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T. Tubritt, T.J. Gilliland, Luc Delaby, M O'Donovan. Comparison of perennial ryegrass varieties for differences in grazing efficiency. Joint 20. Symposium of the European Grassland Federation and 33. Meeting of the Eucarpia section "Fodder Crops and Amenity Grasses", Jun 2019, Zürich, Switzerland. Wageningen Academic Publishers, Grassland Science in Europe, 24, 2019, Grassland Science in Europe. hal-02293582

HAL Id: hal-02293582

<https://hal.science/hal-02293582v1>

Submitted on 2 Jun 2020

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Comparison of perennial ryegrass varieties for differences in grazing efficiency

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Abstract

The aim of this study was to determine differences in grazing efficiency between varieties of perennial ryegrass (*Lolium perenne* L.) and to determine varietal traits influencing grazing efficiency. Grazing efficiency refers to the proportion of leaf tissue that is removed, relative to the amount presented to the animals prior to grazing. Low post-grazing sward heights are desirable as they condition the sward to increase leaf production and thus reduce the proportion of stem in the sward in subsequent rotations. Thirty varieties of perennial ryegrass from the Irish Recommended List were studied. The plots were grazed on nineteen occasions over two years, 2017 and 2018. Pre-grazing sward height, post-grazing sward height, herbage production, nutritive quality and morphology were measured throughout the trial. Varieties differed in their level of grazing efficiency ($P < 0.001$) with post-grazing sward heights ranging from 3.54 to 4.60 cm. Residual Grazed Height (RGH) was derived as a measure of grazing efficiency calculated as the difference between achieved post-grazing height and predicted post-grazing height from a mixed model. Nutritive quality analysis was shown to have a significant effect on grazing efficiency. Organic matter digestibility (OMD) was shown to have a significant negative effect on post-grazing sward height ($R^2 = 0.63$). Tetraploids had greater OMD than diploids (787 g kg⁻¹ DM vs 776 g kg⁻¹ DM respectively).

Keywords: grazing efficiency, perennial ryegrass variety, residual grazed height

Introduction

Maximising the level of herbage utilisation is identified as a key factor influencing profitability on Irish ruminant farms as grazed grass is the cheapest source of ruminant feed relative to purchased feed (Hanrahan *et al.*, 2018). In Ireland grass swards are predominantly harvested by livestock in grazing systems. Identifying perennial ryegrass (PRG) varieties and traits responsible for superior performance within these systems is worthwhile so that varieties employed can perform optimally. Mechanically harvested (cutting) protocols used in variety evaluation trials such as the Irish Recommended List only provide a partial measure of variety performance and thus may be limited in the information they supply (Byrne *et al.*, 2018). The main disadvantage of 'simulated grazing' (cutting protocol) is that varieties that perform well within these evaluation trials may disappoint when they are used on farm which reduces confidence in the trials. Poor grazing efficiency is one such disappointment. Varieties exhibiting greater grazing efficiency are easier to manage and increase herbage utilisation. They are grazed to lower post-grazing sward heights (PGSH) which maintains the quality of the sward in subsequent rotations by conditioning the sward to increase leaf production. Poor grazing efficiency within swards results in discontent and unsettled animals that do not achieve graze-out targets. Farmers may choose to mechanically correct these poor graze-outs by 'topping' but this represents costs to the system, increasing the labour requirement and reducing grass utilisation.

Materials and methods

In 2016, the thirty leading varieties from the Irish Department of Agriculture, Food and the Marine Recommended List were sown and established in 8×4.5 m plots under a randomised block design in three replicates. Fifteen diploid (D) and tetraploid (T) varieties of intermediate and late heading types were used. The plots were rotationally grazed by dairy cows over two grazing seasons, 2017 and 2018. An average of 60 cows grazed the 0.6 hectare paddock on each occasion. Cows were allocated area based on the demand of the herd and the herbage cover in the paddock. Cows were moved on to the next allocation when the majority of plots were grazed to a height of 4 cm. Prior to grazing a 1.2×5 m section of each plot was harvested with an Etesia grass mower to a height of 3.5 cm. Mown herbage was weighed and 0.1 kg of the mown herbage from each plot was dried at 90 °C for 16 hours to determine dry matter (DM) content and herbage yield. A Jenquip rising plate meter was used to measure grass sward height prior to grazing and to measure the PGSH of each plot. A separate sub-sample was obtained from the mown herbage, freeze-dried at -50 °C for 72 hours, milled and scanned under Near Infra-Red Spectrometry (NIRS) for nutritive quality. Analysis of the morphological structure of the sward was undertaken by selecting 20 tillers from each plot and measuring the free leaf lamina (FLL, extended tiller length minus extended sheath length). The leaf, pseudostem, true stem and dead proportions of each plot were also measured on a DM basis. The data were analysed in the statistical program SAS 9.3 (SAS Inst. 2011) using a mixed model with block, grazing event and year used as variables. To account for pre-grazing height differences between varieties, the PGSH of each variety was predicted using pre-grazing height as an additional variable in the model. Residual grazed height (RGH) was used to evaluate grazing efficiency. It is calculated by subtracting predicted from actual PGSH. A negative RGH indicates a greater utilisation performance.

