A RAPID SCREENING METHOD FOR SELECTING GRASS SPECIES WITH POTENTIAL FOR SUPPRESSING PAMPAS GROWTH

J.W. RAY and B. RICHARDSON

N.Z. Forest Research Institute, Private Bag 3020, Rotorua

SUMMARY

A technique using water culture to screen grasses for their effect on pampas grass growth is described. When ryegrass (*Lolium multiflorum* var. Paroa) and pampas grass seedlings were grown together on rafts floating on a nutrient solution, pampas grass growth was inhibited. Root elongation was affected more than shoot elongation. A similar effect was seen when pampas grass was grown in nutrient solutions that had previously supported ryegrass. Here, root growth inhibition increased with increasing nutrient strength. Pampas grass growth inhibition varied with grass species. Liquid culture may offer a rapid technique for screening grasses for their ability to suppress pampas grass growth.

Keywords: pampas grass, grass, growth

INTRODUCTION

Pampas grass (*Cortaderia selloana*) and purple pampas grass (*C. jubata*) are serious weeds in pine plantations in the northern half of the North Island. They impede access for silvicultural operations and present a fire hazard. In addition they reduce *Pinus radiata* growth, and survival through competition for water, light and nutrients. In a trial, in Rotorua, pampas grass reduced tree growth by 75% over the first 2 years (unpublished data). At age three, pampas grass dry matter production is approximately half that of a close-spaced, 5 year old, radiata stand growing on a highly productive site (Gadgil *et al.* 1990a). Pampas grass can be killed with herbicides but, because of its abundant seed production, rapidly re-invades affected sites.

Recently, woody weed invasion has been controlled by oversowing grass and legume species which rapidly occupy cut-over sites (West and Dean 1992). Grasses inhibit pampas grass seedling growth in pot trials (Gadgil *et al.* 1990b). The present experiments were undertaken to see whether liquid culture techniques could be used to screen grasses for their potential to suppress pampas grass growth.

METHODS

Seeds were sown on a disc of fine net, made of a synthetic material (approximate area 2800 mm²). The disc, supported on polystyrene beads (3-4 mm dia.), was floated on a plant nutrient solution (150 ml) contained in a food-grade plastic pot (93 mm top diameter, by 57 mm deep) (Zabkiewicz 1979). The composition of the nutrient solution can be supplied by the authors. Seeds sown on the raft developed into plants which were harvested after 3 weeks. Maximum shoot and root length of each plant was recorded. When the nutrient solution was re-used to grow a second crop of seedlings, it was filtered through a millipore filter (0.45 micron pore size), to remove particulate matter. Thirty six seeds were sown on each disc. The cultures were left overnight in the laboratory (at ambient temperature) and then placed in a constant temperature room (20°C) under fluorescent lights (intensity 90 microeinsteins/sec/m², day length 16 h). When two species were sown on the same disc they were sown in alternating rows of six seeds. Distilled water was added to the pots every other day to replace water lost by evaporation.

Five experiments were carried out, each one replicated four times.

Proc. 46th N.Z. Plant Protection Conf. 1993: 313-318

If no other cultivar or species is quoted, “ryegrass” refers to Italian ryegrass *Lolium multiflorum* cv Paroa and “pampas” refers to *Cortaderia selloana*.

Experiment 1: Pampas grass and ryegrass growth was measured in monocultures or mixtures in nutrient solutions. Three treatments, single nutrient strength (100%).

Experiment 2: Pampas growth was measured (a) nutrient solution, (b) in nutrient solution which had previously grown pampas and (c) in nutrient solution previously used to grow ryegrass. Three treatments, single nutrient strength (100%).

Experiment 3: Pampas growth in a range of six nutrient concentrations (or 100%) was compared with that in a range of seven nutrient solutions (0–400%) previously used to grow ryegrass.

Experiment 4: Pampas was grown in solutions which had been used to grow ryegrass for increasing periods of time (0, 1, 2 and 3 weeks). Four treatments, single nutrient strength (100%).

Experiment 5: Pampas growth in nutrient solution was compared with that in solutions previously used to grow seven different grass species (Italian ryegrass, prairie grass (*Bromus willdenowii* cv. Grasslands Matua), phalaris (*Phalaris aquatica* cv. Grasslands Maru), perennial ryegrass (*Lolium perenne* cv. Exalta), hybrid ryegrass (*Lolium x boucheanum* cv. Grasslands Manawa), oat (*Avena sativa*), browntop (*Agrostis capillaris* cv. Grasslands Muster). Eight treatments, single nutrient strength (100%).

Fishers Protected Least Significant Difference ($P < 0.05$) was used to test for differences among means for each treatment.

Figure 1: The growth of pampas grass and ryegrass seedlings grown as monocultures or grown together. P = pampas monoculture, PMIX = pampas growth in combination with ryegrass, R = ryegrass in monoculture and RMIX = ryegrass growth with pampas. For shoots and roots respectively bars with the same letter are not significantly different at the 5% level.

RESULTS AND DISCUSSION

Experiment 1: Both pampas grass and ryegrass germinated and grew readily on the rafts floating on the nutrient solution (Fig. 1). Compared with its growth in monoculture, pampas root elongation was reduced when it was grown with ryegrass. The growth of

ryegrass roots and shoots were unaffected when grown in the presence of pampas. The decrease in pampas grass growth in the presence of ryegrass could possibly be due to competition for light due to the latter's faster growth.

