The relative contribution of seven forages to the apparent intake of weaned lambs over 12 days

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Abstract
A trial was conducted in Canterbury to determine the relative preference of lambs for seven different specialist forages, each of which was established in a separate plot, replicated three times. Lambs with a history of grazing ryegrass had access to all plots simultaneously and continuously for 12 days. Herbage mass, utilisation and composition were assessed every two days. By day 12 the proportion of the forages utilised ranged from 67 and 65% for red clover and rape respectively to less than 1% for chicory and a new grass sward. In the context of creep grazing the present trial suggests that both red clover and rape might have the potential to motivate lambs to make greater use of creep gates and increase feed intake and consequentially further enhance lamb liveweight performances associated with creep grazing.
Keywords: chicory, creep grazing, diet preference, forage species, palatability, pasja, red clover, ryegrass, white clover

Introduction
Creep grazing, where lambs can access higher quality pastures than their mothers while retaining access to their mothers through a specialised gate, has been shown to produce up to 5 kg heavier lambs at weaning (Moss *et al*. 2009). Achieving a high percentage of lambs using creep gates is essential to maximising the weaning weight benefits. Offering forages which lambs prefer may motivate lambs to use creep gates.

Voluntary feed intake and the nutrient content of feed are major factors in determining lamb growth rate. Sheep select some pasture species over others, and this is linked to feed intake (Pain *et al*. 2010; Parsons *et al*. 1994). To achieve maximum weight gain in weaned lambs, a forage type which is high quality and which encourages high intake is needed. Increased herbage allowance (Brunsdon 1964) and improved intestinal protein supply (Datta *et al.* 1999; Kahn *et al.* 2002) have been shown to increase lamb liveweight gain (LWG)

Chicory (*Cichorium intydus*) is a perennial herb that is most productive from September to May, and research has shown it to have superior growth rates compared with ryegrass and white clover over this period (Corkran 2009). Chicory is tolerant of water stress due to a long tap root and has high digestibility and low fibre content, making it ideal for lamb feed (Matthews *et al.* 1990). Similarly, red clover (*Trifolium pratense*) has high productivity over summer and autumn and has been shown to be favoured over ryegrass/white clover by lambs (Corkran 2009) and, being a legume, has an advantage of enhancing liveweight performances.

Pasja (*Brassica rapa* × *Brassica campestris*) is a high yielding stubble turnip that may be valuable in a grazing system because it can be grazed early (after 60 days) and will continue growing under good grazing management (Stevens *et al*. 1994). It has been previously shown with both pasja and rape (*Brassica napus*), that naive animals may need a period of adaption (de Ruiter *et al.* 2009). Rape is a high protein brassica with good acceptability by stock but before grazing it needs to be mature (de Ruiter *et al.* 2009).

This study investigated the relative preference of lambs for a range of forages in late summer-early autumn.

Methods
The trial was conducted during February 2010, at AgResearch's Winchmore Research Station, in mid-Canterbury, New Zealand.

Trial design
Seven treatments were established in strips each measuring 10 m × 21 m. There were three replicates. Treatments were: a four–year-old pasture consisting predominantly of ryegrass (*Lolium perenne*) /white clover (*Trifolium repens)* (old grass), annual ryegrass (*Lolium multiflorum, cv* 'Feast') (new grass), chicory (*Cichorium intydus*, cv. 'Puna 2'), red clover (*Trifolium pratense* cv. 'Colenso'), rape (*Brassica napus* cv. 'Titan'), pasja (*Brassica rapa* x *Brassica campestris* cv. 'Pasja') and chicory and red clover mixed. With the exception of the old grass, different sowing dates were used to reduce the effect of differing establishment rates to ensure all forages were ready to graze simultaneously. With the exception of the old grass, forages had not been grazed prior this experiment but to aid weed control all forages were mown 5 weeks prior to grazing and the mown material removed.

Weaned Coopworth ewe lambs (n=10) with a

Table 1 Total herbage mass prior to and after 12 days lamb access to 7 forage types (kg DM/ha).

	Day 0	Day 12
red clover	5101	2602
rape	4934	2020
old grass	5092	3723
pasja	5029	4172
red clover & chicory	3050	2732
chicory	2363	2476
new grass	4706	5239

ryegrass/white clover grazing history grazed each replicate block. Thus each block provided unrestricted access to all seven treatments simultaneously. Lambs had continuous access to all treatments for 12 days.

