



Improved per hectare production in a lamb finishing system using mixtures of red and white clover with plantain and chicory compared to ryegrass and white clover

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ABSTRACT

Over a three year period the performance of lambs being finished on three sward treatments were compared. The three treatments included (i) 'Grass-clover mixture'; perennial ryegrass (*Lolium perenne* L.) and white clover (*Trifolium repens*) (ii) 'Plantain-clover mixture'; plantain (*Plantago lanceolata*), white clover and red clover (*Trifolium pratense*) (iii) 'Chicory-plantain-clover mixture'; plantain, chicory (*Cichorium intybus* L.), white- and red-clover. Each year was divided into five grazing periods namely; winter, early spring, late-spring, summer and autumn with only the Grass-clover mixture being utilised in the winter due to the growth profile and management requirements of the herb species. Over the three year period, a total of 3353 kg live weight per ha was produced on the Grass-clover mixture, which was less ($P < 0.05$) than the 3838 kg/ha produced with the Plantain-clover mixture or 3768 kg/ha on the Chicory-plantain-clover mixture. Similarly over the three year period, 1270 kg of carcass weight gain per ha was produced on the Grass-clover mixture, which was less ($P < 0.05$) than the 1706 kg/ha produced with the Plantain-clover mixture or 1732 kg/ha with the Chicory-plantain-clover. This indicates that farmers aimed at lamb finishing can have some confidence that when utilising these herb-clovers mixtures they can increase lamb and meat productivity for at least three years.

1. Introduction

New Zealand grasslands are typically made up of perennial ryegrass (*Lolium perenne* L.) and white clover (*Trifolium repens*; Waghorn and Clark, 2004). While these swards can be productive year round, forage quality and quantity can be poor in the summer to autumn period (Waghorn and Clark, 2004), and be a limiting factor in lamb finishing systems. In New Zealand lambs are finished for slaughter all year round however, lamb growth rates vary based on season and forage type utilised. Therefore identifying the optimal forage to finish lambs on a per season, per year and a multiple year basis should improve productivity in these farming systems. Lamb live weight gains on a perennial ryegrass and white clover pasture during the summer and autumn periods have been reported to be in the range of 100–200 g/day (Fraser and Rowarth, 1996; Barry, 1998) which are lower than those reported for pure swards of plantain (*Plantago lanceolata*; Moorhead et al., 2002), chicory (*Cichorium intybus* L.; Cruickshank, 1986; Scales

et al., 1995; Barry, 1998; Holst et al., 1998), red clover (*Trifolium pratense*; Moorby et al., 2004; Marley et al., 2005) and white clover (Cruickshank, 1986; Marley et al., 2005). These herb and clover species as monocultures or as mixtures are utilised in temperate climates in North America (Sanderson et al., 2005; Lombardi et al., 2015), Australasia (Reed et al., 2008; Raeside et al., 2014; Pembleton et al., 2016) and in Europe (Marley et al., 2003; Andersen et al., 2009) for sheep and cattle production. Recently, it has been reported that herb clover mixtures containing plantain, chicory, white and red clovers can improve lamb live weight gain and carcass weights in spring, summer and autumn (Golding et al., 2011; Cranston et al., 2015; Somasiri et al., 2015a,b; Somasiri et al., 2016a,b). These studies however were season specific while the forages utilised are perennial species and therefore productivity on both an annual and multiple year basis is of interest to farmers. A potential limitation of herb clover mixtures is that they should not be grazed in winter due to partial dormancy and slow forage growth rate (Kemp et al., 2010) and the potential for treading damage

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to the crown of plantain and chicory (Li and Kemp 2005; Kemp et al., 2010) affecting their persistency. Therefore, on an annual and multiple year per ha basis it is possible that a herb clover mixture would be less productive than a perennial ryegrass white clover sward, which can be used to finish lambs year-round. This information is unknown and is required if farmers are to make an informed decision when deciding to plant permanent forages for lamb finishing.

Therefore, the present study compares the performance of lambs over three years on three forage treatments (i) 'Grass-clover mixture' perennial ryegrass and white clover; (ii) 'Plantain-clover mixture' plantain, white clover and red clover; (iii) 'Chicory-plantain-clover mixture' plantain, chicory, white- and red-clover. Each year was divided into five grazing periods namely; winter, early spring, late-spring, summer and autumn to determine productive performance over the entire year. In the winter period only the Grass-clover mixture was utilised. It was hypothesised that, on a per ha basis, the performance of lambs on the herb clover mixtures would be greater than those on the Grass-clover mixture annually, and also cumulatively over the entire three years.

