The effect of grazing high-sugar ryegrass on lamb performance

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Abstract

A multi-year grazing study was undertaken on three commercial properties in the southern South Island to compare the performance of lambs grazing high-sugar ryegrass/white clover (HSG) with lambs grazing a standard ryegrass/white clover pasture (SRG). Cultivars were established in late spring 2012; approximately 400 lambs in each treatment group per property grazed the swards in autumn 2013 and summer/autumn 2014 at a density of 30 to 35 lambs per hectare. Lambs were weighed regularly throughout the season; those that reached the desired weight were sent for slaughter. Across both years and properties, lambs grazing the HSG pasture grew 31 grams per day faster (17%) on average than those grazing SRG ($P<0.001$). These lambs were an average of 0.4 kg heavier in terms of carcase weight at slaughter ($P<0.001$) yielding 0.2 kg more meat per carcase based on VIAScan yield. These results suggest that lambs grazing HSG outperform those grazing SRG.

Keywords: high-sugar ryegrass; lamb performance

Introduction

High-sugar ryegrass (HSG) cultivars are currently being advocated in New Zealand as possessing a number of positive characteristics. These cultivars have been selectively bred for higher water-soluble-carbohydrate (WSC) concentrations (Humphreys 1989). Higher WSC content of grasses is believed to increase palatability and improve growth rates in sheep/lamb production systems and milk yields in dairy systems. NZ research has shown that HSG generates good performance in terms of dry matter (DM) yield and WSC content (Hume et al. 2010), albeit with some variation between warmer and cooler climates. Parsons et al. (2011) has shown that higher WSC content leads to higher rates of nitrogen retention. Considering that lamb liveweight gain reflects the underlying protein retention, HSG should not only offer improvements in carbon efficiency but also improved lamb performance. However, there appears to have been little research looking at the effects of HSG on overall lamb performance in New Zealand. A recent review showed that the relationship between the intake of HSG and liveweight gain has been inconsistent (Edwards 2007). Hence, a grazing study was undertaken to compare the performance of lambs grazing HSG with lambs grazing a standard ryegrass/white clover mix (SRG).

Materials and methods

Three southern South Island properties participated over two seasons (2012/13 and 2013/14) with each property grazing approximately 400 lambs on a HSG/white clover or SRG/white clover pasture.

On each property, two paddocks (6 to 6.5 ha) of similar aspect and topography were identified and sown in either a HSG/white clover or a SRG/white clover mix. Each property used their own ryegrass establishment protocol, with HSG and SRG being sown at a rate of 22 kg per hectare (Table 1). Ceres One50 was the SRG cultivar used across all properties.

Pasture management

Pastures were managed with various stock classes (included mixed-age ewes and cattle) leading up to the allocation of trial lambs. Pasture was allowed to recover to around 1,800 kg DM/ha before commencement of grazing trials. All pasture cover measurements was measured using a sward stick. At the beginning of each trial period, all paddocks were stocked at a density of 30 to 35 lambs per hectare. To control pasture quality during the trial and to ensure lamb feed intake was not restricted, a put-and-take stocking system was used to maintain pasture covers between 1,800 and 2,000 kg DM/ha. Therefore, a number of additional lambs were made available; these were added, or removed, as required. Additional lambs were also added to

Table 1 Pasture mix composition and sowing rates used for high-sugar ryegrass and standard-ryegrass mix pastures at all three sites.

High sugar ryegrass mix (HSG)		Standard perennial ryegrass mix (SRG)	
AberMagic with AR 1 endophyte	9 kg/ha	Ceres One50 with AR 1	18 kg/ha
AberDart with AR 1 endophyte	9 kg/ha	Medium-leaf white clover	2 kg/ha
Medium-leaf white clover	2 kg/ha		
Small-leaf white clover	2 kg/ha	Small-leaf white clover	2 kg/ha
Total sowing rate	22 kg/ha	Total sowing rate	22 kg/ha

Table 2 The effect of grazing high-sugar ryegrass/white clover or standard ryegrass/white clover on average daily gain (ADG), carcase weight at slaughter and weight of meat (from VIAScan) per carcase (least square means ± standard error of the mean, adjusted for the initial live weight).

