EFFECT OF COOL SEASON GRAZING ON LUCERNE PRODUCTION AND APHID POPULATIONS

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Abstract

In a P-year Wairau lucerne trial, plots were grazed on a 3- or 6-weekly rotation; Half of each plot was hard grazed in June to control overwintering aphids. In the second year a spring/autumn spraying was applied.

June grazing reduced aphid populations in spring from 37 to 3 per stem, and gave no significant difference in dry matter yield. Three-weekly spelling, although reducing aphid numbers, halved plant populations and root weight and markedly decreased dry matter yield. In the second year, 6-weekly spelling yielded 13 120 kg/ha, and 3-weekly *only* 3 540 kg/ha. Spraying of aphids increased yields, but not significantly.

The results show that cheap methods of controlling aphids in lucerne can be developed using grazing management.

INTRODUCTION

LUCERNE is capable of producing high yields of dry matter and is regarded as a valuable crop in the New Zealand farming scene. Because of its deep taproot system, lucerne is ideally suited to drought-susceptible areas, where it out-yields conventional pasture, provides high quality feed, and plays a very important part in fodder conservation programmes. However, it does require an intensive rotational grazing system owing to its characteristic regrowth cycle (Langer, 1973) .

Until recently the area sown in lucerne has increased steadily (Lynch, 1967), but is now tending to decline. This change has coincided with the discovery and'subsequent rapid spread of the blue-green lucerne aphid, and more recently the pea aphid, which can reduce yields substantially. Control measures are essential to prevent serious damage (Kain *et al.,* 1976; 1979), but chemical control, though very effective in the short term, can prove costly (Kain *et al., 1977;* O'Connor and Hart, 1977). Alternatively, an integrated control system may allow a reduction in the number of

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spray applications or even their elimination, and provide an effective control without reducing plant production.

We have carried out investigations on integated controls for the past 2 years, with the following objectives: first, to investigate the effect of various cool-season management practices on lucerne spring growth and overwintering aphid populations; secondly, to observe changes in aphid populations under different spring/summer grazing treatments together with the related agronomic effects; and finally, to study the effects of aphid removal using insecticides. From this it was hoped that a management system could be developed for reducing aphid numbers without detrimental effect on the lucerne.

EXPERIMENTAL

The trial was established on a 5-year-old lucerne stand (cv. 'Wairau') on a Wakanui silt loam at Lincoln College. A randomized block split-plot design with four replicates was used. The trial area, measuring 132 × 30 m, was subdivided into 8 main plots using permanent fencing. The main treatments over the 1977-8 and **1978-9** seasons were 3- or 6-weekly spelling intervals between grazing. The experiment commenced in April 1977, when the main plots were subdivided longitudinally by temporary electric fences for the following autumn/winter grazing treatments:

(1) Grazed 30 April, then spelled until spring.

(2) Grazed in April, then on 30 May.

(3) Grazed in April, then on 30 Tune.

Grazing of the main plots commenced on 6/10/77 and concluded on 26/4/78. At all grazings, each subplot or, main plot was grazed with sufficient sheep to remove most of the available herbage within a period of 2 to 3 days.

Dry matter yields were recorded prior to each grazing, using an electronic capacitance meter by the "Tones and Haydock" (1970) technique to locate twc mean sites, and cutting to ground level.

In the 1978-9 season, autumn/winter subplot treatments were altered to:

(1) Grazed 26 April 1978, then spelled until spring.

(2) Grazed 26 April, then on 15 June.

Grazings in the spring commenced on 14/10/78 and were concluded on 20/4/79.

TABLE 1: THE EFFECT OF WINTER GRAZING ON COOL SEASON LUCERNE- YIELDS (kg/ha)

Spelling Period	Yields at 3 November 1977 — Grazing Date 30 April	30 May	30 June
Three-week (2 cuts)	5 470	5 240	5 130
Six-week (1 cut)	6 350	6 200	6 410
Winter yields from 30/4/77	—	300	400
		SE mean ± 360	

	Yields at 14 October 1978 — Grazing Date 26 April	15 June	Winter Yields, 26 April to 15 June
Three-week (2 cuts)	670	660	140
Six-week (1 cut)	2 770	2 370	260
		SE mean ± 190	

TABLE 2: EFFECT OF WINTER GRAZING ON NUMBERS OF APHIDS ON LUCERNE IN SPRING*

Grazing Date	1977 Aphids/stem — 31 October
April	100
Late May	18
Late June	7

	1978 Aphids/stem 13 October	9 November
April	37	0.4
June	3	0.5
		Grazed early November

*Rohitha, 1979.

