EFFECT OF DEFOLIATION MANAGEMENT AND 'TAMA' OVERDRILLING ON WEED YIELDS OF IRRIGATED LUCERNE

J. H. HOGLUND

*Plant Science Department, Lincoln College, Canterbury**

Summary

Summer-autumn defoliation of irrigated lucerne at "first flower" did not allow any weed ingress, in contrast to defoliation at "pre-bud" stage which resulted in weeds contributing 60% of the total yield by June. Infrequent winter defoliation allowed lucerne to recover dominance but this recovery was less at high soil nitrogen, partly owing to increased competitiveness of weeds. Overdrilling 'Grasslands Tama' ryegrass suppressed lucerne growth more than weeds and vigorous Tama caused long-term depletion of the stand. High yields of pure lucerne are possible under irrigation without the use of herbicides, provided high lucerne growth rates are achieved.

INTRODUCTION

Blair (1965) considered lucerne stand life to be favoured by high soil fertility but suggested that irrigation often assisted weed ingress. Lucerne yields may be increased with nitrogen fertilizer (MacLeod, 1965; Hoglund, 1971) but this may increase weed ingress (Brown, 1940).

O'Connor and Vartha (1968) found increased harvest frequency reduced yields, increased weed content, and reported suppression of weeds by overdrilled grasses.

The advent of the lucerne meal industry has increased interest in irrigating lucerne to increase summer production. This paper reports on the effect of summer defoliation management on weed ingress into irrigated lucerne grown at two soil nitrogen levels and of the subsequent effect of lax management and grass overdrilling on yield and composition of these stands.

METHODS

The trial was sited at the Lincoln College research farm on Paparua sandy loam. The stand had been drilled in 90 mm rows in spring 1965 with *Medicago media* Per. cv. 'Wairau'. Two tonne of lime/ha was applied at sowing and 100 kg sulphur-superphosphate/ha/yr thereafter. Lucerne was grazed during winter 1968, shut for hay in early spring and cut on November 6, 1968. The experimental period started on November 7, 1968.

The experimental area was spray irrigated (50 mm/week) during summer and autumn to maintain soil moisture (maximum monthly raised pan evaporation during this experiment was 207 mm in January 1969).

*Present address: Grasslands Division, DSIR, Palmerston North.

Hydrated lime (250 kg/ha) and "Borated Serpentine" superphosphate (250 kg/ha) were applied at the start of the experiment and on April 5, 1969, superphosphate (250 kg/ha) and K₂SO₄ (250 kg/ha) was applied on all plots.

There was a randomized block design, with 3 blocks and 12 plots per block. Each plot was 4.5 × 3.0 m.

Treatments were:

- (1) Defoliation at three stages of maturity: (a) immediate pre-bud (C₁), (b) when 50% of the stems had visible floral buds (C₂), and (c) first flower (C₃). These defoliation treatments continued throughout the experiment, except from March 1969 to November 1969 when all plots were cut three times (see Fig. 2).
- (2) Nitrogen fertilizer: (a) no applied nitrogen (N₀), (b) nitrogen applied after each cut (N₁). Nitrogen was applied as "lime-ammonium nitrate" on all N₁ plots at the rate of 112 kg N/ha initially, followed by further applications after each cut at the rates of 112, 84 and 56 kg N/ha for C₃, C₂ and C₁ plots, respectively, except from March onwards when all plots received 112 kg N/ha after each cut. Hydrated lime was applied on N₀ plots after each cut at the same rate as applied as "lime-ammonium nitrate" on the N₁ plots.
- (3) 'Grasslands Tama' Westerwolds ryegrass (*Lolium multiflorum* Lam.) was overdrilled into half the plots on March 17, 1969 (O₁).

Samples were taken with a sickle-bar mower cutting 25 mm above ground level. Lucerne shoot density and unit stem weights were determined on January 21, 1970, 10 days after a first flower defoliation using a grid and random numbers to locate sample sites.

RESULTS

Defoliation at (C₃), (C₂) and (C₁) resulted in 3, 4 and 5 cuts, respectively, between early November and early March. Defoliation frequency affected dry matter yield more than nitrogen treatment (Table 1).

TABLE 1: EFFECT OF DEFOLIATION MANAGEMENT ON THE YIELD OF LUCERNE GROWN AT TWO LEVELS OF SOIL NITROGEN

Defoliation Treatment	No. of Cuts (6/11/68 to 9/3/69)	Total Herbage Yield (tonne DM/ha)	
		Control	+ Nitrogen
Pre-bud (C ₁)	5	10.0 e	10.7 e
50% bud (C ₂)	4	12.0 d	13.0 c
First flower (C ₃)	3	14.9 b	16.3 a

In June weed yield was directly related to the frequency of the previous defoliation with no significant effect of nitrogen treatments (Table 2) or overdrilling Tama.

For non-overdrilled treatments, there was a highly significant negative relationship between lucerne yield and weed yield for all harvests. The lucerne yield required to completely suppress weed growth increased from June to November (Fig. 1). In June and September, nitrogen fertilizer made weeds more competitive with lucerne.

