THE EFFECT OF TOPPING AND REPEAT GRAZINGS ON CALIFORNIAN THISTLE AND PASTURE PRODUCTION

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ABSTRACT

Over two consecutive seasons, seven grazing periods with adult sheep at two stocking rates and with and without topping were evaluated for control of Californian thistle in an established pasture. Grazing alone was ineffective and needed to be combined with topping to successfully reduce thistle numbers. Herbage available at the beginning of each grazing rotation was highest in the non-topped laxly grazed plots, but pasture utilization and production were greatest in the hard grazed plots.

Keywords: Californian thistle, topping, grazing, stems, dry matter

INTRODUCTION

Californian thistle (*Cirsium arvense*) is a recognised weed in New Zealand pastures. Its presence has been shown to reduce pasture production (Reece and Wilson 1983) and utilization by stock (Hartley and James 1979) and cause the rejection of hay (Oswald 1985). Californian thistle is difficult to control once established, because of an extensive root system. Prior to the introduction of translocated herbicides, control of this weed was achieved by removal of the foliage. The destruction of top growth, however, does not usually result in the death of the plant as new aerial shoots produced from the base of the cut stalk and from adventitious root buds enable the plant to continue growing. Welton *et al.* (1929) found that the storage of food reserves in the root system, which allowed the production of new shoots, depended on the quantity of foliage and amount of root growth and that through early and continued mowing of the foliage, and therefore the depletion of these reserves, death of the plant could ultimately result. By regular mowing each month for four seasons Welton *et al.* (1929) was able to reduce thistle numbers to a few scattered individuals but a single mowing when thistles were in full flower had little effect. Hodgson (1968) reported that cutting alfalfa (*Medicago sativa*) twice a year for 5 years reduced Californian thistle numbers in the crop by 98% and Schreiber (1967) achieved similar results over 4 years.

Since the introduction of translocated herbicides, control of Californian thistle has been dominated by the use of the phenoxy group of herbicides. Usually these herbicides have been the sole method of control attempted but in some cases an integrated approach has been used. Amor and Harris (1977) used a combination of MCPB and mowing to reduce thistle numbers by over 90% but found numbers had increased again 12 months after the final treatment. Control of Californian thistle using grazing animals has also been reported by Hartley and James (1979), Hartley and Thomson (1981), and Mitchell and Abernethy (1993).

In South Otago and Southland, control of Californian thistle by repeat mowing is not attempted as farmers perceive wastage of pasture which could otherwise be fully utilized for fattening lambs. This study investigated the effects of combining mowing with grazing on Californian thistle stem numbers, pasture production and utilization over 2 years.

MATERIALS AND METHODS

The investigation was carried out near Invercargill in a 30 year old ryegrass (*Lolium perenne* L) and white clover (*Trifolium repens* L) dominant pasture growing on a Waikiwi silt loam soil.

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A factorial trial design with four replicates of four treatments was used. Plot size was 1400 m² with plots separated from each other by electric fences. The treatments were: pasture topped and hard grazed (THG), pasture not topped/hard grazed (HG), pasture topped/lax grazed (TLG), and pasture not topped/lax grazed (LG). The pasture was topped using a tractor mounted rotary disc mower cutting to a height of 5-7.5 cm prior to the first grazing in each year. Stock density in all cases was 350 ewes/ha with stocking periods averaging 5 days in the hard grazed plots, and 3 days in the lax grazed plots. In the hard grazed plots, pasture was usually eaten to a height of 1 to 3 cm, while in the lax grazed plots, pasture of between 6 and 10 cm remained after grazing which was similar to the normal grazing practiced on this farm. Three stocking periods between weaning in December and mating in March were completed year 1 with a further four grazing periods in year 2. With the exception of the first grazing in each season, grazing periods were imposed as thistle leaf regrowth began to harden and become 'prickly' in the topped treatments.

Pasture production, utilization and thistle growth were measured before and after each rotational grazing but not from the March 1994 grazing. Four quadrats each 0.36 m² were randomly placed in each plot and all herbage, including Californian thistles, cut to a height of approximately 1 cm using a shearing hand piece. Pasture and thistles were then separated and dried overnight at 80°C to determine drymatter (DM) production. Thistle aerial shoots numbers (stems) were counted along a permanent 40 m long by 1 m wide transect/plot before each grazing period and again in January 1995, 10 months after the final grazing.

