Breeding phalaris for greater tolerance to acid soils

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The gradual acidification of lighter soils on the tablelands of S.E. Australia under leguminous pastures (1) has revealed the susceptibility of the commercial cultivars of Phalaris aquatica L. to the mineral excesses and deficiencies which occur at low soil pH. The roles of toxic concentrations of aluminium and manganese have been investigated, and the possibilities for breeding resistant cultivars explored.

Methods

Thirty-nine phalaris lines, including wild populations, overseas cultivars and Australian cultivars were tested in nutrient solution with varying concentrations of aluminium from 0 to 10 ppm. A modified, half-strength Hoagland's solution was used with a R concentration of 1 ppm and a pH of 4.1, adjusted daily. Solutions were replaced every 3 or 4 days. In a second experiment. 16 phalaris lines were assessed for manganese tolerance over the range 0.5 to 210 ppm Mn in a half-strength Hoagland's solution of pH 5.0.

Results and Discussion

Root length and root dry weight were the characters most responsive to Al. No phalaris lines were as tolerant as subterranean clover or cocksfoot, both recognized as Al-tolerant species (Table 1). Most accessions from Algeria and Libya were highly susceptible (e.g. CRI 19275). Many lines, including the Australian cultivars and the current Canberra breeding population, are mixtures of sensitive and tolerant genotypes. The segregations observed in the progeny of crosses within and between these classes in cv. Noy (Israel) suggest that two dominant alleles, or possibly three, are complementary in controlling tolerance. A set of 46 half-sib families in the Canberra breeding population has been tested by the haematoxylin root-staining method (2), which appears promising as a preliminary screen. These families were then tested in nutrient solution containing 6 ppm Al, and their productivity is now being determined on an acid soil rich in Al.

Table l. Response of phalaris and other species to Al and Mn in solution

	Al Experiment Root Dry Wt. (% of control)						Mn Experiment Shoot Dry Wt (% max.)		
Treatment (ppm)	0	2	4	6	8	10	0.5	40	150
Australian	100	38	34	26	22	16	100	97	76
Sirosa	100	81	53	32	34	15	75	100	68
El Golea	100	74	53	30	13	42	100	91	74
CPI 19275	100	16	7	11	2	2	100	83	51
Egret wheat	100	51	18	15	13	15	100	97	49
Currie cocksfoot	100	158	79	58	53	42	Not determined		
Woogenellup sub cl.	100	95	94	71	51	26	100	53	24

In the manganese experiment, top dry weight in one group of lines responded positively at 40 ppm Mn. In the remaining lines, dry weight fell progressively but gradually from 0.5 ppm Mn. However, both groups can be regarded as highly tolerant of Mn, with few leaf symptoms evident even at 90 ppm Mn in the solution. The degree of tolerance in the best lines is comparable to that in the most tolerant wheats, e.g. Carazinho, and considerably greater than that in Woogenellup subterranean clover.

Testing of an advanced breeding population is continuing with the aim of breeding phalaris cultivars resistant to Al. The possibility of reducing the Mn concentration of phalaris herbage is also being investigated.

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