TABLE 2: EFFECT OF PREVIOUS DEFOLIATION MANAGEMENT ON JUNE WEED YIELDS OF LUCERNE GROWN AT TWO LEVELS OF SOIL NITROGEN

Previous Defoliation Management					Weed Yield (kg DM/ha)	
					Control	+ Nitrogen
Pre-bud	....	....	....	....	1390 a	1230 a
50% bud	....	....	....	....	360 b	460 b
First flower	....	....	....	....	4 c	1 c

The increased competition from weeds with nitrogen fertilizer decreased recovery of lucerne (Fig. 2). Without nitrogen fertilizer, lucerne generally recovered at the expense of the weeds.

Overdrilling Tama had little effect on the weed component unless combined with nitrogen fertilizer, but under all treatments Tama reduced the percentage contribution of lucerne to the total yield (Fig. 2).

Overdrilling Tama and nitrogen fertilizer increased total yields slightly in September (Table 3).

FIG. 1: Changes in the competitive relationship between lucerne and weeds with time when grown at two levels of soil nitrogen.

FIG. 2: Botanical composition of lucerne stands as affected by previous defoliation management, soil nitrogen level and tama overdrilling.

TABLE 3: EFFECT OF PREVIOUS DEFOLIATION MANAGEMENT AND TAMA OVERDRILLING ON HERBAGE YIELDS AT TWO NITROGEN LEVELS IN SEPTEMBER (kg DM/ha)

<i>Treatment</i>	<i>C₁</i>	<i>C₂</i>	<i>C₃</i>
O ₀ N ₀	3020 c	3110 c	2840 c
O ₀ N ₁	3470 abc	3330 bc	3470 abc
O ₁ N ₀	2900 c	3250 bc	3060 c
O ₁ N ₁	3890 ab	3980 a	3800 ab

O₀ not overdrilled.
O₁ overdrilled.

N₀ no nitrogen.
N₁ nitrogen after each cut.

Following 10 months' uniform defoliation management, previous defoliation history still affected lucerne stem density yield (Table 4). Nitrogen fertilizer reduced stem density at all cutting frequencies, particularly where Tama was overdrilled. The particularly severe reduction in C₂O₁N₁ plots resulted in a significant second order interaction. Tama had yielded most on this treatment (Fig. 2).

Nitrogen fertilizer depressed lucerne yields when associated with Tama overdrilling or previous frequent (C₁) defoliation (Table 4).

TABLE 4: LUCERNE VIGOUR (JANUARY 1970) AS AFFECTED BY PREVIOUS TREATMENTS

<i>Previous Treatment</i>			<i>Stem Density</i>	<i>Unit Stem Weight</i>	<i>Lucerne Yield</i>
<i>Defoliation</i>	<i>Overdrilling</i>	<i>Nitrogen</i>	<i>(No./m²)</i>	<i>(mg DM/stem)</i>	<i>(g/m²)</i>
Pre-bud (C ₁)	—	—	893 b	224	200 c
	—	+	618 de	216	134 d
	+	—	874 bc	250	219 c
	+	+	654 cd	216	141 d
50% bud (C ₂)	—	—	1140 a	195	222 c
	—	+	1023 ab	205	210 c
	+	—	1063 ab	236	251 abc
	+	+	403 e	236	95 d
First flower (C ₃)	—	—	1145 a	250	286 ab
	—	+	980 ab	305	299 a
	+	—	1153 a	208	240 bc
	+	+	827 bcd	227	188 c

Significance of F

* $P < 0.05$

** $P < 0.01$

C**, O**

N**, C × O*

O × N*, C × O × N*

N.S.

C**

N**

O × N*

DISCUSSION

In agreement with O'Connor and Vartha (1968) summer defoliation frequency affects total yield (Table 1) and weed content (Table 2). Defoliation at "first flower" maintained high yields of lucerne even under irrigation and high soil nitrogen. Irrigation (Blair, 1965) and high soil nitrogen (Brown, 1940) are often blamed for lucerne deterioration but

this experiment would suggest that, although management may be more critical under these conditions, pure stands can be maintained without chemical weed control if high lucerne growth rates are achieved.

Lax defoliation management during winter allowed frequently defoliated lucerne (C_i) to recover from a minor component (40%) of the stand in June to a dominant component (74%) by November (Fig. 2). At high soil nitrogen recovery was not so great (35 to 56%) because of increased competition from weeds.

Unlike other experiments (O'Connor and Vartha, 1968), few beneficial effects could be attributed to grass overdrilling in this experiment (Table 3) as Tama suppressed lucerne recovery to a greater extent than it suppressed weeds (Fig. 2). There did not appear to be any long-term depression of lucerne vigour by Tama at low soil nitrogen (Table 4), nor was there any winter total yield advantage (Table 3). The winter yield advantage obtained from overdrilling Tama into weed-infested stands at high soil nitrogen was associated with reduced lucerne vigour (Table 4) which would allow more potential sites for subsequent weed invasion.

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