After the third grazing in year 1, thistles in the non-topped treatments were mown and the trial area grazed as part of the farm's winter rotational grazing system. In year 2, thistles in the non-topped treatments were mown on 22 February 1994 and all trial plots hard grazed between 14 and 24 March 1994, later becoming part of the winter grazing programme.

Californian thistle stem counts were analyzed by a generalised linear model using a Poisson distribution and a log link. Pasture production and utilization data were analyzed by analysis of variance.

RESULTS

At the beginning of the investigation 15 January 1993, the thistle population over the trial area averaged 12.5 stems/m² (range 5.7-18.9, s.d. = 4.2) and varied in height from 10 cm to 90 cm with the tallest plants flowering. Thistle stem numbers increased significantly between February and March 1993 in both topped treatments ($P < 0.05$) (Table 1) but by the following December the number of stems was significantly less than in March in these treatments and also significantly lower than the number of stems found in the untopped treatments at the same time ($P < 0.05$). The number of stems in the topped plots declined further over the summer of 1994 and by mid-March were significantly lower than at the beginning of summer ($P < 0.05$). There were no significant differences between the topped treatments at any stage.

TABLE 1: Californian thistle stem numbers/m² (SEM) before each rotational grazing and 10 months after the final grazing.

Date of count	Topped, hard grazed	Topped, lax grazed	Hard grazed	Hard grazed
15.1.93	10 (1.6)	14 (1.9)	15 (1.9)	13 (1.8)
10.2.93	10 (1.5)	3 (0.9)	13 (1.8)	11 (1.7)
1.3.93	17 (2.0)	16 (2.0)	22 (2.3)	13 (1.8)
15.12.93	5 (1.1)	7 (1.3)	22 (2.4)	19 (2.2)
11.1.94	5 (1.2)	6 (1.2)	23 (2.4)	23 (2.4)
14.2.94	4 (0.9)	3 (0.8)	22 (2.4)	20 (2.3)
14.3.94	1 (0.5)	2 (0.8)	18 (2.1)	22 (2.4)
11.1.95	1 (0.1)	1 (0.5)	7 (1.3)	10 (1.6)

The HG treatment showed a non significant increase in stem numbers between the first and third grazings and in March numbers were significantly higher than in the LG treatment ($P<0.05$). At all subsequent counts there were no significant differences between these treatments, but on all occasions there were significantly more thistles in the grazed only treatments than in the topped treatments ($P<0.05$). By mid-March 1994 thistle numbers in the topped hard grazed and topped lax grazed treatments had decreased from the initial counts by 90% and 86% respectively while the hard grazed and lax grazed had increased by 20% and 69% respectively. By January 1995, 2 years after the trial began, thistle density in the topped plots averaged $1/m^2$ which was significantly lower than in the grazed only plots where thistle density averaged $8.5/m^2$ ($P=0.05$).

Data for pasture and thistle dry matter production in the HG treatment prior to the first grazing could not be collected as the plots were mown before quadrat samples could be taken. Over the other three treatments pasture mass averaged 3250 kg DM/ha ($sd=580$). In the first summer/autumn period pasture mass prior to each grazing was significantly higher in the LG than in all other treatments on all occasions except before the March 1993 grazing when both lax grazed treatments had accumulated significantly ($P<0.05$) more pasture DM than the hard grazed treatments. In the second year the situation was similar but differences were not always significant (Table 2). Before the February 1994 cut, however, the pasture mass in both topped plots was significantly higher than in both untopped treatments ($P<0.05$). Pasture production between grazings (Table 2) was highest in the THG treatment with significant increases being recorded. In the first year, 83% of available pasture was eaten in THG, 46% in TLG, 67% in HG and 30% in the LG treatments respectively. In year two these figures were, 65%, 45%, 47% and 35% respectively.

