI in cows grazing the high (P<0.001, +1.2 g/kg) than in those grazing the low PA swards (32.5 g/kg). However, there was no effect (P>0.05) of pre-grazing PM and PA on milk fat (Fig. 3d) and lactose (Fig. 3e) content in PI and PII. The highest PDMI and MY were achieved by cows grazing the M20 swards in both periods. Milk output and milk solids per ha were greater (P<0.001) in cows on the medium pre-grazing PM swards (16,020 and 1,202 kg/ha, respectively) than in those on the high pre-grazing PM swards (14,658 and 1,115 kg/ha, respectively). The M20 swards had the highest (P<0.001) milk output (16,983 kg/ha) and milk solids per ha (1,268 kg/ha). There was an effect of PA on BW and BCS. Cows in the high PA swards showed higher BW (Fig. 3g) and BCS (Fig. 3h) than those in the low PA swards in PI (P<0.05, 519 *vs.* 511 kg and P<0.05, 2.80 *vs.* 2.68, respectively) and PII (P<0.01, 527 *vs.* 512 kg and P<0.05, 2.67 *vs.* 2.50, respectively).

Discussion

Grazing management, sward measurements and sward quality. The results from this study indicate the importance of using medium *vs.* high pre-grazing PM swards during the grazing season, by ensuring lower post-grazing sward heights, higher pasture utilization and greater sward quality (higher CP and OMD values) that enabled dairy cows to achieve greater MY due to higher grazing intensity as reported by STAKELUM and DILLON (2007).

Sward structural characteristics. The results from the current experiment show that in PII compared to PI, there was higher leaf proportion and lower dead proportion in the upper sward horizons. This was due to the previous grazing management imposed. Applying the medium pre-grazing PM level throughout the grazing season in the current trial increased the leaf to stem ratio (5.15) compared to the high pre-grazing PM level applied (4.62). This agrees with the results of McEVOY et al. (2009), who reported a cumulative effect of grazing severity on leaf to stem ratio.

Pasture intake. There was no effect of pre-grazing PM swards on PDMI in either period. Nevertheless, in PI the medium and the high pre-grazing PM levels had similar NDF contents, but in PII, following the reproductive stage of the plant, the quality of the medium pre-grazing PM swards remained relatively constant, while the high pre-grazing PM sward quality deteriorated, with high NDF content. Thus, in PI, offering the high pre-grazing PM swards resulted in higher levels of PDMI. However, in PII the PDMI of the M15 swards was similar to that of the H15 swards, while the PDMI of the M20 swards was significantly higher than all other treatments. Data from the current experiment show that, the PA (P<0.001) had a large effect on PDMI. In fact, increasing the PA led to higher PDMI in both periods. However, the PDMI response to the PA was different between the periods. For the same post-grazing sward height, the PDMI difference between the low PA groups was higher in PI than in PII. This is explained by the fact that post-grazing sward height rapidly increases with increasing PA. Therefore, grazing too leniently in spring to increase PA and/or cow performance results in deterioration of sward quality in mid- to late-season, and in a sharp reduction in cow performance in subsequent grazing rotations. The implication is that grazing systems designed to maximize individual cow performance are inefficient in utilization per ha. Thus, the possibilities to increase PDMI by increasing PA are rather limited on a long-term basis and alternative strategies are necessary to increase PDMI and milk production from grazing systems. An interesting strategy would be to develop sward structures with high leaf proportion and low dead proportion, allowing the maintenance of a high PDMI together with a low residual post-grazing sward height (McEVOY et al., 2009).

Animal measurements. The higher levels of MY and MSY per cow found in the current trial on the M20 swards in both periods was likely due to the cumulative effect of several sward conditions: higher sward quality, better sward structural characteristics and greater PDMI. STAKELUM and DILLON (2007) described large differences in MY (ranging between 2.6 and 2.1 kg/cow/day) when treatment differences in pre-grazing PM levels were up to 2,300 kg DM/ha. McEVOY et al. (2009) showed 0.4 kg more milk per day in the medium pre-grazing PM swards (1700 kg DM/ha) when compared to the high pre-grazing PM swards (2200 kg DM/ha). This is in line with the results of the current study (0.8 kg more milk per day were found in the medium *vs.* the high pre-grazing PM swards). In our study, an increase in MY and MSY was found by enhancing PDMI, offering high *vs.* low PA swards throughout the grazing season. STAKELUM and DILLON (2007) and McEVOY et al. (2009) reported similar results to those mentioned.

Milk output and milk solids per hectare. The results obtained from our experiment indicate that offering medium pre-grazing PM and high PA swards to dairy cows increases milk output per ha and milk solids per ha. This mainly occurs due to improved sward quality because of intense grazing of the sward throughout the grazing season (McEVOY et al., 2009). This increase in milk output (+8.5 %) and milk solids (+7.2 %) per ha from the medium compared to the high pre-grazing PM swards and in milk output (+10.8 %) and milk solids (+9.0 %) per ha from the high compared to the low PA swards highlights the potential importance of applying efficient grazing management practices in pasture-based milk production systems.

