The competitive performance of a weed with introduced grasses on acid soils

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Experiments were conducted to assess the individual tolerance to aluminium toxicity of a tolerant ecotype of annual ryegrass (*Lolium rigidum*) and of two pasture grasses (*Phalaris aquatica* cv. Sirosa) and (*Dactylis glomerata* cv. Porto). Then, the competitive performance of the ryegrass ecotype was evaluated with phalaris and with cocksfoot on pots containing an acid (high aluminium) soil.

Methods

The tolerance of grasses to Al was tested by measuring the root growth of seedlings, using a microhydroponics cell system and leachates from acid soils which ranged from low to high alumin-ium, and were low in manganese.

The competition study comprised a pot experiment in which ryegrass was grown in a replacement series with phalaris or cocksfoot (de Wit 1960) on acid soil (high Al) taken from the rye-grass site. A binary competition model was used to evaluate a coefficient of competitive performance (K values) for each species against the other. K values range from 1 (dominance) to (suppression).

Results

The tolerance of the species to a range of aluminium concentration of leachates are indicated in Table 1 and was in the order: cocksfoot ryegrass phalaris.

The competitive performance of annual ryegrass with phalaris and cocksfoot is shown by the values in Table 2, for harvests at 12, 24 and 36 weeks after sowing. Phalaris growth was suppressed by ryegrass, and the suppression became progressively greater (1st to 3rd harvest). The Al tolerant cocksfoot eventually out-competed ryegrass.

Table 1. Tolerance ratings to aluminium of annual ryegrass, phalaris and cocksfoot.

Grass Species	ED(Al)50*	Rating
Annual ryegrass	188	Tolerant
Phalaris	28	Sensitive
Cocksfoot	272	Tolerant

* Equivalent dose of aluminium (mM Al) to cause 50% reduction in plant growth.

Table 2. Competitive performance of annual ryegrass when grown with either phalaris or cocksfoot on an acid soil*.

		Harvest Time		
Competitive Performance		1st	2nd	3rd
Ryegrass v. Phalaris				
Annual Ryegrass	Krp	2.5	9.0	14.1
Phalaris	Kpr	0.4	0.2	0.1
Ryegrass v. Cocksfoot				
Annual Ryegrass	Krc	1.8	0.7	0.5
Cocksfoot	Kcr	0.6	1.4	2.4

* natural soil pH = 3.7 (1:5, soil:0.01 M calcium chloride).

Discussion

The relative tolerance of ryegrass, phalaris and cocksfoot to Al toxicity (screening study) appeared to account for the outcome of competition between ryegrass and phalaris and ryegrass and cocksfoot when these mixtures were grown on the acid soil (taken from the same site as the ryegrass ecotype).

The experiments indicate the futility of planting sensitive species such as phalaris cv. Sirosa on acid soils in the presence of acid tolerant weeds. A better approach is to plant tolerant species, such cocksfoot cv. Porto. Alternatively, lime rates must be applied to improve the performance of phalaris.

Reference

Wit, C.T. (1960). On competition. *Agricultural Research Reports* 66.8, Pudoc, Wageningen, The Netherlands, 82 pp.