TABLE 2: Pasture dry matter (kg/ha) before and after each grazing, percent pasture utilization at each grazing and pasture production (kg/ha) between grazings.

Treatment	15.1.93	10.2.93	1.3.93	15.12.93	13.1.94	14.2.94
Topped hard grazed						
DM before	-	1780	1360	2240	2170	3470
DM after	600	250	270	800	600	1404
% utilized	-	86	80	64	72	60
DM production ¹		1180	1110	-	1370	2870
Topped lax grazed						
DM before	3160	2040	2480	2650	2370	3240
DM after	1600	1220	1260	1290	1490	1750
% utilized	49	40	49	51	37	46
DM production		440	1240		1130	1750
Hard grazed						
DM before	3020	1780	1320	2550	2270	2550
DM after	1050	600	400	1120	940	1870
% utilized	65	66	70	56	59	27
DM production		730	720		1150	1620
Lax grazed						
DM before	3580	3420	3150	2850	2930	2670
DM after	2700	2270	2220	1790	1950	1700
% utilized	25	34	30	37	33	36
DM production		720	880		1110	720
LSD ($P<0.05$)						
DM before	750	460	560	430	540	520
DM after	470	350	550	200	250	550
DM production		445	355		520	610

¹production between grazings

Thistle dry matter averaged 980 kg/ha (sd=460) before the initial grazing 15 January 1993. After the 14 February grazing in year 2, dry weight of thistles measured was 1.25 kg/ha in THG plots, 70 kg/ha in TLG plots, 2920 kg/ha in HG plots and 3580 kg/ha in LG plots.

DISCUSSION

The roots of Californian thistle act as an organ of water and are important for nutrient absorption and translocation, and for the storage of food reserves (Welton *et al.* 1929). The repeated removal of foliage using mowing, herbicides, grazing animals or various combinations of the three has been shown to reduce thistle infestation (McKay *et al.* 1958; Hodgson 1968; Schreiber 1967; Hartley *et al.* 1984) through the depletion of root reserves. Spraying and mowing once for hay in 2 successive years has been observed to reduce Californian thistle numbers drastically in a South Otago farm (unpublished data). Failure to exhaust root reserves, however, can result in rapid recovery (Amor and Harris 1977).

In this trial, the removal of thistle vegetative growth at the bud stage by topping initiated adventitious root bud growth and the resultant aerial shoots were readily grazed by sheep. It was observed that vigorous pasture growth between grazing periods encouraged newly emerged thistle shoots to grow more upright and remain at a palatable "soft" stage for longer than in nearby set stocked pasture where emerging thistles rapidly developed spines. Oswald (1985) stated that animals would not graze closely to "growing weed plants" including Californian thistle, but in this trial, pasture at the base of mature thistle plants was well grazed although in the HG plots some pasture was lost in areas of dense thistles due to heavy trampling.

Numerous adventitious shoots were produced in late autumn in the topped plots in both years and the late removal of these shoots had an adverse effect on the number of shoots emerging the following spring and summer. Sheep ate all cut herbage including thistles three to four hours after topping at the bud stage and as a result, no hard, prickly dead thistles remained in the topped treatments to impede subsequent grazings. Grazing off the cut thistle stalks while they are still green prevents these stalks from becoming woody and protecting new thistle shoots as they emerge from the base of the cut stalks. When the stalk and emerged new shoots were repeatedly removed, it was noticeable that shoots at the final grazing in each year had emerged from root buds some distance from the old stalks.

Mature Californian thistles in this trial only produced new aerial growth from root buds if the above ground portion of the plant was damaged by grazing or removed, and it was noticeable in the LG treatment that very low numbers of new shoots were produced, suggesting plant survival was not threatened. McKay *et al.* (1958) concluded that "the most expensive control measure for Californian thistle was doing nothing" and that "integrated methods of control combined with persistence and vigilance are the keys to thistle control and to greater profits". Topping appears to be the essential factor in achieving thistle control regardless of whether it is combined with heavy or lax grazing and the timing of grazings used in this trial would fit easily into grazing systems used on lamb fattening properties in lowland South Otago and Southland. When combined with heavy grazing, however, pasture production and utilization by stock is increased.

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