Competitive effects of wireweed (*Polygonum aviculare* L.) on lucerne (*Medicago sativa* L.) during the establishment phase.

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Abstract

Wireweed (*Polygonum aviculare* L.) is a troublesome weed of the southern Australian dryland cropping region. It is particularly prevalent in cereal crops, a nuisance in canola and field peas but a serious weed during the establishment phase of lucerne pastures. Significant competition between establishing lucerne and wireweed occurs where cultivation has been used for weed control, sowing has been delayed due to a late break and where low soil temperatures favour wireweed germination. To investigate the competitive effects of wireweed on a range of lucerne cultivars with varying levels of winter activity (WAL) a glasshouse pot experiment was conducted from October to December 2009. Lucerne cultivars were established in the presence or absence of wireweed. Our hypothesis was that high winter activity level provides increased resistance to the competitive effects of wireweed than low winter activity level. Cultivars included Sardi 10 (WAL 10, L1), Genesis (WAL 7, L2) and WL 342 HQ (WAL 2, L3). Lucerne top (leaf and stem), root dry matter (DM) and plant height were assessed 3, 6 and 9 wks after sowing. There was no effect of wireweed on lucerne biomass at 3 weeks and only L3 had reduced biomass at 6 weeks. At 9 weeks, biomass was reduced in all lucerne cultivars when grown with wireweed. When grown on their own, there was no difference in above ground biomass between lucerne cultivars at 3 wks, but at 6 and 9 wks L3 had more above ground biomass than L2. There was no effect of wireweed on lucerne height at 3 and 6 weeks but at 9 weeks, wireweed reduced L2 plant height. Results suggest that winter activity level is not an indicator of competitive ability against wireweed.

Key Words

Wireweed, lucerne, competition, establishment

Introduction

Wireweed (*Polygonum aviculare* L.) is a problematic weed of cropping systems in Australia, including canola and field peas, being ranked as one of the top twenty weeds (McGillion and Storrie, 2006). It is also a serious weed of lucerne and establishing pastures (Auld and Medd, 1987). More wireweed seedlings emerge after soil disturbance (Courtney, 1968) and direct drilling pasture tends to discourage wireweed germination (Fernandez-Quintanilla *et al.*, 1984). Significant competition between establishing lucerne and wireweed may occur in pasture establishment situations where cultivation has been used for weed control, sowing has been delayed due to a late rainfall break and where low soil temperatures favour wireweed germination. The aim of this research was to investigate the competitive effects of wireweed on a range of lucerne cultivars with different levels of winter activity. Our hypothesis was that high winter activity level provides increased resistance to the competitive effects of wireweed than low winter activity level.

Methods

A glasshouse pot experiment was established with three lucerne cultivars of different winter activity levels (WAL) grown with or without wireweed; the cultivars were Sardi 10 (WAL 10, L1), Genesis (WAL 7, L2) and WL 342 HQ (WAL 2, L3). The experiment design was a split plot design with 7 treatments and 3 harvest times (3, 6, 9 weeks after sowing) as follows: T1, wireweed (W) grown on its own; T2, L1 grown on its own; T3, L2 grown on its own; T4, L3 grown on its own; T5, L1 + W; T6, L2 + W; T7, L3 + W. There were 4 replicates for treatments T1 to T4, and 6 replicates for treatments T5 to T7.

Pots (120 * 10 cm diameter, 1099cm^3 volume) were filled with a sandy soil mixture (Debco™ Seed Raising Mix) and wetted with liquid fertiliser mix to supply nutrients (Thrive™). Lucerne seeds were pre-germinated in Petri dishes and wireweed seeds were germinated in seedling trays prior to planting in the experimental pots. Both lucerne and wireweed seedlings were planted at cotyledon growth stage. Treatment pots were randomly allocated to glasshouse tables with each harvest time represented on each table. Pots were kept well watered and temperature and humidity was monitored.

At the three harvest times whole plants were extracted from pots and the root systems were washed. Lucerne stems and wireweed primary and secondary branches were counted, and the height or length (mm) of plants recorded. Above and below ground biomass was assessed by drying tops and roots for 24 hours at 70?C and weighing.

Lucerne above ground biomass, wireweed above ground biomass and lucerne height were analysed using analysis of variance (ANOVA) appropriate for a split-plot design. The treatment structure was specified as *HarvestTime*Cultivars* and the block structure was specified as *Block/WholePlot/SubPlot* in GenStat 11 (Payne *et al.,* 2008). Residual values were examined graphically to check distributional normality and constant variance assumptions. Least significant differences (5% level) were used to separate the means, subject to significant F tests.