Year	Treatment	ADG (kg/d)	Carcase weight (kg)	Meat (kg)
2012/13	HSG	0.238 ± 0.006	17.27 ± 0.07	9.46 ± 0.05
	SRG	0.215 ± 0.006	16.92 ± 0.06	9.23 ± 0.05
2013/14	HSG	0.210 ± 0.005	17.78 ± 0.04	9.65 ± 0.04
	SRG	0.171 ± 0.005	17.33 ± 0.05	9.47 ± 0.04
		Significant effects		
Treatment – HSG vs SRG		<0.001	<0.001	<0.001

maintain stocking densities when trial lambs were sent for slaughter. While the additional numbers of lambs and the grazing days were included in the analysis, the live weight gain data from these additional lambs were not included.

Animal management

Trial lambs were randomly selected (within each property) prior to allocation, tagged (electronic ID) and weighed. Lambs were held in the yards for six hours, quarantine-drenched, and then held for a further six hours prior to being allocated to their treatment group. Across all properties, treatment allocations were balanced for initial (start) live weight. In both years, lambs were weighed regularly throughout the season and those that reached the desired live weight (40.5 kg for slaughter 1, 43.5 kg for slaughter 2) were sent for slaughter at the Alliance Group Ltd Lorneville processing plant. Carcase weight and ViaScan® meat-yield data were collected for each lamb. Those that had not reached the desired weight remained on farm or were sold as stores.

Pasture composition

Bulk herbage samples were taken from each treatment per site and sent to Hill Laboratories (Hamilton) for extended feed analyses (crude protein, acid detergent fibre (ADF), neutral detergent fibre (NDF), soluble sugars and metabolisable energy (ME). Clover and any weed species were removed from the sample before analysis.

Data analyses

The data were analysed as a replicated design over two years with the three properties as replicates. The analysis used initial live weight, average liveweight gain, and the slaughter records of carcase weight and VIAScan® yield. The analysis used a linear model fitted in the statistical software package "R", version 3.1.0.

The analysis sought to estimate the effect of treatment where all recorded variables (property, year, start weight, days to slaughter and sex (one property only)) were fitted (and dropped when not significant). An interaction term for treatment by year was also fitted across all models. Linear effects of initial weight were fitted as a covariate in models of average daily gain, carcase weight and meat production. Pre-slaughter live weight was also fitted to models for carcase weight and meat production.

The 2013/14 season data for properties one and two were analysed for the proportion of animals slaughtered over two slaughter dates. This was to determine how increased growth rate was affecting the proportion of animals ready for slaughter at draft events. Grazing days were calculated to illustrate any productive differences between HSG and SRG. This is the number of days grazed multiplied by the number of lambs grazing the treatment. This includes any animals that have been added or removed from the treatment as a part of pasture management.

Results

Lamb performance

The comparisons of performance of lambs grazing HSG and SRG for lamb growth rates, carcase weights and VIAScan® yield are shown in Figure 1.

Performance across properties

Lambs grazing HSG had significantly greater ($P<0.001$) average daily gain, carcase weight at slaughter and ViaScan® yield than lambs grazing SRG (Table 4). Property and start date had a significant effect in all models and slaughter date had a significant effect on carcase weight and VIAScan® yield levels.

Proportions of Lambs Finished

Figure 2 presents the proportion of lambs slaughtered or retained on Properties one and two in the 2013/14 season: at slaughter 1, 36% of HSG lambs were above the target live weight to be drafted compared to 27% of SRG lambs ($P<0.01$). The proportions of lambs from the two treatments drafted for slaughter 2 were not significantly different. This left 25% of all HSG grazed lambs to be sold as stores or returned for finishing elsewhere on the properties compared to 38% of SRG grazed lambs ($P<0.01$).

Pasture composition

Average levels of crude protein, ADF and NDF were 16%, 27% and 45% of DM respectively. Water soluble sugar concentrations in SRG were 8% of DM, while HSG had levels 1.6 to 2.9% higher than SRG.

