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Effect of rotationally grazing perennial ryegrass white clover or perennial ryegrass only swards on dairy cow feeding behaviour, rumen characteristics and sward depletion patterns

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ABSTRACT

The effect of sward type, grass only (GO) or grass white clover (GWc), on lactating dairy cow feeding behaviour, herbage depletion rate and rumen function was investigated in rotationally strip-grazed swards at a daily herbage allowance of 17 kg dry matter (DM)/cow/day, in two experiments. In 2011, eight rumen-cannulated cows were blocked into two groups and allocated to each sward type for a 14-day period in a change-over design (2 sward types × 2 periods) on three occasions: late spring, summer, and autumn. Feeding behaviour, rumen pH and rumen volatile fatty acids and ammonia contents were measured. Following a continuous design, in 2012 feeding behaviour and herbage depletion rate measurements were undertaken at similar times to those in 2011 over 2–3 weeks in late spring, summer and autumn. Twenty-six (spring) and 36 (summer and autumn) cows were used. Grazing sward height (GSH) was measured five times/day. The percentage of grazed vegetative units, and the extended tiller height, free leaf lamina, tiller DM weight and tiller leaf DM weight of perennial ryegrass (ryegrass) tillers were estimated four times/day. During late spring, summer and autumn, sward white clover content (DM basis) was 7.5%, 8.8% and 30.9%, respectively, in 2011, and 18.0%, 29.7% and 30.6%, respectively, in 2012. In 2011 cows had similar grazing times on both sward types. Cows on GWc spent less time ruminating than cows on GO. Cows had similar total volatile fatty acids on both swards but the isoacids and D-lactic acid percentages, ammonia content and rumen pH were higher in autumn for cows grazing GWc. In 2012, cows on GWc grazed for longer in late spring, ruminated for less time in summer and for less time at night in autumn compared to cows grazing the GO sward. Both sward types had similar post-grazing sward heights and sward height depletion rates, except during morning grazing in autumn, when GWc had a greater sward height depletion rate. A similar percentage of grazed ryegrass tillers was observed between sward types, but the percentage of ryegrass grazed was greater than the percentage of white clover grazed in the GWc swards. The ryegrass tillers in the GWc swards were smaller than those in the GO swards but had similar depletion rates. The GWc swards influenced cow feeding

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behaviour and rumen characteristics with increased effect in autumn because of an increase in white clover content and a decrease in ryegrass quality.

1. Introduction

In temperate regions, such as New Zealand and Ireland, dairy systems are predominately grass based. In these regions, perennial ryegrass (hereafter referred to as "ryegrass", *Lolium perenne* L.) is the most widely sown grass species (Belgrave et al., 1990; Rath et al., 2005). The quality and quantity of herbage in ryegrass dominant (hereafter referred to as "ryegrass only") swards are highly dependent on nitrogen (N) fertiliser application.

The N fertilizer application restrictions established by EU legislation (Council Directive 91/676/EEC) have resulted in renewed interest in white clover (hereafter referred to as "clover", *Trifolium repens* L.) utilisation in Ireland due to its ability to fix atmospheric N, high tolerance to grazing pressure and high nutritional quality (Frame and Newbould, 1986; Steinshamn, 2010).

Rutter et al. (2004) reported that dairy cows showed a partial preference for clover compared to ryegrass, as clover represented 74% of the diet when the two species were available as side-by-side swards. This partial preference was attributed to the faster rumen passage rate of clover compared to ryegrass, as clover is more easily broken down due to its lower fibre content and higher fermentation rate (Beever et al., 1986a; Dewhurst et al., 2003; Steinshamn, 2010). Consequently cows grazing grass white clover (hereafter referred to as "mixed") swards spend more time grazing, have faster intake rates (Ribeiro Filho et al., 2003, 2012) and spend less time ruminating (Phillips et al., 2000) than cows grazing ryegrass only swards. Differences in rumen fluid characteristics, such as the quantity and proportions of volatile fatty acids (VFA), and rumen pH, have been reported between cattle fed clover (Beever et al., 1986a, 1986b; Dewhurst et al., 2003) or mixed (Ribeiro Filho et al., 2003) compared to ryegrass only fodder (grazing, zero grazing grass or silage). As a result, cows grazing mixed swards ad libitum can potentially increase dry matter (DM) intake (DMI) and ultimately milk yield relative to ryegrass only swards (Harris et al., 1997; Phillips and James, 1998; Ribeiro Filho et al., 2003). The preference for clover relative to the other sward constituents in mixed swards has not been clearly assessed due to the difficulty in identifying the herbage species selected without disturbing natural feeding behaviour pattern. Additionally, it is unclear what effect the cow's preference for clover will have on the feeding behaviour pattern in rotationally grazed mixed swards when a restriction is imposed, such as where a fixed daily herbage allowance (DHA) is offered.

Rotationally grazed ryegrass only (Barrett et al., 2001; Orr et al., 2004) and clover only swards (Orr et al., 2004) change in structure and composition as the sward is depleted. The daily grazing motivational state of cattle fluctuates between hunger-stimulating and satiety-eliciting (Baile and McLaughlin, 1987; Phillips, 1993). The changes in sward structure (e.g. leaf:stem ratio and density), added to the motivational feeding state, lead to different grazing behaviour patterns (Barrett et al., 2001; Orr et al., 2004), but the specific effects of adding clover into ryegrass swards are unknown.

The clover content of grazed swards varies throughout the grazing season. Thus it is likely that feeding behaviour and the ruminal digestion process on mixed swards will vary depending upon the time of year and also differ compared to cows grazing on ryegrass only swards. Recording the sward depletion rate would provide information that could help develop better strategies to optimise mixed swards management and utilisation under intensive rotational grazing.

The objectives of this experiment were to identify the effect of white clover inclusion in perennial ryegrass swards, rotationally strip-grazed under intensive grazing conditions, on daily feeding behaviour pattern, sward depletion rate and rumen characteristics during the grazing season.

2. Material and methods

Two experiments were undertaken at Teagasc, Dairygold Research Farm, Animal & Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork, Ireland (52°09′N; 8°16′W; 46 m a.s.l.) during 2011 and 2012. Site description, sward management and animal production are described in Enriquez-Hidalgo et al. (2014) for 2011. Management was similar in 2012. Briefly, the ryegrass only (GO) and mixed (GWc) swards were established in 2010 and each year both received 260 kg N/ha/yr. Fertiliser N was applied following grazing; 60 kg N/ha of urea were applied before the end of April and 200 kg N/ha of calcium ammonium nitrate thereafter. At the beginning of each grazing season 30 and 40 spring-calving dairy cows in 2011 and 2012, respectively, were balanced on breed and previous animal performance traits and then randomly assigned to graze each sward (hereafter referred to as "main herds"). Rotational grazing was practiced and swards were strip grazed using a temporary electric fence with fresh herbage offered daily after morning milking. Target post-grazing sward height (Post-GSH) was 4 cm above ground level (>4 cm) and cows received a DHA of 17 kg DM/cow/day (>4 cm). If a Post-GSH greater than 4 cm was measured, cows grazed the same area until the target 4 cm Post-GSH was attained. Swards were not topped during the experiments. The DHA was calculated according to the estimated sward density and the daily pre-grazing sward height (Pre-GSH, see below). Cows had free access to a water trough and received no supplementation. Milking took place at ~8:00 h and at ~15:00 h daily and cows spent ~3 h per day outside the grazing area. Animal handling and sampling procedures carried out in the experiments were performed according to the Irish Minister for Health and Children guidelines set under section 8 of the Cruelty to Animals Act, 1876.