2. Materials and methods

2.1. Experimental site

The study was completed over three consecutive years (2011/2012 (Year one), 2012/2013 (Year two) and 2013/14 (Year three)) with each year divided into five periods namely; winter, early spring, late-spring, summer and autumn). Each 'study year' began in winter (the June to August period). The total yearly rain fall between June and May were 1009 mm, 865 mm and 771 mm for years one, two and three, respectively (National Institute of Water and Atmospheric Research, Weather station E0536D, 40°38' S and 175°61' E)

Data collected in the periods of early spring, late-spring, summer and autumn in 2011/2012 and 2012/2013 only, have been previously published in Somasiri et al. (2015a,b, 2016a,b) individually based on each season and without examination on a per year basis. In addition the data presented in these studies did not include Year three nor did

they include the winter period. The number of grazing days for each of the finishing periods are given in Table 1. The experimental site was situated between 40°21'S and 175°37' E on the Mognie Pasture and Crop Research Unit, Massey University, 4 km south of Palmerston North, New Zealand with an altitude of 30 m (shortest day 21 June). The soil type was Tokomaru Silt Loam which is imperfectly to very poorly drained due to a fragipan (Cowie and Rijkse, 1977). This study was conducted with the approval of the Massey University Animal Ethics Committee.

Three forage treatments were compared (i) 'Grass-clover mixture' perennial ryegrass (*Lolium perenne* L.) cultivar One50 and white clover (*Trifolium repens*) cultivar Bounty; (ii) 'Plantain-clover mixture' plantain (*Plantago lanceolata*) cultivar Ceres Tonic, white clover and red clover (*Trifolium pratense*) cultivar Sensation; (iii) 'Chicory-plantain-clover mixture' plantain, chicory (*Cichorium intybus* L.) cultivar Puna II, white- and red-clover using the same cultivars. All forage treatments were on the same experimental site. The Grass-clover mixture was used in all of the five periods but the Plantain-clover and Chicory-plantain-clover mixtures were only used during early spring, late-spring, summer and autumn due to the potential issues outlined earlier.

2.2. Forage treatments

The Grass-clover mixture was sown in autumn 2009. The area used for both Plantain-clover mixture and Chicory-plantain-clover mixture were initially power harrowed to remove approximately 1/3 of the existing two year old plantain cultivar Ceres Tonic. After which the other cultivars were sown in autumn 2011. Sowing rates ha⁻¹ were as follows; Grass-clover mixture, ryegrass 20 kg and white clover 4 kg; Plantain-clover mixture, plantain 6 kg, white clover 4 kg and red clover 6 kg; Chicory-plantain-clover mixture, chicory 6 kg, plantain 6 kg, white clover 4 kg and red clover 6 kg. The grazing area per forage treatment was 2.25 ha consisting of three replicates of 0.75 ha each. Each replicate was subdivided into three 0.25 ha paddocks, which were each halved using temporary electric fencing for grazing management.

Table 1

Number, live weight at the start of the feeding period (kg) and duration of the study period of lambs allocated to each of the feeding mixtures (Grass-Clover, Plantain-Clover or Chicory-Plantain-Clover mixtures) in each season (Winter, early Spring, late-Spring, Summer and Autumn) in each of the three years of the study (Year 1–3).

Season	Mixture								
	Grass-Clover			Plantain-Clover			Chicory-Plantain-Clover		
	n ^a	Start live weight (kg) (Mean ± SD) ^b	Duration (days)	n	Start live weight (kg) (Mean ± SD)	Duration (days)	n	Start live weight (kg) (Mean ± SD)	Duration (days)
Year 1									
Winter	44	36.0 ± 0.51	56	–	–	–	–	–	–
Early spring	69	41.4 ± 0.40	28	69	41.2 ± 0.40	28	57	41.3 ± 0.44	28
Late-spring	90	32.4 ± 0.35	40	90	32.5 ± 0.35	40	90	32.5 ± 0.35	40
Summer	48	32.8 ± 0.48	49	84	32.8 ± 0.37	49	84	32.8 ± 0.37	49
Autumn	57	34.3 ± 0.44	35	65	34.2 ± 0.42	35	66	34.3 ± 0.41	35
Year 2									
Winter	36	36.6 ± 0.56	56	–	–	–	–	–	–
Early spring	66	34.6 ± 0.41	36	66	34.8 ± 0.41	36	65	34.9 ± 0.42	36
Late-spring	90	32.6 ± 0.35	43	90	32.5 ± 0.35	43	89	32.6 ± 0.36	43
Summer	48	35.9 ± 0.48	25	48	35.8 ± 0.48	25	66	35.8 ± 0.41	25
Autumn	57	34.1 ± 0.44	43	36	34.2 ± 0.56	43	57	34.1 ± 0.44	43
Year 3									
Winter	45	35.8 ± 0.50	75	–	–	–	–	–	–
Early spring	57	30.9 ± 0.44	42	57	30.6 ± 0.44	42	57	30.8 ± 0.44	42
Late-spring	72	31.2 ± 0.40	47	72	31.2 ± 0.40	47	72	31.2 ± 0.40	47
Summer	48	34.0 ± 0.48	28	48	34.0 ± 0.48	28	57	34.1 ± 0.44	28
Autumn	45	35.1 ± 0.50	35	15	35.1 ± 0.87	35	30	35.1 ± 0.61	35

^a n = number of lambs.

^b SD = standard deviation.

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