SUPPRESSION OF WEED GROWTH DURING THE GERMINATION AND ESTABLISHMENT OF NATIVE GRASSES USED FOR REVEGETATION

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Summary. Effective revegetation of conservation areas and degraded sites with Australian native grassland species is often limited by the generally slow early growth of native grasses. Vigorous exotic grass and broadleaf weeds which are stimulated to germinate at the time of sowing are often major competitots. In this paper we evaluate the potential of several non-chemical methods for suppressing weed growth during the germination and establishment of wallaby grass, *Danthonia richardsonii*, and kangaroo grass, *Thomeda triandra*: broadcasting seeds versus drilling them in rows; increasing the planting density above that which may normally be recommended for establishing a stable grassland community; applying phosphate fertiliser; and, adding to the seed mix a vigorous but short lived cover (or nurse) crop.

INTRODUCTION

Many of Australia's native grasses exhibit considerable tolerance of drought conditions and nutrient deficient soils (1,2,3). As a result of these adaptations, their perceived persistence, and a growing appreciation of their aesthetic qualities and conservation value, interest has increased over recent years in using them for sustainable grazing systems, soil conservation and amenity plantings. Research by the CSIRO's Division of Plant Industry in Canberra into the development and management of native grasses for use in revegetation programmes has targeted two species, namely the cool-season perennial, wallaby grass, *Danthonia richardsonii* (5), and the summer-growing perennial, kangaroo grass, *Themeda triandra* (syn. *Themeda australis*) (7).

Effective revegetation with Australian native grassland species is often limited by the generally slow early growth of native grasses in combination with competition from more vigorous exotic grass and broadleaf weeds which are stimulated to germinate at the time of sowing. Kangaroo and wallaby grass seedlings, for example, produce less biomass over the first 2 to 3 months following germination compared with agricultural species used for revegetation such as tall fescue, *Festuca arundinacea,* and perennial ryegrass, *Lolium perenne* (Reyenga, unpublished data). The presence of weeds can significantly reduce the emergence and biomass production of wallaby grass and, to a lesser extent, kangaroo grass (4). There has been little success in the selection of post-emergent herbicides that are able to control grass weeds without detrimental effects on the native grasses (6). A greater level of weed control has been achieved with residual pre-emergent herbicides (4,6) and manipulations of the site, seedbed, and seed mix (8). Two experiments were conducted to evaluate the effectiveness of various sowing methods and planting densities, and the presence or absence of a cover crop on the suppression of weed growth during the germination and establishment of wallaby grass and kangaroo grass. The effect of phosphate fertiliser on weed growth was also measured in the second experiment. Our hypothesis was that by manipulating these factors the competitiveness of the sown native grasses could be improved relative to the volunteer species.

METHODS

Experiment 1. The first experiment with wallaby grass was conducted at the ACT Parks and Conservation Service field site at Yarralumla, ACT, on a low fertility sandy loam which had been cultivated and sown down to native grasses 6 years earlier but which, becuase of regular mowings, had become overgrown with weeds, particularly flat weed, *Hypochoeris radicata*. The experiment had a 2x2x2 factorial design with three randomised complete blocks, and a plot size of 1 m^2. The treatments were as follows:

Factor 1 = two planting methods, broadcasting versus drilling seeds in rows 15 cm apart.
Factor 2 = two planting densities, low (1000 germinable seeds/m^2) and high (3000 germinable seeds/m^2).
Factor 3 = presence (+) or absence (-) of a cover crop of cereal rye, *Secale cereale*, sown at 100 germinable seeds/m^2 either broadcast or in rows with the wallaby grass.

The site was rotary hoed and raked to remove excessive vegetative matter prior to seeds of wallaby grass and cereal rye being either drilled or broadcast and covered with soil to a depth of 1 cm on 12 March 1993. The plots were initially irrigated to promote germination. Emergence counts of sown and volunteer species were taken 5 weeks after sowing in two fixed 30x30 cm subplots. Weed and grass biomass will be harvested in mid September from the same subplots.

Experiment 2. A second experiment, which had the same treatments and design as Experiment 1, but sown to kangaroo grass rather than wallaby grass, was begun in a heated glasshouse on 5 May 1993. Being a warm season species, kangaroo grass would not have grown well in the field during the cool winter months. Seeds were sown at a depth of 1 cm into 28x57.5x7.5 cm wooden flats filled with soil collected from the site of Experiment 1. An additional fourth treatment factor was included in this experiment which involved either the application of superphosphate (with the seeds) at a rate of 250 kg/ha (9.1% P) to all low sowing density treatment combinations or the absence of application. Two additional control treatments were also included to determine to what extent the weeds and kangaroo grass were being suppressed in absolute terms in each of the other treatments. In the first control, weeds were allowed to grow without competition from grass or cover crop. In the second control, sown using the broadcast method at a high density without a cover crop, all weeds were removed regularly by hand. It was hypothesised that this treatment combination would produce the maximum biomass of a kangaroo grass because of its greater utilisation of soil resources. Emergence counts of sown and volunteer species were taken 5 weeks after sowing in fixed 10x57.5 cm subplots. Weed and grass biomass will be harvested in August 1993.

RESULTS AND DISCUSSION

These experiments are still in progress and so only the emergence data from Experiment 1 are presented here (Table 1). The combined emergence of volunteer broadleaf weeds (principally flat weed and wireweed, *Polygonum* sp.) and grasses (*Digitaria* sp. and *Eleusine* sp.) was high in this experiment (greater than wallaby grass in low density treatments (Table 1)) and demonstrates one of the major problems faced when establishing native grasses from seed. Neither the percentage germination of wallaby grass, the number of grass weeds nor the total number of weeds that emerged after 5 weeks was significantly altered by either the sowing rate of wallaby grass, sowing method or the presence of a cover crop ($P>0.05$). Although there were no significant differences in the germination of cereal rye between treatments, germination percentages greater than 100% were common, due to the subsampling procedure and uneven distribution within the plots. The number of broadleaf weeds was significantly reduced by the presence of the cover crop (F=4.94 d.f.=1,14 P=0.043), possibly because the cereal rye was able to germinate within several days (7) and reduce the availability of resources such as moisture and light to the weeds. This conclusion is tentative however, given that the emergence of the grass weeds was not affected. All treatments in this experiment would appear to have given an establishment density in excess of practical requirements but weed biomass measurements should indicate if the higher density sowings offer an advantage for early weed control.

Table 1. Mean emergence counts for wallaby grass, cereal rye, and grass and broadleaf weeds per m^2 5 weeks after sowing. Significant differences are indicated in the text

Group	Grass sowing density	Broadcast		Drilled	
	Cover crop	-	+	-	+
Wallaby grass	High	1645	1332	1388	1835
	Low	723	709	524	566
% Emergence	High	54.7	44.4	46.2	60.5
	Low	72.3	70.9	52.4	56.6
Cereal rye	High	-	127.7	-	105.5
	Low	-	122.1	-	105.4
Grass weeds	High	786	725	934	1153
	Low	777	777	685	653
Broadleaf weeds	High	307	205	353	383
	Low	512	292	398	339
Total weeds	High	1093	931	1288	1536
	Low	1289	1069	1082	992

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