TABLE 3: EFFECT OF SPELLING INTERVAL ON PLANT POPULATION AND ROOT WEIGHT AT 22/4/79

Spelling' Interval	Plant Population (Plants/m')	Root Weight (g/plant)
Three-week	21.4	5.5
Six-week	52.5	11.8
L.S.D. 0.01	29.1	0.68

In order to investigate the possible yield losses with aphid feeding under grazing, insecticide applications (pirimicarb, 200 g a.i./ha) were begun in the second season on half of each main grazing management plot once aphid numbers had exceeded 10 per stem. The insecticide was then applied twice more at approximately 3-weekly intervals during spring. An additional insecticide application was made in mid April.

Dry matter samplings in 6-weekly plots were measured as in the 1977-8 season, but because of increased weed invasion and stand deterioration in the 3-weekly plots, the number of quadrats was increased to 5 per treatment and cut to ground level. Samples were subsampled for botanical composition and dry weight. At the end of the experiment, plant populations and crown and taproot weights were determined by excavating two 0.5 m^2 randomly chosen sites to a depth of 20 cm.

Aphid population counts were caried out by the Entomology Department, Lincoln College, prior to each grazing. The methods of sampling were as outlined by Penman *et al.* (1979).

RESULTS

In both the 1977-8 and 1978-9 seasons the winter grazing management to control overwintering aphid population had no significant effect on lucerne yield at the initial 6-weekly grazing in spring (Table 1). The hard winter grazing did, however, have a significant effect on the overwintering aphid population, as shown in Table 2.

June grazing virtually eliminated the wintering aphid population compared with April-grazed plots, and the initial spring grazing also resulted in a further reduction in aphid populations. Grazing lucerne every 3 weeks throughout the warm season proved an effective means of controlling aphid numbers. Even during the peak flight period of November and December, aphid numbers remained low. For example, there were *ca.* 14 aphids/stem on 20 December in the 3-weekly rotation, compared with *ca. 50* aphids/stem on the B-weekly rotation. However, as shown in Fig. 1, 3-weekly spelling was very detrimental to lucerne yield. This decline became increasingly apparent over the second season, with 6-weekly spelling producing nearly three times more lucerne per hectare than 3-weekly spelling. The shorter spelling interval also had a severe effect on plant population and root weight (Table 3). with plant population showing a 50% reduction in the 3-weekly spelled plots. The crowns and taproots were also

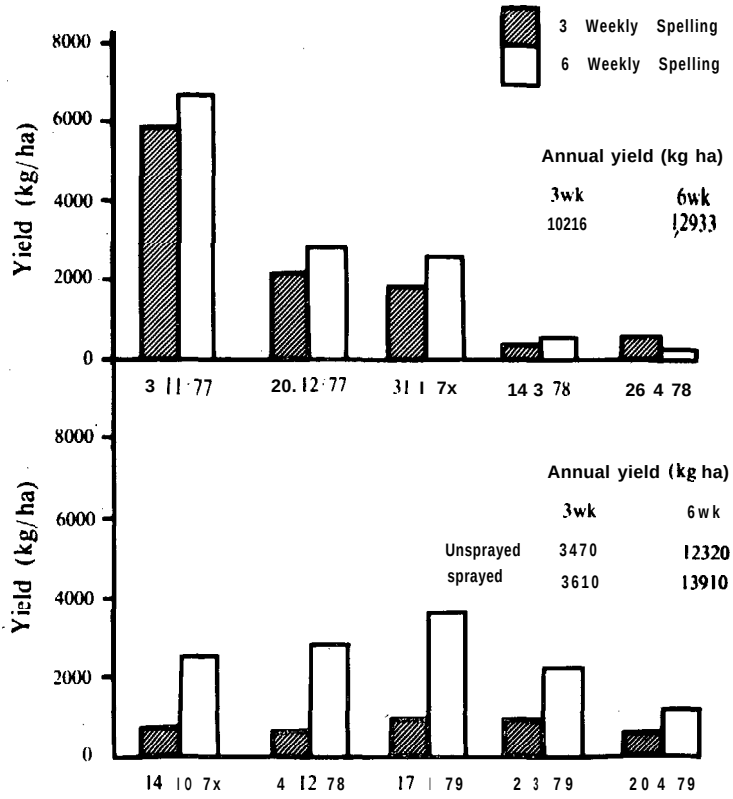

FIG. 1: *Lucerne yield with 3- or 6-weekly spelling.*

greatly reduced in weight and were noticeably much smaller, and there were fewer new crown buds developing, compared with the 6-weekly spelled plants.

Associated with the decline in plant population and yield there was a rapid influx of weed species, e.g., barley grass *(Hordeum murinum)*, annual poa *(Poa annua)*, dandelion *(Taraxacum officinale)*, sheep's sorrel *(Rumex acetosella)*, and white clover *(Trifolium repens)*, into the 3-weekly plots. In these plots, populations of weed species remained at high levels throughout the season,, unlike the 6-weekly plots, which showed a steady decline in weed ingress with the drier summer conditions (Table 4). Scotch thistle *(Cirsium vulgare)* was also a major -problem in the 3-weekly spelling with an average of 2 plants/10 m^2 which covered

TABLE 4: PERCENTAGE WEEDS (DW) IN 3- AND 6-WEEKLY SPELLED LUCERNE DURING 1978-79

	6-weekly spelled	*3-weekly spelled*
Spring	42.0	68.0
Mid-summer	0.1	47.0
Autumn	7.0	76.0

19% of total area when fully grown. In contrast, there were no thistles present in any of the 6-weekly spelled plots.