Results and discussion

Varieties were found to significantly differ in PGSH ($P<0.001$). The average PGSH across the two years was 4.1 cm which ranged from 3.54 cm (Astonenergy (T)) to 4.6 cm (Boyne (D)). Pre-grazing height was shown to have a significant positive relationship with PGSH ($R^2=0.63$). Boyne had the greatest pre-grazing height at 11.13 cm which was 2.07 cm higher than the lowest variety Astonenergy at 9.06 cm. Astonenergy achieved the lowest RGH of -0.38; Clanrye (D) had the highest RGH of +0.34. Herbage yield is a major trait within variety evaluation and a key selection trait for farmers. Therefore, the superior varieties within this trait are those that achieve negative RGH values whilst also producing large herbage yields. Twymax (T) and Aspect (T) are examples of such varieties as they had RGH values of -0.2 and -0.18 and produced an average annual herbage yield of 13,400 and 12,500 kg DM ha⁻¹ respectively. From Figure 1 a positive relationship can be observed between herbage yield and RGH ($R^2=0.33$). Not all varieties conform to this relationship though. For example, varieties such as Twymax and Rostta (D) produced similar levels of herbage (13,000 kg DM ha⁻¹) but had large differences in RGH; -0.2 and +0.14 respectively. Tetraploids were shown to have significantly better graze-out performance than diploids ($P<0.001$). This can be seen in Figure 1 with tetraploids dominating the left (negative) portion of the graph and diploids dominating the right (positive). Varieties identified for superior graze-out performance had increased levels of Organic Matter Digestibility (OMD) and a greater proportion of leaf within the sward. A 10 g kg⁻¹ DM increase in OMD was associated with a 0.2 decrease in RGH ($R^2=0.63$). Tetraploid OMD (787 g kg⁻¹ DM) was 115 g kg⁻¹ DM greater than diploids (776 g kg⁻¹ DM) which equates to a 0.23 difference in RGH. Varieties with increased leaf proportion had lower RGH values. A 50 g kg⁻¹ DM increase in leaf proportion decreased RGH by 0.23 ($R^2=0.54$).

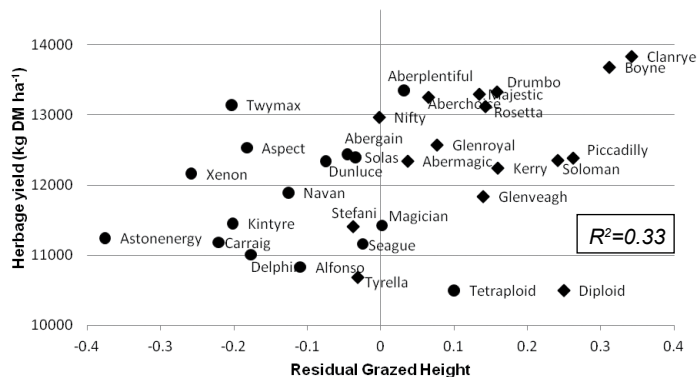


Figure 1. Relationship between varietal Residual Grazed Height and herbage yield.

Conclusion

Varieties were shown to differ in the level of efficiency that cows were able to graze them. Using RGH as a measure of grazing efficiency allowed varieties to be compared accurately by taking pre-grazing height differences into account. Herbage yield is a key trait of importance in variety selection and therefore high yielding varieties with negative RGH values are superior within grazing systems. Tetraploid varieties were identified as having a greater graze-out performance than diploids, although genetic variation between diploids shows room for improvement. As in other studies (such as O'Donovan and Delaby, 2005) increased OMD and increased leaf proportion were identified as factors responsible for improved grazing efficiency. Variety breeders can indirectly select for varieties with improved grazing efficiency by selecting for increased OMD and greater leaf proportion within the sward. The study also shows that farmers wishing to improve the grazability of their swards should incorporate increased proportions of tetraploids within their seed mix.

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