SEEDLING ESTABLISHMENT, PLANT SURVIVAL AND RESPONSE TO GRAZING OF NEW ACID-SOIL TOLERANT *PHALARIS* POPULATIONS

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Abstract

Stands of the winter-active phalaris (*Phalaris aquatica*) cultivars have been difficult to maintain under the combined stresses of continuous grazing and high soil acidity. A population that contains genes from the highly acid soil tolerant *P. arundinacea*, the cultivar Landmaster, and selections from intensively grazed trials have been evaluated under these conditions. The new populations had significantly better seedling establishment and survival on an acid surface-soil site than the cultivars Holdfast and Sirosa, but all entries increased their basal area during 18 months of heavy grazing, apparently using less acid subsoil for root growth.

Key words: Phalaris, acid-soil tolerance, grazing tolerance, cultivars, breeding.

Perennial pasture species will play a major role in strategies to counter the causes of land degradation and reduced profitability of animal enterprises. Phalaris has already proved to be a valuable species in drought-prone environments but the persistence of current cultivars, particularly Sirosa, in situations of low soil fertility and heavy grazing has been questioned. The evaluation of improved forms of phalaris must therefore be done under the combined influence of sub-optimal soil conditions and grazing pressure (3).

Several approaches to this problem have been used in the development of improved populations. One takes advantage of the high tolerance to aluminium shown by the closely related species *P. arundinacea* (1). Back-cross populations of *P. aquatica* with introgressed genes from *P. arundinacea* have been developed and tested on acid soil sites (4). An "Acid Tolerant" population was formed from these sources. A second approach has involved selection within *P. aquatica* for productivity and persistence on shallow, acid soils and culminated in the development of the cv. Landmaster (2). Finally, selection for grazing tolerance (GT) has been practiced in long-established swards of broadly-base populations (BBP GT) of *P. aquatica*, the parent families of cv. Holdfast (Holdfast GT) and an early generation of the population "Perla Retainer" (Perla GT).

This paper reports on the establishment and survival over summer of seedlings of these new phalaris populations on an acid soil site on the southern tablelands of NSW. Thereafter the response to continuous grazing was followed over an 18 month period.

Materials and methods

A field trial was sown on a shallow, acid soil near Canberra, A.C.T. on 11 May, 1995. In extracts of soil (0-10 cm depth) in 0.01M $CaCl_2$ solutions, pH was 4.1 and the concentrations of Al and Mn were 7.4 mg/kg and 35.2 mg/kg soil, respectively. Eight replicates of "Acid Tolerant", cv. Landmaster and cv. Holdfast, and four replicates of Holdfast GT, Perla GT, BBP GT, cv. Sirosa and Porto cocksfoot (*Dactylis glomerata* L.) were sod-seeded into herbicide-killed swards. Plots consisted of 8 rows, 1.36 m wide and 10 m long in a randomised block design. Seedling counts were made in all plots in August 1995. Estimates of seedling survival over summer were made in May 1996 from the mean of four counts per plot of the presence of phalaris in a grid containing 25 10 x 10 cm square subdivisions.

Grazing commenced in May 1996 at a stocking rate equivalent to 10 DSE/ha. The plots were grazed continuously until mid-April 1997 when the sheep were remov-ed during very dry weather that had reduced the amount of feed on offer. Grazing was recommenced in September 1997 and continued until December 1997. In spring 1996, autumn 1997 and spring 1997 estimates of the basal cover of phalaris

were obtained by counting hits on live tiller bases at intersection points of 10 cm squares in a 50 x 50 cm quadrat. Four counts were made in each plot. Separate analyses of variance were done on the 8-replicate and 4-replicate entries.

Results and discussion

Establishment and seedling survival: Acid Tolerant had significantly denser seedling populations than Landmaster and Holdfast (Table 1). However, at the end of the first summer there was little difference in percentage presence of phalaris herbage in the swards between Acid Tolerant and Landmaster but both were significantly better than Holdfast. Establishment of the GT populations was better than Sirosa and Porto cocks-foot and the differences were maintained at the end of the first summer. Although the sowing rates of all populations were calculated to take into account differences in germination percentage, the establishment of Holdfast and Sirosa may have been affected by other seed quality factors.

Basal cover measurements under grazing: The basal cover of all entries increased during the period of grazing and Holdfast, Sirosa and Perla GT appear to have spread at a faster rate than the other entries. The expression of differences in grazing tolerance between these populations may require a longer exposure to grazing. The significantly lower basal cover of Holdfast compared with Acid Tolerant and Landmaster, and of Sirosa compared with the three grazing tolerant populations reflects the seedling density differences that were present at the end of the first summer.

The differences that were evident between the new phalaris populations and the older cultivars at establish-ment are encouraging and may reflect properties that improve their ability to establish on soils that are acid at the surface. Subsoil levels of pH and Al (5.04 and 0.3 mg/kg soil respectively at 20-40 cm depth) at this site were more favourable for plant growth and suggest that once plant roots attain this depth, soil acidity would not influence their survival. This may help to explain why the relative persistence of these populations was strong-ly related to their seedling survival at the end of the first summer.

References

1. Culvenor, R.A., Oram, R.N, Fazekas de St. Groth, C. 1986. Aust. J. Agric. Res. **37**, 383-396.

2. Oram, R.N. 1996. *Aust. J. Exp. Agric*. **36**, 913-914.

3. Oram, R.N. and Culvenor, R.A. 1994. *N.Z. J. Agric. Res.* **37,** 329-339.

4. Oram, R.N., Culvenor, R.A., and Ridley, A.M. 1993. In "Genetic Aspects of Plant Mineral Nutrition." Edited by P.J. Randall, E. Delhaize, R.A Richards and R. Munns. *Kluver Academic Publishers*, Dordrecht, The Netherlands. pp. 17-22.