

The effect of phosphorus availability and soil type on manganese accumulation in *lupinus albus* L.

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The pig and poultry industries are major consumers of lupin meal in Australia and concern has been expressed that the high manganese levels which occur in *L. albus* (1) may make it of limited use as a stockfeed (2). Proteoid roots occur on *L. albus* and have been shown to be the main sites of manganese reduction and uptake in the root system (3). The extent of development of these root structures has been shown to be influenced by the levels of soil phosphorus. The effect of phosphorus availability and soil type on manganese accumulation in *L. albus* was therefore examined.

Methods

An experiment was conducted in pots under glasshouse conditions involving three contrasting soils and six levels of superphosphate. Soils were a clay from Horsham (pH 8.6) and sandy loams from Walpeup (pH 6.7) and Rutherglen (pH 4.8).

Results and Discussion

The proportion of the root system which developed proteoid roots was not significantly affected by soil type, but was reduced by phosphorus application. Shoot manganese levels were significantly influenced by soil type (decreasing in the order Rutherglen > Walpeup = Horsham) and decreased significantly with increasing phosphorus application (Table 1). Significant regressions were obtained relating manganese uptake and proteoid root weight for each soil type.

Table 1. Shoot manganese levels (ppm)

Soil	Superphosphate addition/pot (g)					
	0	0.133	0.334	0.667	1.333	6.67
Rutherglen	15,050 a	13,900 a	13,250 a	14,750 a	12,450 a	9,700 b
Walpeup	1,450 c	1,150 d	1,250 cd	1,100 de	1,100 de	1,020 de
Horsham	1,500 c	1,550 c	1,500 c	1,150 d	880 e	630 f

Values followed by the same letter are not significantly different at $P < 0.05$ by Duncan's multiple range test

These findings indicate that the levels of manganese that accumulate in *L. albus* are primarily determined by soil pH, but decrease with increasing phosphorus availability in a particular soil type.

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