Results

The average daily maximum and minimum temperatures during the experiment were 29.4?C and 19.5?C, respectively. Average relative humidity was 50%. There was no effect of wireweed on above ground lucerne biomass at 3 weeks after sowing (Table 1).

Table 1. Lucerne above ground biomass (g), wireweed above ground biomass (g) and lucerne height (mm) at 3, 6 and 9 weeks after sowing.

Harvest Time	Cultivars	Lucerne biomass	Wireweed biomass	Lucerne height
3 weeks	T1 (W)	0.000	0.054	0.000
	T2 (L1)	0.093	0.000	202.8
	T3 (L2)	0.106	0.000	206.7
	T4 (L3)	0.170	0.000	216.5
	T5 (L1+W)	0.127	0.064	204.5
	T6 (L2+W)	0.108	0.067	183.7

	T7 (L3+W)	0.101	0.059	170.1
6 weeks	T1 (W)	0.000	1.745	0.000
	T2 (L1)	2.219	0.000	616.2
	T3 (L2)	1.151	0.000	472.5
	T4 (L3)	3.526	0.000	553.8
	T5 (L1+W)	1.578	1.468	480.6
	T6 (L2+W)	0.905	1.494	451.5
	T7 (L3+W)	1.414	1.713	433.1
9 weeks	T1 (W)	0.000	8.953	0.000
	T2 (L1)	8.793	0.000	695.0
	T3 (L2)	6.255	0.000	735.0
	T4 (L3)	7.783	0.000	817.5
	T5 (L1+W)	3.966	6.763	595.0
	T6 (L2+W)	3.471	6.916	570.0
	T7 (L3+W)	5.628	6.714	750.0
lsd (5%)		1.411	1.650	138.5

F-test probabilities

HarvestTime (H)	<0.001	<0.001	<0.001
Cultivars (C)	<0.001	<0.001	<0.001
Interaction (H*C)	<0.001	<0.001	<0.001

At 6 weeks after sowing, there was a reduction in biomass in low winter activity lucerne (L3) when grown with wireweed. At 9 weeks after sowing, above ground biomass was reduced in all lucerne cultivars in the presence of wireweed.

There was no effect of lucerne on above ground wireweed biomass at either 3 or 6 weeks after sowing. At 9 weeks after sowing, all lucerne cultivars reduced wireweed biomass compared with wireweed grown on its own.

At 3 and 6 weeks after sowing, there was no effect of wireweed on lucerne plant height. At 9 weeks after sowing, only L2 plant height was reduced in the presence of wireweed.

There was no difference in below ground lucerne biomass in the presence of wireweed for any lucerne cultivar and similarly, there was no difference in wireweed root biomass in the presence of lucerne (data not shown).

Discussion

It is generally recognised that above ground plant biomass can explain about two thirds of a plant's competitive ability with plant height also making some contribution (Gaudet and Keddy, 1988). The biomass results show that in the first 3 weeks of growth there was no difference in biomass accumulation between the lucerne cultivars and wireweed. At this stage of growth the plants were small and there was no competition for light, water, nutrients or space. At 6 weeks, only the low winter activity level lucerne cultivar (L3) was affected by wireweed with slightly reduced biomass. At 9 weeks however, all 3 lucerne cultivars had reduced biomass in the presence of wireweed. At this stage of growth the lucerne plants had multiple stems with an upright growth habit whilst the wireweed plants had multiple branches with a prostrate growth habit (Figure 1). At 9 weeks, wireweed plants had an average of 21 branches per plant with the average length of branches being 790 mm. In contrast, the lucerne plants had an average of 4 stems per plant with an average height of 675 mm.

Figure 1. Treatment pot showing upright growth of lucerne and prostrate growth of wireweed at 6 weeks.

The results also suggest that the winter activity level of lucerne is not a good indicator of its competitive ability against wireweed because there was no consistent pattern in the effect of wireweed on lucerne biomass.

The major implication of wireweed's competitive ability over lucerne after 9 weeks is that the wireweed plants have been able to establish and produce multiple branches, all of which have the ability to flower and produce significant numbers of seeds. Wireweed has a strong tap root and would compete for moisture against lucerne. Additionally, when the lucerne is grazed by animals, the prostrate growth habit of wireweed provides it with an advantage in light capture when the lucerne is commencing its regrowth period. Additional research is required to determine the competitive ability of wireweed against lucerne after a grazing episode.

Conclusion

Winter activity level in lucerne cultivars is not a good indicator of competitive ability against wireweed. Lucerne can compete against wireweed in the first few weeks of growth but after 9 weeks, wireweed can significantly reduce lucerne above ground biomass. This has implications for lucerne establishment in paddocks that contain high populations of wireweed and in the grazing management of lucerne to prevent wireweed seed production.

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