The effect of grazing management on the growth and reproductive development of chicory

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Abstract

Grasslands Puna chicory (*Cichorium intybus*) is a perennial herb with a potential as a forage in dryland regions of New Zealand. Chicory was initially grazed either hard (H), lax (L) or not at all (Z), then subsequently hard (HH, LH or ZH) or lax (HL, LL or ZL) grazed. The mean growth rate of chicory was 151 kg DM/ha/day from 0 to 48 days and was -12 kg DM/ha/day from 49 to 88 days, the latter due to low rainfall.

The growth rate in the H and Z treatments was greater than that in the L treatment over 0-48 days. After 88 days net leaf production was greatest in the H treatment. The percentage of total herbage yield as stem ranged from 18% in the HL treatment and 99% in ZL. The reproductive growth of chicory can be suppressed by hard grazing without a detrimental effect on growth rate but it appears that zero or lax grazing results in herbage yield consisting mainly of stem.

Additional key words: Cichorium intybus, *herbage production, dryland*

Introduction

Chicory is a perennial herb with potential both as a forage crop and in pasture mixtures suitable for dryland farming regions in New Zealand. Grasslands Puna chicory has been specifically bred as a forage cultivar which produces high levels of herbage under rotational grazing (Lancashire 1978; Lancashire and Brock 1983) and high liveweight gain in both calves and lambs (Fraser *et al.*, 1988). Chicory has been reported to have high daily growth rates in excess of 200 kg DM/ha/day in summer in the Manawatu (Hare *et al.*, 1987) but there is little information on how to effectively utilize and control this growth.

The objectives of the research were (1) to examine the effect of grazing management on the growth and reproductive development of chicory in the spring and summer and (2) to use this information to formulate practical recommendations for the use of chicory on farms.

Methods

The trial was located on the Pasture and Crop Research Unit at Massey University on Tokomaru silt loam soils. Three 0.1 ha paddocks of chicory were sown in late 1986. The swards were rotationally grazed with Romney ewes prior to the commencement of the experimental period. Three grazing treatments were imposed on the one year old chicory swards in late October 1987, prior to stem elongation, to measure the effect of management on both reproductive growth and leaf growth in the sward. The plant population in October was 100 plants/m^2.

The following two step grazing treatment was imposed:

Step 1. Hard (H), Lax (L) or nil (Z) grazing at the stage of stem elongation followed by step 2

Step 2. Hard (H) or Lax (L) grazing

Lax grazing was defined as removal of 50% of the green leaf and hard grazing as removal of 90% or more of the green leaf.

The experimental design was a split plot with the first grazing at hard, lax, and zero intensities being the main plots and hard and lax intensities at the second grazing being the sub-plots. All treatments were replicated three times.

Sward measurements were carried out before and after each grazing and 40 days after the second grazing (31 January 88).

Results

High growth rates were measured after the first grazing with the mean for all treatments being 151 kg DM/ha/day for the 48 day period. The growth rates in the hard and zero grazed treatments were significantly greater than in the lax grazed treatment over the first 48 days (Table 1). Between days 49 and 88 the sub-plot treatments of hard and lax grazed were significantly different with mean daily growth rates of -20 and -4 respectively (Table 1). The main plot treatments and the interactions were not significant. Thus mean daily growth appeared to be influenced more by the previous grazing intensity rather than the intensity of earlier grazings.

Net Herbage production was greater in the hard and zero grazed treatments relative to the lax grazed treatment over the first 48 days (Table 2). Net herbage production after the second grazing at day 48 was either negative or extremely low. From day 49 to 88 the main treatments of hard, lax, and zero grazing produced significantly different quantities of leaf dry matter. The net leaf dry matter production at 88 days in the hard grazed main plots was 1387 kg DM/ha which was significantly greater than the 626 and 195 kg DM/ha for lax and zero respectively.

Most of the growth by chicory was accumulation of stem dry matter. The percentage of stem in the shoot dry matter at 48 days was 74% meaned over the three treatments (Table 3) compared with a mean of 8% at the beginning of the trial. At 88 days the percentage of stem in the main plot hard grazed treatment was significantly less (41%) than that in the lax (70%) and zero (91%) grazed treatments. The main plot by sub-plot interaction was significant with the percentage of stem being greater than 80% of total dry matter in both zero grazed treatments and in the lax/lax treatment at 88 days (Fig. 1).

