THE EFFECTS OF SEED INOCULATION, NITROGENOUS FERTILISER AND HERBICIDE ON THE SEED YIELD OF LUPINUS ANGUSTIFOLIUS CV. UNIWHITE

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ABSTRACT

The effects of seed inoculation and application of nitrogenous fertiliser and herbicide on the seed yield of the sweet white lupin cultivar Uniwhite was measured in two field trials. In one trial, seed inoculation increased seed yield and there was a further increase in yield from nitrogen fertiliser application. In the second trial, highest yields were obtained from inoculated seed when no nitrogen fertiliser was applied. Nitrogen fertiliser increased seed yield in the absence of seed inoculation, but decreased yields in the presence of seed inoculation. Herbicide applications increased seed yield in both trials.

INTRODUCTION

Lupins, like other leguminous plants, can obtain their nitrogen requirement through symbiotic association with nitrogen fixing bacteria in root nodules. In ground previously uncropped with lupins, the specific strain of Rhizobia may be absent and inoculation of the seed may be required to produce effective nodulation. In Western Australia, field experiments on recently cleared land showed that inoculation of **Lupinus luteus** seed greatly improved the nodulation of plants (Shipton and Parker, 1966). Gladstones (1967) has recommended that sweet white lupin seed be inoculated before sowing except where the crop is to be grown on areas where lupins have been cultivated previously.

Low alkaloid (sweet) cultivars of **Lupinus angustifolius** have recently been introduced into New Zealand as the seed is a valuable source of protein for concentrated stock rations.

The need for good weed control in lupins to produce maximum seed yields has been demonstrated by Betts (1975), Mitchell et al (1975) and Rhodes (1975). Pre-emergence application of atrazine has been shown to be effective in weed control, but further information on the effect of lower rates of atrazine than those previously used in trials was considered desirable, since high rates of atrazine may adversely affect the growth of subsequent crops.

Since little work had been done previously on the effects of seed inoculation and the use of fertiliser nitrogen as an alternative or additional nitrogen source in lupin seed crops, it was decided to study the effects of these factors on lupin seed yield.

EXPERIMENTAL METHOD

Experiments were laid down at Waihope Valley, Marlborough and Appleby, Nelson, with **Lupinus angustifolius** cv. Uniwhite in Autumn, 1974.

Nitrogen at 0 and 90 kg/ha and atrazine at 0.2, 0.4, 0.6 and 0.8 kg a.i./ha were tested with and without inoculation of seed in a full factorial combination.

Lupins were seeded at 130 - 150 kg/ha in 18 cm rows on 40 x 1.25 m plots in two randomised blocks of 16 treatments.

Details of the sites are given in Table 1.

TABLE 1: Experimental details

Site	Waihopai Valley	Appleby
Soil Type	Renwick	Ranzau
Soil analyses* (pH, Ca, K and P)	5.8, 6, 8, 10	6.2, 11, 5, 14
Seeding Date	17.5.74	10.5.74
Nitrogenous fertiliser application date	31.7.74	13.8.74
Herbicide Application date	28.5.74	16.5.74
Harvest Date	14.1.75	9.1.75

* M.A.F. quick test results, Truog test P.

The seed was inoculated with a commercially available inoculant immediately before sowing. Nitrogen as nitrolime was applied when the lupins were approximately 10 cm high.

Atrazine was applied pre-emergence in 800 l/ha of water with a knapsack sprayer.

Molybdenum at 0.06 kg/ha as sodium molybdate, potassium at 75 kg/ha as potassium chloride and 350 kg/ha of lime reverted superphosphate were applied to all plots after sowing.

Weed cover was assessed visually in September from three random 1.25 x 0.6 m quadrats per plot.

At harvest, yield was assessed by heading whole plots. Grain samples were taken for moisture and protein analysis.

RESULTS AND DISCUSSION

Inoculation increased seed yield at both sites and appeared to be a worthwhile practice (Table 2).

TABLE 2: Effects of seed inoculation and nitrogen fertiliser (N) on seed yield

	Seed yield (kg DM/ha)	
	Waihopai Valley	Appleby
No inoculum, no N	1250 cC	1770 cC
N only	1480 bB	2410 bB
Inoculum only	1780 aA	2360 bAB
Inoculum plus N	1570 bAB	2760 aA
Main effects		
No inoculum	1370 bB	2090 bB
Inoculum	1680 aA	2560 aA
No nitrogen	1520 a	2060 bB
Nitrogen	1530 a	2580 aA
Interactions	1% sig.	NS
CV%	10.3	10.4

The position regarding nitrogen application was less clear. Nitrogen applied in the absence of inoculation increased yield at both sites. Nitrogen applied in the presence of inoculation increased yield at Appleby but decreased yield at Waihopi Valley. At Waihopi Valley, the crop nitrogen requirement appeared to have been met through nodule activity, where seed had been inoculated prior to sowing. Additional nitrogen increased weed cover (Table 3) and thus crop competition, resulting in reduced seed yield. In the absence of inoculation, fertiliser nitrogen was shared between the crop and weeds, but the crop yield response to nitrogen was greater than the reduction in yield from increased weed competition.

TABLE 3: Effects of herbicide, seed inoculation and nitrogen fertiliser on weed cover

		Percent ground weed cover	
		Waihopi Valley	Appleby
Atrazine (kg a.i./ha)	0.2	80 aA	59 aA
	0.4	54 bAB	30 abA
	0.6	32 bcB	26 abA
	0.8	22 cB	16 bA
No inoculum		46 a	31 a
Inoculum		48 a	34 a
No nitrogen		38 bA	23 a
Nitrogen		55 aA	42 a
Interactions		NS	NS
CV%		29.7	78.4

At Appleby, there was no significant effect on weed cover from inoculum or nitrogen fertiliser application (Table 3) and similar increases in seed yields were obtained from both treatments (Table 2). This would suggest that the nitrogen supply from either treatment was not sufficient to meet the crop's requirement with the result that the increase in yield from both nitrogen sources was additive.

Atrazine applied at increasing rates resulted in increased seed yields (Table 4) and decreased weed ground cover (Table 3) at both sites. However, complete weed control was not achieved at the highest rate of atrazine application. From Figure 1, the optimum rate of atrazine application does not appear to have been reached at Appleby, since yields were still increasing at the highest rate of herbicide applied. At Waihopi Valley, the magnitude of the yield response appeared to be diminishing with increasing rates of herbicide, so that the highest rate used may have been near to optimum in terms of seed yield.

There were no significant treatment effects on seed protein content at either site. Seed protein content, on a moisture-free basis, was approximately 26% and 19% at Waihopi Valley and Appleby respectively.

TABLE 4: Effects of Herbicide on seed yield

	Seed yield (kg DM/ha)	
	Waihopai Valley	Appleby
Atrazine (kg a.i./ha)		
0.2	1370 bB	2050 bB
0.4	1500 abAB	2300 abAB
0.6	1590 aAB	2390 aAB
0.8	1620 aA	2550 aA

CONCLUSIONS

The results of these experiments indicate that inoculation of lupin seed prior to sowing can give worthwhile increases in seed yield. Nitrogenous fertiliser application may also be advisable where soil nitrogen levels are expected to be low and where weed control can be achieved.

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