SEEDING RATES, ROW SPACING AND LUCERNE (MEDICAGO SATIVA CV SARANAC) SEED PRODUCTION

R.B. Wynn-Williams and T.P. Palmer
Crop Research Division
DSIR
Lincoln

ABSTRACT

Three lucerne seed production trials were conducted at Lincoln at seeding rates from 0.56 to 8.96 kg/ha, and row spacings of 19, 38 and 76 cm. Lucerne leaf cutter bees were released on two trials but there were not enough pollinators to give maximum yields. First year seed yields in trials 1-3 were 133, 25, and 51 kg/ha respectively. Neither row spacing nor seeding rate had any effect on seed yield in the first or second year in trial 1. In trial three, first year seed yields were higher from 10 and 38 cm rows, and from 2.24 and 8.96 kg/ha. Forage yields were reduced at seeding rates below 0.84 kg/ha in two trials and in 76 cm rows in one trial.

Still higher seed yields may be obtained by earlier sowing, using more pollinators and earlier weed control, but the trials do not provide information on optimal seeding rates or row spacings when pollination is complete.

INTRODUCTION

Lucerne seed yields in New Zealand are low and erratic, with an average yield of 50 to 100 kg per harvested hectare. In some states of the U.S.A. average yield is about 500-600 kg/ha. The primary limiting factor in New Zealand is the lack of suitable pollinators (Hadfield and Calder 1936, Palmer 1966, Palmer-Jones and Forster 1972). The alfalfa leaf cutter bee, **Megachile rotundata,** an efficient pollinator of lucerne, has been introduced into New Zealand and in suitable areas should increase seed yields and make them more reliable. **Nomia melanderi,** the alkali bee, is also an efficient lucerne pollinator, and may be useful in some parts of New Zealand (Donovan pers. comm.)

Lucerne for seed production should be managed to take full advantage of these pollinators. With the prospect of obtaining high yields regularly, lucerne can be managed specially for seed production.

In New Zealand seed is produced from lucerne in rows 9 or 18cm apart, at seeding rates of 6-12 kg/ha and is not usually harvested in the year of sowing. Experiments conducted overseas have shown that highest seed yields are obtained from lucerne sown at 0.5 to 2.0 kg/ha in rows 60-150 cm apart (Pedersen and McAllister 1955, Bolton 1956, Zaleski 1956, Law **et al.** 1957, Jones and Pomeroy 1962, Melton 1962, Abu-shakra **et al.** 1969, Goplen 1972). Pedersen **et al.** (1972) suggested that row spacings should vary with soil type and the size to which plants are expected to grow.

Pedersen and McAllister (1955) showed that widely spaced plants produced flowers with more nectar than closely spaced plants, and were visited more frequently by bees. Other authors have claimed that wider spacing permits easier access by pollinators (Kreizinger and Law 1945); that among wider spaced plants humidity is lower and insecticides and herbicides penetrate more thoroughly, and consequently there is less damage from diseases and pests (Pederson **et al.** 1972); that widely spaced plants use less water (Melton 1962) and make the soil moisture level more controllable (Pedersen and McAllister 1955); and that seeds mature more uniformly (Melton 1962). On the other hand sowing very low plant populations in wide rows may reduce hay yields, and necessitate cultivation or the use of herbicides to prevent weed infestation.

MATERIALS AND METHODS

Three trials were laid down at Lincoln on a Paparua sandy loam, to determine the effect of seeding rate and row spacing on lucerne seed production in the presence of adequate pollinators, and to determine the potential for seed production in the year of sowing (Table 1). In a fourth trial with the design of Trial 2, sown at Winslow in Mid-Canterbury in 1973 with Saranac, establishment counts were similar to those of the corresponding treatments of Trial 3. This trial was abandoned because of poor lucerne growth and excessive weed development.

TABLE 1: Sowing date, plot size, cultivar, and treatment of three lucerne seed production trials sown at Lincoln

Trial No.	Sowing date	Plot size (m)	Cultivar	Treatments: Row spacing (cm)	Seeding rate (kg/ha)
1	18.10.72	19.2 x 5.8	Saranac	19 38 76	0.56 0.84 1.12
2	18.10.72	10.0 x 9.0	Caliverde	19 38 76	0.56 1.12 2.24
3	12.10.73	10.0 x 9.1	Saranac	19 38 76	0.56 1.12 2.24 8.96

Trial 1 1972/3 Plants were counted on 25.11.72. The lucerne sown in 38 and 76 cm rows was intercultivated once for weed control. Leaf cutter bees were released on the area in January when the lucerne started to flower. Seed was harvested on 17.4.73.

1973/4 On 9.10.73 the trial was cut and forage production measured and half of each plot was closed for seed, and on 21.11.73 the other half was cut and closed. Leaf cutter bees were released on the trial when the lucerne started to flower. The early-closed subplots were harvested on 6.3.74 and the others on 27.3.74.

Trial 2 1972/3 Plants were counted on 23.11.72 and the plots were harvested on 18.4.73. The seed yields were low and plots were not threshed separately.

1973/4 In the spring two forage cuts were taken on 8.10.73 and 29.11.73, and the trial was abandoned because of a limited supply of pollinators.

Trial 3 Plants were counted on 27.11.73 and all plots were cultivated for weed control. Bees were not released on this trial. The trial was sprayed with 2.8 litres/ha of diquat on 1.5.74 to dessicate weeds, mainly **Erodium** spp., and green lucerne, and was direct-headed on 12.5.74.

RESULTS

Plant numbers

Seedling lucerne numbers/m row increases less than proportionally as seeding rate and row spacing increased except in trial 1 when establishment was greater than expected at the highest seeding rate (Table 2).