TABLE 1: Main daily growth rate of Puna chicory herbage grazed at different intensities between 30 November 1987 and 25 January 1988

Grazing Treatment	Mean daily growth rate (kg DM/ha/day)
	0-48 days
Hard	174
Lax	92
Zero	188
$LSD_{0.05}$	68
	49-88 days
Hard	-20
Lax	-4
$LSD_{0.05}$	15

TABLE 2: Net total herbage and net leaf dry matter production of Puna chicory grazed at different intensities between 30 November 1987 and 25 January 1988.

Grazing Treatment	Total Production (kg DM/ha) 0-48 days	Total Production (kg DM/ha) 49-88 days	Leaf Production (kg DM/ha) 0-48 days	Leaf Production (kg DM/ha) 49-88 days
Hard	8356	-269	902	1387
Lax	4441	418	-124	626
Zero	9053	-1190	-847	195
$LSD_{0.05}$	2925	n.s.	n.s.	753

Discussion

This experiment supported previous findings (Lancashire 1978; Lancashire and Brock 1983) that chicory swards can in favourable conditions grow at rates in excess of 150 kg DM/ha/day. Reduced accumulation rates were measured over the later part of the experiment as a result of the low rainfall received (9.6mm) during the last 30 day period and to the disappearance of leaf not grazed at the previous grazing. Accumulation rates were, therefore, reduced under a situation of moisture stress which suggested that to be useful in dry times of the year, chicory

TABLE 3: The percentage of stem in the total shoot dry matter before grazing commenced at 0, 48 and 88 days.

Grazing Treatment	Percentage Stem 0 days	48 days	88 days
Hard	8	69	41
Lax	9	71	70
Zero	6	82	91
$LSD_{0.05}$	n.s.	n.s.	22

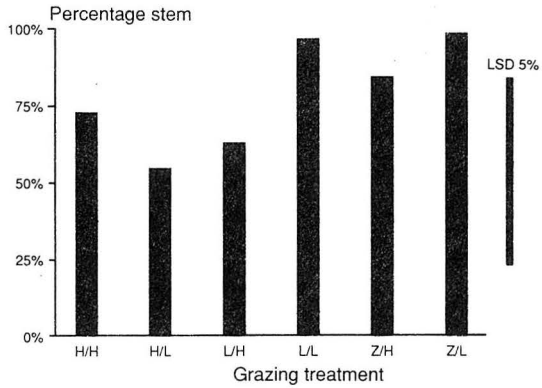

Figure 1: Percentage of stem in the total herage dry matter of chicory after 88 days. Treatments are described in text.

herbage would need to be accummulated during times of adequate moisture then retained as standing herbage.

Hard grazing (H) in late October did not significantly reduce total herbage yields compared with allowing the sward to become totally reproductive (Z) (Table 2). Lax grazing (L) at stem elongation, however, significantly reduced crop growth rates (Table 1) and total crop yield (Table 2). Provided the crop is suppressed over the reproductive period, it may be possible to increase grazing intervals and transfer feed (H/L treatment). The poor performance of crops grazed laxly during stem elongation is possibly related to the removal of a large proportion of leaf compared to no grazing (Z treatment) but not removing the primary reproductive stem (*cf.* H treatment).

Grazing treatment had a significant affect on sward components (Fig. 1). Treatments not grazed in October (Z/H and Z/L) or only laxly grazed (L/L) developed swards with a high proportion (>80%) of the total yield being stem. The major differences between the grazing treatments were in the proportion of stem in total sward production rather than in the total yield. Unless grazing is hard enough during the reproductive phase in spring to remove most of the stem then subsequent sward production will be predominantly stem material although total yield is relatively unaffected.

In practice the suppression of leaf growth that results from the presence of stem in chicory swards means that swards will need to be regularly grazed if high leaf yields are to be obtained.

Conclusions

1. Chicory should be grazed often enough to prevent reproductive stems becoming mature (e.g., every 5 weeks) rather than be used as a crop to accumulate large quantities of herbage to overcome feed shortages.

2. Spring grazing management can alter both the quantity and quality of chicory available for summer feed.

3. If reproductive growth of chicory is not controlled yield will consist mainly of mature stems.

4. Controlling reproductive growth need not reduce growth rates of chicory in the late spring/early summer.

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