IMPROVING LUPIN COMPETITIVE ABILITY AGAINST ANNUAL RYEGRASS

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Summary The competitive ability of cultivars of narrow-leaf lupin (*Lupinus angustifolius* L.) and broad-leaf lupin (*Lupinus albus* L.) against annual ryegrass (*Lolium rigidum* Gaud.) were compared over two seasons. Cultivars of broad-leaf lupin tended to be more competitive than narrow-leaf lupin. The potential of lupins to compete with annual ryegrass was influenced by seasonal conditions. Early, vigorous growth and large leaf area may give broad-leaf lupin cultivars a competitive advantage.

INTRODUCTION

Lupins can play an important role in crop rotations, as a disease break for cereal root diseases and for maintaining soil fertility. However, Lemerle *et al.* (1995) ranked narrow-leaf lupin as being one of the least competitive of the main winter crops against annual ryegrass. Allen (1977) found that increasing lupin plant density improved its competitive ability. Because lupins are such poor competitors, they are more dependent on chemicals for weed control; which are not always available now that herbicide resistance in annual ryegrass is widespread. The aim of these experiments was to determine the variation in competitive ability between cultivars of narrow and broad-leaf lupin and the potential to improve competitive ability.

MATERIALS AND METHODS

Cultivars of both narrow and broad-leaf lupin (Table 1) were sown in the field at Wagga Wagga in 1993 and 1994. Cultivars were sown at 80 kg ha^{-1} on the 28th May in 1993 and at 80 and 140 kg ha^{-1} on the 9th June in 1994. All plots were sown with 12 kg ha^{-1} phosphorus as grain legume superphosphate using a cone seeder. Annual ryegrass was sown immediately after the lupin by hand-broadcasting a weighed amount (0.7 g m^{-2}) of seed mixed with sand and then incorporated using light harrows. Plots were 1.6 m wide (eight rows) by 8 m long.

In 1993, the experimental design was a split-plot with four replicates, cultivars as the main plots, weedy and weed-free as the sub-plots. In 1994 the design was a split-split-plot with four replicates cultivars as the main plots, seeding rate as the sub-plots and weedy and weed-free as the sub-subplots. Broad-leaf weeds were controlled by hand-weeding in both years.

Plant establishment was recorded by counting the number of lupin plants in 2 × 1 m length of row in each plot. Annual ryegrass establishment was recorded by counting total number of plants in 3 × 0.1 m^2 quadrats per plot. Dry matter of annual ryegrass was estimated from a 0.25 m^2 quadrat cut at flowering from each weedy plot and dried at 80°C for 48 h.

Table 1. Grain yields (t ha^{-1}) of lupin cultivars grown with (weedy) and without annual ryegrass (weed-free).

Cultivar	1993			1994[A]		
	weed-free (t ha^{-1})	weedy (t ha^{-1})	weedy (% reduction)	weed-free (t ha^{-1})	weedy (t ha^{-1})	weedy (% reduction)
L. angustifolius						
Geebung	3.20	0.33	90	0.77	0.36	54
Yorrel	2.17	0.35	84	0.61	0.27	56
Merritt	–	–	–	0.60	0.30	51
L. albus						
Ultra	3.88	1.65	57	0.80	0.40	50
Kiev Mutant	4.62	1.29	72	1.17	0.59	50
Mutoluppa	4.16	2.21	47	1.01	0.57	43
LSD (P=0.05)	0.63	0.63		0.34	0.34	

[A] Mean of two seed rates.

Table 2. Annual ryegrass dry matter (g m^{-2}) growing with lupin cultivars.

	Annual ryegrass dry matter g m^{-2}	
Cultivar	1993	1994
L. angustifolius		
Geebung	546	142
Yorrel	480	124
Merrit	–	117
L. albus		
Ultra	434	136
Keiv Mutant	454	121
Mutoluppa	427	116
LSD (P=0.05)	50	36

Grain yield was harvested at maturity using a small plot header. Competitive ability of lupin was accessed by comparing grain yield from weedy and weed-free plots, and by suppression of annual ryegrass.

RESULTS AND DISCUSSION

Lupins emerged within three weeks of sowing and average plant densities for all cultivars were 39 plants m^{-2} in 1993, and 37 and 63 plants m^{-2} in 1994 for the 80 and 140 kg ha^{-1} seed rates, respectively. Although there was some variation in density between cultivars this was not statistically significant. For example, Yorrel in 1993 had plant numbers of 46, while Mutoluppa were 31. Annual ryegrass emerged about one week after the lupin, the density of annual ryegrass was 159 and 145 plants m^{-2} in 1993 and 1994, respectively. Rainfall during the growing season (May–November) was 440 mm in 1993 and 193 mm in 1994.

In 1993 and 1994, grain yield of lupin was influenced by a significant interaction ($P<0.05$) between cultivar and weed competition (Table 1). In 1994 there was no significant effect of crop density on weed competition in contrast to the data of Allen (1977). Low rainfall during 1994 could account for the lack of response in competitive ability to higher plant densities.

The largest reductions in grain yield due to annual ryegrass competition were in the narrow-leaf cultivars Geebung and Yorrel in 1993 and 1994, whilst the most competitive cultivar was Mutoluppa. Grain yield of the weed-free plots was much higher in 1993 than 1994. This can again be attributed to the low rainfall.

There was no significant effect of lupin cultivar on annual ryegrass dry matter. However, cultivars that were strongly competitive such as Mutoluppa tended to have lower annual ryegrass dry matter compared to a less competitive cultivar such as Geebung (Table 2). In both seasons, broad-leaf cultivars were more competitive against annual ryegrass than narrow-leaf cultivars. Larger leaf size and more vigorous early growth appear to give broad-leaf lupin a much greater potential to suppress the weed. Other studies have shown that competition for light is likely to be very important as short cultivars with less vigour are more likely to be poorly competitive (Arnold *et al.* 1985, Lemerle *et al.* 1995). Further experiments are required over a variety of seasons to confirm these findings.

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