Conclusions

The combination of medium pre-grazing PM and high PA swards resulted in: (1) enhanced sward quality due to higher CP and OMD values, (2) improved efficiency of grazing management due to low post-grazing residuals but high pasture utilization, and (3) better sward structural characteristics were achieved due to higher leaf and lower dead proportions (>4.0 cm) in the swards. It resulted in higher PDMI, MY and MSY. More milk solids per cow and milk solids per ha were achieved by Holstein-Friesian cows grazing in the M20 swards than in the rest of the sward treatments compared. Therefore, applying appropriate grazing management strategies offers further benefits from pasture-based milk production systems.

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Received: 29 September 2014
Accepted: 9 June 2015

ROCA-FERNÁNDEZ, A. I., M. A. O'DONOVAN, J. CURRAN, A. J. GONZÁLEZ-RODRÍGUEZ: Utjecaj prinosa pašnjaka i pašnog obroka na kvalitetu travnjaka, unos paše i proizvodnju mlijeka. Vet. arhiv 85, 609-620, 2015.

SAŽETAK

Šezdeset četiri holštaj-frizijske krave nasumično su razvrstane u četiri skupine (M15, M20, H15 i H20), uzevši u obzir 2x2 faktorijalni dizajn s obzirom na: dvije razine prinosa pašnjaka prije napasivanja (PM, kg DM/ha) - srednja (M-1600) naprema visoka (H-2400), te dvije razine pašnog obroka (PA, kg DM / krava / dan) - niski (15) naprema visoki (20). Istražena su dva razdoblja (PI naprema PII). Između travnjaka s visokim i srednjim prinosom prije napasivanja (PM), u prvom razdoblju utvrđene su razlike s obzirom na gustoću travnjaka (P<0,001; H = 255 naprema M = 235 kg DM/cm/ha) i visinu trave (P<0,001; H = 14,8 naprema M = 10,9 cm). U drugom razdoblju, statistička značajnost i razlike između navedenih skupina iznosili su P<0,001; H = 216 naprema M = 196 kg DM/cm/ha i P<0,001; H = 14,3 naprema M = 13,0 cm. Najniža visina trave i najviša iskoristivost pašnjaka nakon napasivanja utvrđene su usporedbom niskog i visokog pašnog obroka tijekom prvog razdoblja (P<0,001; niski = 4,1 naprema visoki = 4,9 cm te P<0,001; niski = 98,8 naprema visoki = 89,9%) kao i tijekom drugog razdoblja (P<0,001; niski = 4,3 naprema visoki = 5,0 cm te P<0,001; niski = 97,1 naprema visoki = 89,9%). Sadržaj sirovih proteina i probavljivost organske tvari tijekom prvog razdoblja bili su viši kod pašnjaka sa srednjim prinosom pašnjaka prije napasivanja u odnosu na pašnjake s visokom razinom prinosa prije napasivanja (P<0,001; M = 210 naprema H = 176 g/kg DM i P<0,05; M = 846 naprema H = 836 g/kg DM. Tijekom drugog razdoblja, statistička značajnost i vrijednosti navedenih pokazatelja iznosili su (P<0,05; M = 212 naprema H = 192 g/kg DM i P<0,05; M = 828 naprema H = 821 g/kg DM). Navedeno se može pripisati većem udjelu lišća i manjem udjelu uvenule mase na pašnjacima sa srednjim prinosom prije napasivanja u odnosu na pašnjake s visokim prinosom prije napasivanja. Usporedba niskog i visokog pašnog obroka tijekom prvog razdoblja, pokazala je statistički značajne razlike za unos suhe tvari pašom (P<0,001; niski = 16,5 naprema visoki = 14,7 kg DM/krava/dnevno), proizvodnju mlijeka (P<0,01; niski = 23,8 naprema. visoki = 22,7 kg/day) te proizvodnju krute tvari mlijeka (P<0,05; niski = 1,69 naprema. visoki = 1,61 kg/krava). Tijekom drugog razdoblja, viši unos suhe tvari pašom utvrđen kod visokoga pašnog obroka u odnosu na niski pašni obrok (P<0,001; visoki = 15,7 naprema niski = 14,1 kg DM/krava/dnevno), viša je bila i proizvodnja mlijeka (P<0,001; visoki = 15,4 naprema niski = 13,6 kg/day) te proizvodnja krute tvari mlijeka (P<0,01; visoki = 1,19 naprema niski = 1,08 kg/krava). Najviša proizvodnja mlijeka po hektaru (P<0,001; 16,983 kg/ha) i krute tvari mlijeka po hektaru (1,268 kg/ha) utvrđena je kod krava koje su napasivane u skupini M20 travnjaka.

Ključne riječi: unos trave, obrok trave, proizvodnja mlijeka, kvaliteta pašnjaka