TABLE 2: Seedling lucerne plants/m row from different seeding rates and row spacings in three trials

Treatment	Plants/m row Trial		
Row spacing (cm)	1	2	3
19	5	11	16
38	8-	11	29-
76	15-	27-	38-
Seeding rate (kg/ha)			
0.56	6	8	5
0.84	9		
1.12	13+	15-	9-
2.24		27-	18-
8.96			50-

+,— Significantly different at 1% level from expected. (Expected= % establishment at low seeding rate or narrow row spacing x number of seeds/m row).

Seed yields

Seed yields in the year of sowing of 135, 25 and 51 kg/ha were obtained from trials 1-3 respectively. In trial 1 first year yields were unaltered by row spacing or seeding rate (Table 3).

TABLE 3: Seed yields from different seeding rate and row spacing treatments. Trial 1.

Treatments	Seed yield (kg/ha) First Year	Second Year	
		Early Closing	Late Closing
Row spacing (cm)			
19	141 a	172 ab	154 a
38	140 a	198 a	151 a
76	119 a	162 b	152 a
Seeding rate (kg/ha)			
0.56	129 a	182 a	166 a
0.84	132 a	168 a	147 a
1.13	139 a	181 a	144 a
CV %	17	18	19

In the second year, early closing yielded more than late closing, and yields were highest from the intermediate row spacing at the early closing date, but were unaltered by seeding rate.

In trial 3, the only other trial harvested, seed yield was reduced in wide rows and at the two lower seeding rates (Table 4).

TABLE 4: Seed yield in the year of sowing from different row spacings and seeding rates, trial 3.

Treatment	Seed yield (kg/ha)
Row spacing (cm)	
19	54 A
38	56 A
76	43 B
Seeding rate (kg/ha)	
0.56	32 C
1.12	49 B
2.24	61 A
8.96	63 A
CV %	17

Forage Yields

Total growth at harvest was measured in trials 1 and 2 in 1972/73. In trial 1 green weight was correlated with seed yield ($r = 0.726^{**}$ d.f. 35), and like seed yield showed no treatment effects (Table 5). In trial 2 yield was similar at all sowing rates, but was lower from the widest row spacing.

TABLE 5: Total growth at harvest and different row spacings and seeding rates from two trials

Treatment	Total growth (kg g w/ha) Trial 1	Trial 2
Row spacing (cm)		
19	3600 a	2960 a AB
38	3740 a	3180 a A
76	3750 a	2530 b B
Seeding rate (kg/ha)		
0.56	3720 a	2900 a
0.84	3750 a	—
1.12	3630 a	2700 a
2.24	—	2700 a
CV %	11	22

In the spring following establishment, forage yield in trial 1 was the same from all row spacings, and lower (13%) from the lowest seeding rate. In trial 2 the lowest seeding rate yielded less (14%) and the widest rows yielded less (15%) than the mean of the other treatments (Table 6).

TABLE 6: Forage yield from different seeding rates and row spacings.

Treatment	Forage yield (kg dw/ha)		
	Trial 1	Trial 2	
	9.10.73	8.10.73	29.11.73
Row spacing (cm)			
19	4250 a	4990 A	4460 A
36	4190 a	4880 A	4340 A
79	4140 a	4090 B	3860 B
Seeding rate (kg/ha)			
0.56	3900 B	4120 B	3870 B
0.84	4190 AB	—	—
1.12	4490 A	4930 A	4260 A
2.24	—	4900 A	4530 A
CV %	10	31	8

Pollination

Leaf cutter bees were released on trials 1 and 2 but unfavourable weather conditions resulted in few bees remaining to work. Estimates of the numbers released, and those remaining to work the trial areas are given in Table 7.

TABLE 7: Number of leaf cutter bees/ha released and working

	1972/73		1973/74	
	released	working	released	working
Trial 1	1200	200	7200	1000
Trial 2	120	0	—	—

DISCUSSION

The number of pollinators working the trials was inadequate for maximum seed production. The number of bees necessary will vary with flower production and the suitability of weather for bee activity. Hobbs (1973), working in Alberta with summer temperatures similar to Lincoln, considered that 50,000 bees per hectare, would provide about 15,000 working females, were sufficient for complete pollination. Districts with warmer summers than Lincoln would be more favourable for bee activity (Donovan 1974).

The production of economic seed yields in the year of sowing is feasible. To achieve them, lucerne should be sown early and be free of early weed competition, and the soil should provide adequate moisture until flowering. These trials were sown in mid October, but better yields might have been obtained by sowing in September, and the earliest harvest from earlier sowing would increase the reliability of high yields. For early weed control pre-plant or pre-emergence herbicide treatment, followed by post-emergence treatment or inter-row cultivation as soon as possible, is essential. Most post-emergence herbicides reduce the growth of lucerne, and cannot be applied early enough to suppress weeds completely. With sowings in wide rows, inter-cultivation can give adequate early weed control.

In dry springs, pre-plant irrigation may be necessary to give rapid and even germination of lucerne, and on good soils one more irrigation may be necessary to give maximum growth by the end of December. Provided lucerne establishes well, good seed yields can be obtained from seeding rates of 0.5 to 2.0 kg/ha, with no apparent advantage from higher seeding rates. Forage yields were lower from very low seeding rates of .56 kg/ha and wide row spacings, but the reductions were not very great.

With reliable, high first-year seed yields which should be obtainable in districts suitable for leaf cutter bee activity, rapid multiplication of cultivars for the local market or for nothern hemisphere customers should be feasible.

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