Measurements

On every second day two quadrats (0.25 m^2) were randomly placed on each treatment and the herbage within was cut to ground level using an electric hand-piece. The herbage was then washed, dried and the herbage mass determined. The resulting change in herbage mass (kg DM/ha) was used to indicate the proportion of herbage apparently utilised by lamb grazing. These samples were also separated into their herbage species components to determine within-treatment herbage species disappearance.

Statistical analysis

The "percentage utilised" was calculated using the difference in herbage mass of sown species from day 0 to day 12. An analysis of variance on the percentage utilised of each cultivar was performed using GenStat (version 11). The data was found to be normally distributed and had constant variance. Differences were deemed significant at the 95% confidence interval.

Results

Lambs apparently utilised a greater proportion of both the red clover and rape reducing the total herbage mass from 5101 to 2602 kg DM/ha and from 4934 to 2020 kg DM/ha respectively (Table 1) after 12 days access. They apparently utilised 67% and 65% of the sown species in the red clover and rape swards respectively (Table 2). This was significantly ($P < 0.05$) more than 27% of old grass, the next most preferred species. The latter was not significantly different from pasja, and red clover/chicory of which 16% and 14% of the sown species was utilised respectively. Less than 1% of the chicory and new grass was utilised, with the new grass apparently being the least preferred.

Lambs began to utilise the red clover and rape within the first 2 days of the trial and continued to do so throughout the 12 days (Figure 1). When approximately 30% of red clover and rape had been utilised, increasing quantities of old grass, pasja, and red clover/chicory mix began to be utilised. Only during the last 4 days was there an apparent utilisation of chicory.

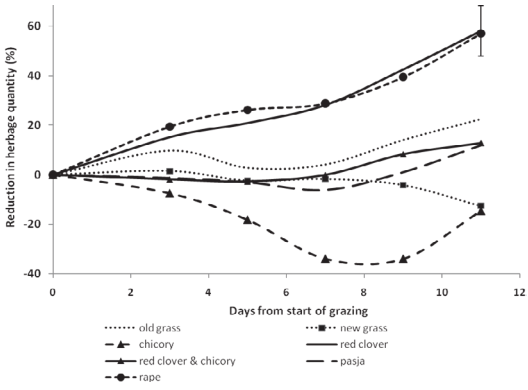

Figure 1 Reduction in sown species component of the herbage-mass present relative to that present at the commencement of lamb grazing (day 0). Data points are running means of two measurements obtained at 2-day intervals. Error bar is SEM for mean of days 10 and 12.

Table 2 Proportion of herbage mass apparently utilised by lambs (%) over 12 days following their continuous access to all herbage types simultaneously. Means with superscript letters in common are not significantly different; $P<0.05$.

	Proportion utilised (%)
red clover	67[a]
rape	65[a]
old grass	27[b]
pasja	16[bc]
red clover & chicory	14[bc]
chicory	-1[cd]
new grass	-14[d]

In the old pasture, the proportion of grass to clover had increased by day 12, indicating a lamb relative preference for the clover (Table 3). Initially the new grass and pasja contained very little weed and this did not change over the 12 days. Chicory and red clover both had a high percentage of weeds with 31 and 44% respectively on day 1, and this percentage increased slightly during the 12 days grazing. The percentage of weeds in rape increased from 2 to 23% by day 12, while there was a similar ratio of weeds to sown species in the red clover/chicory mix. The most common weed was scrambling speedwell (*Veronica persica*), with fathen (*Chenopodium album*) the next most common.

Discussion

The level of apparent utilisation of some forages was significantly greater than for others. Lambs apparently utilised a considerably higher proportion of the red clover and rape than the five other available options. Lambs have a clear preference for some species over others. For example, lambs prefer white clover to grasses (Ulyatt 1981) and are aided in their ability to harvest it when the two species are established separately (Cosgrove *et al.* 1999; Marotti *et al.* 2002). Pain *et al.* (2010) and Corkran (2009) also found red clover was highly attractive to lambs and was preferred to chicory and ryegrass.

In the present experiment lambs with no experience of grazing red clover or rape utilised these forages to a greater extent than an old ryegrass/white clover based pasture, which in turn was preferred over pasja, chicory and newly established ryegrass. The preference for red clover is in agreement with the work of Corkran (2009) and Pain *et al.* (2010).