Figure 1 Summary boxplots illustrating the mean and quartile performance of lambs grazing either high-sugar ryegrass/white clover or standard ryegrass/white clover, of average daily gain (kg/d) (ADG), carcase weight (kg) and meat yield (kg of meat per carcase), from combined 2012/13 and 2013/14 seasons.

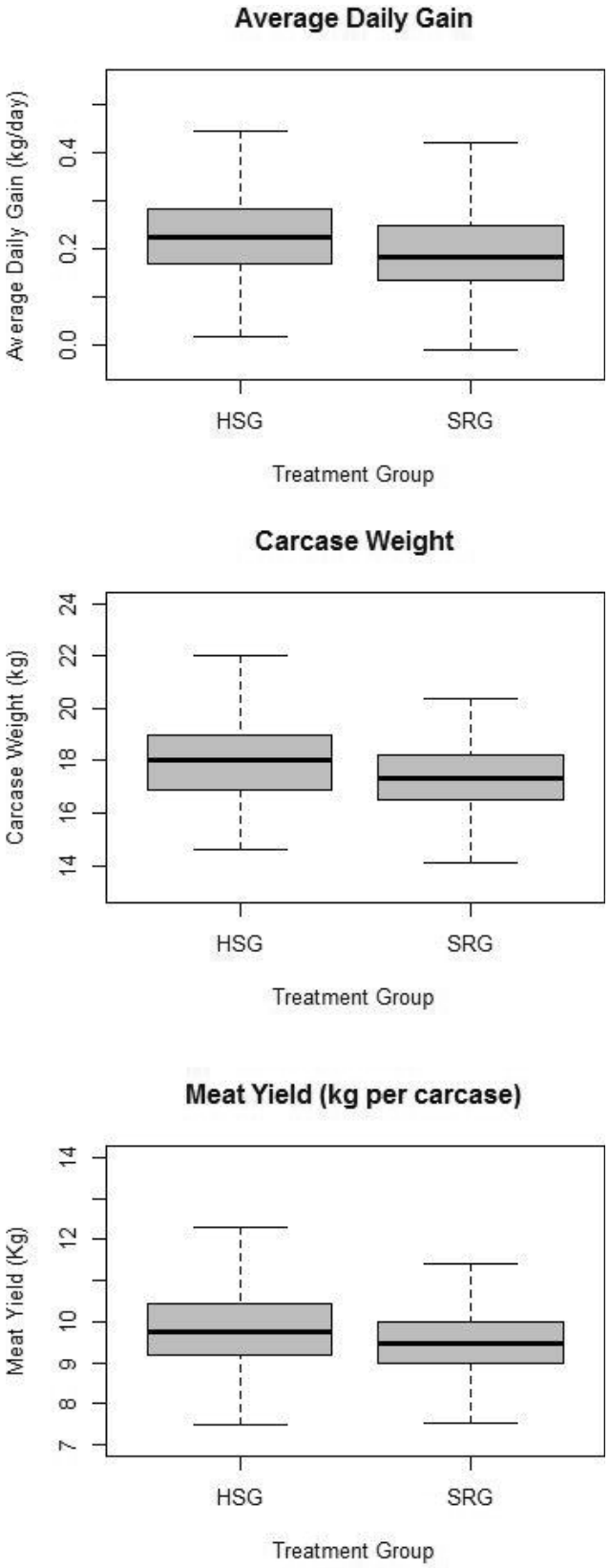
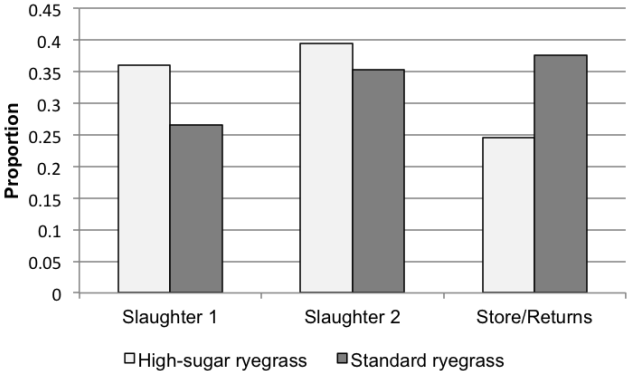


Figure 2 Proportion of lambs grazing either high-sugar ryegrass/white clover or standard ryegrass/white clover that were either sent for slaughter or sold as stores in 2013/14.