In the 1978-9 season, aphid populations in unsprayed plots reached 50/stem. These populations exceeded recognized damage thresholds of cu. 10 aphids/stem in the final week prior to grazing. By spraying, aphid populations were held to l/stem over this same period. The large differences in aphid populations were not reflected in a significant increase in annual dry matter yield in the sprayed plots (Fig. 1) , although yields in sprayed areas were about 10% higher at each grazing. Spraying did, however, result in a significant seasonal increase in lucerne yield of 1590 kg/ha/yr under 6-weekly spelling (Table 5).

TABLE 5: EFFECT OF SPRAYING ON LUCERNE YIELD AT PEAK SPRING APHID POPULATION

	6-weekly Lucerne Yield (kg/ha)	
	Unsprayed	*Sprayed*
4/12/78	2 960	3 280
	SE mean ± 120	
17/1/79	3 620	3 880
	SE mean ± 140	

DISCUSSION

We found no significant effects on spring lucerne yields from the different autumn/winter grazings which were used. This is in contrast to Janson (1975), who found that winter defoliation reduced spring growth. There are two possible reasons for this. First, as suggested by Penman *et al.* (1979), the reduced aphid burden obtained with June grazing may have enabled greater spring growth to be achieved in that treatment. Kain *ef al.* (1977) found that midwinter control of aphids by spraying gave increases in lucerne production of 10% in winter and 20% in spring. Secondly, the timing of the initial spring grazing can also influence the yield obtained. In both seasons, grazing of the 6-weekly plots

did not commence until the mid-spring period. Janson (1975) found that it was only under an early spring harvesting regime (i.e., grazing in September) that winter grazing significantly reduced initial spring yield. If harvesting was delayed until October, all yield differences had disappeared. Therefore, winter grazing to control over-wintering aphid populations would appear to be an effective and inexpensive means of reducing aphid populations, with the advantage of providing additional winter feed. Control in autumn/winter by spraying as advocated by Kain *et al. (1977)* is more costly and time-consuming and can be avoided if a large mob of sheep is available.

Three-weekly spelling, although very effective at controlling aphids, is potentially damaging to plant population and yield if continued over an extended period '(Table 1; Fig. 1). It is well known that frequent grazing results in the removal of crown shoots before sufficient time has elapsed to restore plant root reserves (Langer, 1973), resulting in reduced plant vigour and yield and increased plant death, The reduced plant population and root weight in Table 3 indicate that this occurred. The lower plant population and frequent grazing interval also meant that a dense shading canopy required to control weed species naturally present in the stand was never formed; a factor which Janson (1976) considered was responsible for weed control in well-managed stands. This enabled the survival of weed populations that competed directly with the lucerne, explaining the presence of the Scotch thistles in 3-weekly spelled plots only (Table 4). The pattern of weed development under 6-weekly spelling showed a similar effect to that found by Janson (1976).

Throughout the season, the resulting aphid mortality from grazing (Penman *et* al., 1979) indicated that this may also provide a means of controlling aphid populations. Three-weekly grazing, though more effective than 6-weekly, could not be recommended as a control because of the agronomically damaging effect on the plant. The lack of a significant response in dry matter yield with spraying was unexpected, but could be due to aphid numbers not being present for a sufficient period of damaging populations for significant yield reduction to occur (Penman et al., 1979). Kain *et al.* (1979) suggested that losses in herbage production did not occur below 30 aphids/stem except in autumn where growth was slow; these levels were only being reached in the finaldays before grazing. It has also been shown by Kain et *al.* (1977, 1979) that maturing lucerne is able to withstand higher aphid densities than young growing stems.

Cool-season grazing of lucerne has been shown to provide a very effective means of controlling overwintering aphid populations and results in lucerne remaining relatively aphid-free until early November. At the very least this may delay the need for an insecticide application and may well eliminate the spraying altogether if further spring grazings keep aphid numbers low. However, spraying may still be necessary in early summer if aphids build up to high levels following the spring flights. The only way to completely eliminate the need to spray is to use an aphid-resistant cultivar such as Rere, at present being developed by Crop Research Division, DSIR. Our results show that cool-season grazing does not affect the initial spring, or subsequent lucerne production, but the timing of, the winter grazing is important. It should occur after autumn aphid flights have ceased, e.g., late May, and be completed by the end of June. Later grazings in July or August are more likely to harm recovery growth. Grazing should be done quickly and completely with a large mob of sheep to remove all top growth. If this technique is followed, the lucerne should be free of damaging levels of aphids for the next 4 months.

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