The observations of de Ruiter *et al*. (2009) indicate that lambs need at least two weeks to adapt to a brassica crop, however, in the present study, lambs preferred rape to five other options. The rape crop was mature, as it had been established for 145 days, including 35 days re-growth prior to grazing, which is essential to a high level of acceptance by livestock (de Ruiter *et al.* 2009). Rape maturity dates differ with cultivar. This trial used 'Titan', a rape/kale interspecies cross that is of medium height and is early maturing with a recommend time till grazing of 70-90 days post-sowing. This cultivar has also proved to be the most preferred rape cultivar in preference trials (PGG Wrightsons 2011). The greater preference for rape in the present trial may have been assisted by the presence of alternative species. It has been suggested that lamb liveweight performances are enhanced on brassicas when they are part of a mixed diet. Summer ryegrass that is high in fibre has been given as an example of a good complementary feed to brassicas (de Ruiter *et al.* 2009).

Lambs appeared to graze rape without an obvious adaptation period. The period of adaption before acceptance that has been observed with naive lambs on brassica is likely to be due to the time the microbe population in the rumen takes to adjust to the shifts in ratios of carbohydrate, crude protein and fibre component (de Ruiter *et al.* 2009). Perhaps an explanation of the absence of an adaptation period in the current trial was the availability of forages (i.e. established ryegrass) which enabled lambs to select a "balanced" ration.

Chicory is generally described as being highly acceptable to stock, however lamb preference of red and white clover over chicory, as occurred on this experiment, has been reported in several studies (Pain *et al.* 2010; Corkran 2009; Horadagoda *et al.* 2009). This previous work was carried out during late summer, suggesting that acceptability of chicory may vary seasonally.

Lambs appeared to preferentially select clover from the grass pastures, as found in other studies (Cosgrove *et al* 1999). Red clover had a high percentage of weeds (44%) on day 1 and this percentage increased slightly during the 12 days, suggesting that the lambs

Table 3 Herbage species composition of swards (%) at the start compared to the end of a 12 day period over which time grazing lambs had simultaneous and continuous access to all forages.

	Grass	White clover	Red clover	Rape	Pasja	Chicory	Weeds
Day 0							
old grass	55	39	--	--	--	--	6
new grass	99	--	--	--	--		1
chicory	--	--	--	--	--	69	31
red clover	--	--	56	--	--	--	44
rape	--	--	--	97	--	--	2
pasja	--	--	--	--	96	--	4
chicory & red clover	--	--	32	--	--	49	19
Day 12							
old grass	70	24	--	--	--	--	6
new grass	100	--	--	--	--	--	
chicory	--	--	--	--	--	55	45
red clover	--	6	28	--	--	--	66
rape	--	--	--	77	--	--	23
pasja	--	--	--	--	93	--	7
chicory & red clover	--	--	39	--	--	46	15

selected the sown species over the weeds, mainly scrambling speedwell. The lambs also selected rape over weeds, with the percentage of weeds in the sward increasing from 2 to 23% over the 12 days grazing. There were similar ratios at the end as the start for red clover:chicory:weeds. This lack of selection within a mixed sward may be explained by the work of Cosgrove (2005) who found intake was higher on separate swards of white clover and ryegrass than on a mixture. The relatively low level of lamb acceptance of the new grass may at least in part be attributed to the presence of a fungal infection (viz. rust) on this forage.

It is accepted that herbage growth over the 12 days was not accounted for in this trial. Its accurate measurement was virtually impossible as the herbage mass of the various species changed rapidly and independently, which would have affected growth rates. For example, the apparent low level of lamb acceptance of the new grass will have ensured its growth rate was higher than most if not all other species compared, which explains its increase (negative reduction) shown on Figure 1. The non-inclusion of growth may have led to an under estimation of the level of utilisation of the apparently less preferred species by day 12. However, by day 6 clear preferences had emerged, by which time differences in herbage growth would have been negligible.

Forages that lambs find attractive may be an effective motivator for lambs using creep grazing systems. Both red clover and rape have potential in this regard. Lamb weaning weights have been increased by up to 5 kg where creep grazing has been available and this was achieved when offering ryegrass/white clover pastures (Moss *et al*. 2009). Permitting lambs to creep graze onto red clover or rape, both of which are considerably more nutritious than grass based pastures (Marley *et al.* 2005), might be expected to further enhance lamb pre-weaning growth rates in creep grazing systems.

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