Discussion

The overall aim of the trial was to provide an assessment of the comparative performance of lambs grazing high-sugar ryegrass/white clover with standard-ryegrass/white clover pastures in southern South Island commercial farming systems.

Our results show that lambs grazing HSG out-performed lambs grazing SRG. This was consistent over two seasons and three properties and across all performance measures. Lambs grazing HSG grew on average 31 grams per day faster (17%); their carcases were on average 0.4 kg heavier at slaughter, yielding 0.2 kg more meat per carcase based on VIAScan® yield. The difference in estimated carcase-weight gain was 19% greater in lambs grazing HSG (initial carcase weight of 14.1 kg – assuming a dressing percentage of 45% for the 31.3 kg start live weight). The higher growth rates also meant that a higher proportion of lambs met desired slaughter weights earlier than lambs grazing SRG; this resulted in a decrease in the proportion of lambs remaining unfinished at the end of the trial period. On properties one and two in the 2013/2014 season, 25% of HSG lambs remained unfinished compared to 38% in the SRG treatment.

The HSG ryegrasses have been selectively bred for increased WSC (water soluble carbohydrate) concentration. The rationale for increasing WSC was that it would be expected to boost the supply of readily available energy to support microbial degradation of plant protein in the rumen (Kingston-Smith & Theodorou 2000). Dewhurst & Qiao (2007) further explained that the higher content of readily available energy enhances the efficiency of protein utilisation, and hence shifts the partition of digested nitrogen, with more moving towards growth and production, while less is excreted as urea. As a comparison to our study where we recorded a 17% improvement in liveweight gain, investigations in the UK by Lee & Jones (2001), demonstrated a 12% increase in liveweight gain in lambs (pre-wean) grazed on high-WSC pasture, compared to a low-WSC control; there was also a positive relationship between liveweight gain and WSC concentration. Evans & Scurlock (1986) further reported that not only did HSG increase liveweight gain but also carrying capacity.

In our experiment, the evidence of increased productivity is evident through a higher proportion of HSG lambs being finished earlier than SRG lambs and through the increase in total carcase weight gain. There was also a 5% increase in grazing days for the HSG pasture compared to the SRG pasture, but this was not statistically significant. These results are further supported by studies reported by Jones & Roberts (1991) and Munro et al. (1992) which indicated increased productivity from cultivars with higher WSC expression. However, as reported by Edwards (2007), not all studies have demonstrated a productivity advantage from high-WSC cultivars. This is illustrated in a UK study with lambs in two grazing systems (rotational and continuous) where high-WSC cultivars did not show any significant impact on overall liveweight gain in either system (Marley et al. 2007). Marley found that animals under rotational grazing grew significantly faster than those under a continuous-grazing system, but there were no differences between high and low WSC pastures under rotational grazing or continuous grazing.

It was not possible to measure pasture persistence in this trial as measurements were only collected over the first two years after establishment of new HSG and SRG pastures. However, the question of persistence is of importance to farmers. There is anecdotal evidence that suggests that HSG persist well. However, there are few scientific reports on the long-term (greater than seven years) persistence of either HSG or SRG, and hence investigation of this issue would require a longer time-frame than most studies are able to achieve.

This experiment has demonstrated that farmers should consider the use of HSG ryegrasses in their farming systems, especially those in the Southern region of New Zealand. Significant performance advantages were found in lamb-finishing systems for the three farms for the cultivars evaluated. However, it must be noted this experiment specifically evaluated a mix of AberMagic and AberDart high-sugar ryegrasses compared to Ceres One50 ryegrass. Farmers have many cultivars of both HSG and standard ryegrasses to choose from, and comparisons of other cultivars may give different results. The interaction of the ryegrass cultivars with the clover component is also an aspect for further study. Obviously, further cultivar comparison studies are needed to fully quantify the impact of alternative cultivars. Furthermore, the focus of this study has also been on lamb-finishing and further understanding of the impact of HSG on the whole-farm system would be of value.

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