The tolerance of common weeds and native grasses to acid soils

B.B. Rubzen[1], E.C. Wolfe and K.R. Helyar

[1]*School of Agriculture, Charles Sturt University, Wagga Wagga, N.S.W.*

Traditionally, lime is recommended to combat soil acidity, along with the adoption of less acidifying farming practices and the use of species which are adapted to acid soils (Scott and Fisher 1989). Although the tolerance of crops and pastures is well-known (*e.g.*, Helyar and Conyers 1994), little information is available on the adaptation of weeds to acid soils. In New South Wales, native grasses and weeds account for over 40% of the composition of most "improved pastures" (Kemp and Dowling 1991). Therefore, the management of pastures on acid soils requires an understanding of the tolerance of weeds and native grasses to aluminium and manganese toxicities.

Methods

A glasshouse experiment was conducted to screen common weeds and some native grasses for tolerance to two types of acid soils. One soil was dominated by aluminium toxicity (high in aluminium and low in manganese) and the other soil was dominated by manganese toxicity (high in manganese and low in aluminium). Seven acid/lime treatments, comprising the addition of acid to one treatment and six rates of lime (equivalent to 0-8 tons/ha of lime) were imposed on eight weed species and two wallaby grasses, *Danthonia richardsonii* (A) and *D. linkii* (B). The tolerance ratings of species were based on ED50 values (equivalent dose of Al or Mn to produce 50% reduction in yield) calculated from response curves generated from a derived mathematical model.

In a second experiment, four ecotypes of both *D. richardsonii* and *D. linkii* were screened for tolerance to Al and Mn.

Results

For aluminium tolerance ratings of the species, annual ryegrass was the most tolerant followed by sorrel, wild oat, silvergrass, and catsear (Table 1). Soft brome, Paterson's curse and wireweed were sensitive to aluminium. For manganese tolerance ratings, soft brome, wild oat and annual ryegrass were classified highly tolerant followed by silvergrass and Paterson's curse. Catsear and sorrel were sensitive while wireweed was highly sensitive.

For the native grasses, wallaby grass-A was tolerant to Al and sensitive to Mn, and the ecotypes of *D. richardsonii* ranged from sensitive to highly tolerant of Al and tolerant to Mn. All the ecotypes of *D. linkii* were sensitive to Al and highly sensitive to Mn.

Table 1. Aluminium and manganese tolerance ratings of common weeds and native grasses.

Weeds and native grasses	$(Al)_{50}$[A]	rating[B]	$(Mn)_{50}$[C]	rating[D]
Annual ryegrass	(136)	HT	(131)	HT
Sorrel	(99)	T	(31)	S
Wild oat	(96)	T	(145)	HT
Silvergrass	(82)	T	(52)	T
Catsear (flatweed)	(79)	T	(33)	S
Wallaby grass-1)	(76)	T	(29)	S
Soft brome	(57)	S	(256)	HT
Paterson's curse	(45)	S	(41)	T
Wireweed	(39)	S	(19)	HS
Wallaby grass-2	(16)	HS	(16)	HS

Notes: 1 = D. richardsonii; 2 = (D. linkii); A - Equivalent dose of soil aluminium (mM) to produce 50% reduction in root yield.; C - Equivalent dose of soil manganese (mg/mL) to produce 50% reduction in root yield; B,D - HT = Highly Tolerant; T= Tolerant; S = Sensitive; HS = Highly Sensitive.

Discussion

Amongst the weeds tested, there exists a range of tolerance to both Al and Mn toxicities. The tolerance to acid soil environments of common weeds like annual ryegrass may influence their competitive performance against sensitive intro-duced species like canola and phalaris. On the other hand, weeds adapted to acid soils could be used, as a last resort, as plants to salvage degraded areas which are, or have become, too acid to support profitable agricultural production systems. Such weeds could prevent further degradation of acid soils due to erosion, could restore the soil cover, and could be used as alternative feed.

The sensitivity of some wallaby grasses to Al and Mn toxicities may restrict their use in pastures, but a potentially useful range of tolerance is available in *D. richardsonii*.

References

Helyar, K.R. and Conyers, M.K. (1994). Ranking commercial pasture cultivar sensitivity to acidity and allocating estimated response functions to the cultivars. Final report to the WRDC. Agricultural Research Institute, N.S.W., Wagga Wagga.

Kemp, D.R. and Dowling, P.M. (1991). Species distribution within improved pastures over central NSW in relation to rainfall and altitude. *Australian Journal of Agricultural Research* 42, 647-659.

Scott, B.J. and Fisher, J.A. (1989). Selection of genotypes tolerant of aluminium and manganese. In "Soil Acidity and Plant Growth" (Ed. A.D. Robson). Academic Press, Sydney.