Experiment 2: Pampas root growth, but not shoot growth, was reduced when seed was grown in a nutrient solution in which ryegrass had previously been grown. Pampas growth was unaffected when grown in a solution in which pampas had grown previously (Fig. 2).

Figure 2: Pampas grass growth in fresh and used nutrient solutions. P = pampas grown in fresh nutrient solution, PIP = pampas grown in a solution in which pampas had been grown, PIR = pampas grown in a solution used to raise ryegrass. For shoots and roots respectively bars with the same letter are not significantly different at the 5% level.

Experiment 3: Although poor root growth occurred in distilled water, maximum root elongation occurred at a nutrient strength equivalent to 6.6% of that in the basic medium (Fig. 3). This would suggest that the poor pampas grass root growth observed in solutions previously used to grow ryegrass was not due to nutrient depletion. Root growth remained constant over a concentration range of 33.3 to 100% of the standard solution. Over the same range of nutrient concentrations shoot growth reached its maximum at 13.3%.

Figure 4 shows the effect of growing pampas grass in a range of nutrient solutions, from distilled water to four times the strength of the standard nutrient solution, after they had been used to grow a single crop of ryegrass. Maximum root growth occurred in distilled water. Maximum root growth suppression occurred when the nutrient strength reached 60%, with a slightly increased growth in solutions double and four times that of the standard nutrient. The range of nutrient concentrations tested had little effect on shoot growth, but all shoots were smaller than those of plants which had been grown in fresh nutrient solutions. The effect of the previous ryegrass crop was to depress pampas grass root growth at nutrient concentrations of 66.6% that of the standard strength and above. Interestingly, pampas grass root growth was stimulated by distilled water and low nutrient concentrations, which had previously raised a crop of ryegrass.

Figure 3: Pampas grass growth in nutrient solutions of increasing strength. 0% = distilled water, 100% = standard nutrient solution.

Figure 4: Pampas grass growing in a range of nutrient solutions in which ryegrass had been grown for 3 weeks. 0% = distilled water, 400% = four times the nutrient in the standard solution.

Experiment 4: The longer ryegrass was grown in the standard nutrient solution, the greater the inhibition of pampas growth (Fig. 5). Pampas root and shoot growth were significantly reduced when the seedlings were grown in a nutrient solution that had supported ryegrass growth for 2 weeks.

Figure 5: Pampas grass growth in nutrient solutions which have supported ryegrass growth for increasing time periods. For shoots and roots respectively bars with the same letter are not significantly different at the 5% level.

Figure 6: Pampas grass growth after different grasses have been grown in nutrient solutions. P = pampas growing in fresh nutrient solution, R = ryegrass, MAT = Matua, prairie grass, MAR = Maru, phalaris, OAT oats, EXA = Exalta perennial ryegrass, MUS = Muster browntop, MAN = Manawa ryegrass. For shoots and roots respectively bars with the same letter are not significantly different at the 5% level.

Experiment 5: Filtered solutions, in which seven different "grasses" had been grown for 3 weeks all significantly reduced pampas shoot and root growth compared with that grown in a previously unused nutrient solution (Fig. 6).

The results indicate that suppression of pampas grass growth by other grasses is root mediated as found by Gadgil *et al.* (1990b). They found that pampas growth suppression was greater when Italian ryegrass was grown in sand to which nutrients had been added. In our studies, pampas growth inhibition occurred in solutions which had previously supported ryegrass but only when the nutrient concentrations were above a certain level.

It seems unlikely that pampas growth inhibition is due to lack of nutrients as maximum root growth occurs at very low nutrient levels. Naqvi and Muller (1975) claimed that Italian ryegrass produced allelopathic chemicals. However it would be premature to claim proof of allelopathic interference until the active chemical is isolated.

The bioassay technique reduces the time taken to screen grasses for their inhibitory effects on pampas growth from a minimum of 4 months, for pot trials, to 6 weeks.

ACKNOWLEDGEMENTS

The authors wish to thank S. Bodle for her painstaking assistance and R. Gadgil, R. Gaskin, K. Steele, and Ian Popay for their helpful criticism of the manuscript.

REFERENCES

- Gadgil, R.L., Barton, P.G., Allen, P.J. and Sandberg, A.M., 1990a. Growth of pampas grass (*Cortaderia* spp.) in New Zealand *Pinus radiata* forests. *N.Z. J. For. Sci.* 20: 176-183.
- Gadgil, R.L., Sandberg, A.M., Allen, P.J. and Gallagher, S.S., 1990b. Partial suppression of pampas grass by other species at the early seedling stage. *In: Alternatives to the Chemical Control of Weeds*, Bassett, C., Whitehouse, L.J. and Zabkiewicz, J.A. (Eds.) FRI Bulletin 155.
- Naqvi, H.H. and Muller, C.H., 1975. Biochemical inhibition (allelopathy) exhibited by Italian ryegrass (*Lolium multiflorum* L.). *Pakistan J. Bot.* 7: 139-47.
- West, G.G. and Dean, M.G., 1992. Oversowing: the race to occupy forest sites. *What's New in Forest Research* No. 223. New Zealand Forest Research Institute.
- Zabkiewicz, J.A., 1979. Evaluation of herbicidal activity after root uptake by gorse and radiata seedlings. *Proc. 32nd N.Z. Weed and Pest Control Conf.*: 319-323.