COMPETITION BETWEEN FIREWEED, *SENECIO MADAGASCARIENSIS* POIR., AND ITALIAN RYEGRASS, *LOLIUM MULTIFLORUM* LAM. CV. CONCORD

[1]B.M. Sindel and [2]P.W. Michael
School of Crop Sciences, University of Sydney 2006
[1]Present address: CSIRO Division of Plant Industry GPO Box 1600 Canberra ACT 2601
[2]Present address: 5 George Street Epping 2121

Summary. Concurrent field trials were conducted to determine the competitive effects, at increasing densities, between the newly introduced Italian ryegrass, *Lolium multiflorum* cv. Concord, and fireweed, *Senecio madagascariensis*. Concord ryegrass proved to be a particularly strong competitor by reducing the growth and survival of fireweed while itself showing no significant reduction in yield (P=0.05). The most rapid decrease in fireweed yield occurred at ryegrass densities between 1 and 100 plants/m^2. Concord ryegrass has potential to be utilised in the control of fireweed, particularly under high fertility conditions, where it was shown to have a competitive advantage.

INTRODUCTION

Fireweed, *Senecio madagascariensis* Poir., a toxic African plant, is now a common weed in coastal pastures of New South Wales and south-eastern Queensland (8). For the dairy industry in N.S.W., control costs some 100 000 man hours and $250 000 annually (11).

A mail survey of the fireweed problem, undertaken during spring 1985 (11), indicated that a large number of farmers who had moderate amounts of the weed were concerned about its suppression of crop and pasture productivity, and that control was difficult to achieve. Moreover, glasshouse and field trials with grazing oats, *Avena strigosa* cv. Saia (9), highlighted the importance of fireweed as a competitive weed and showed its potential to reduce pasture productivity, particularly those with species less competitive than oats.

The two field experiments reported here were undertaken to determine the competitive effects between fireweed and the newly introduced Italian ryegrass, *Lolium multiflorum* Lam. cv. Concord, which had previously proven successful in competing with fireweed under glasshouse conditions (10). The experiments were run concurrently and adjacent to one another during 1987 at Camden, N.S.W. In the first experiment, the effect of increasing densities of ryegrass on the growth of fireweed was assessed. The aim of the second experiment, designed similarly to the previously reported fireweed and oats competition field trial (9), was to measure the reduction in productivity of Concord ryegrass caused by different densities of fireweed.

METHODS

Soil preparation and general management of the area, including fertiliser treatments, were the same as described in (9). Concord ryegrass was sown on 22 April using a Connor Shea Coulter Coil Tyne Drill at a depth of 2.5 cm and with 15 cm between rows. Immediately after sowing, 'Starter 18' fertiliser was broadcast at two rates - low (30 kg N, 14 kg P/ha) and high (120 kg N, 55 kg P/ha). Fireweed seedlings, raised according to the procedure adopted in (9), were transplanted to the field at the 10 leaf stage some 22 days later. Both experiments were split plot factorial designs with four replicates. Sub plots were 1x1 m and contained 6 rows of ryegrass.

Experiment 1 Experiment 1 had 10 treatments: two levels of soil fertility (low and high) (main plots) x five ryegrass densities (sub plots). Fireweed plants were evenly spaced and sown at a set density of 18/m^2. Ryegrass, sown originally at 35 kg/ha, was thinned by hand 13 days after sowing to 0, 50, 100, 200 or 400 plants/m^2. Plant spacing within rows was approximately 12, 6, 3 and 1.5 cm respectively. The single harvest of plant tops occurred on 25 August when ryegrass was at full tillering and fireweed at mid flowering. Heights of ryegrass plants were approximately 15 and 40 cm and fireweed plants 30 and 40 cm in low and high fertility plots respectively. Dry weight yields were measured on a whole plot basis and the number of fireweed capitula recorded for four random plants/plot.

Experiment 2 Experiment 2 had 16 treatments: two levels of soil fertility (main plots) x eight fireweed densities (sub plots). Ryegrass was sown at a set rate of 15 kg/ha giving a density of 280 plants/m^2 when counted 6 weeks after sowing, the same as that obtained with Saia oats in (9). Fireweed densities were 0, 1, 2, 5, 10, 15, 25 and 40 plants/m^2. Each sub plot was divided into a grid of 40 squares (5x8) to which single fireweed plants were randomly allocated.

Ryegrass plants were harvested to a height of 3 cm on each of three occasions to simulate grazing by livestock at 9, 21 and 27 weeks after sowing. At the first harvest, both ryegrass and fireweed canopies were 15 and 30 cm in low and high fertility plots respectively. Fireweed had begun to flower. Additional 'Starter 18' fertiliser was broadcast at a low rate (30 kg N, 14 kg P/ha) and a high rate (60 kg N, 27 kg P/ha) between the first and second harvests in order to maintain the differential between low and high fertility treatments, and to ensure adequate growth for harvesting in low fertility plots. The second harvest occurred when ryegrass was at mid to late tillering, and 30 and 55 cm tall in low and high fertility plots respectively; fireweed was at mid flowering, and 35 and 45 cm tall. At the third harvest, fireweed, which was beginning to senesce, was also cut and weighed and the number of dead plants counted.

RESULTS AND DISCUSSION

Experiment 1 Concord ryegrass grew vigorously at high fertility but at low fertility the leaves yellowed and growth was much reduced. Despite 2 weeks of heavy rains prior to harvest, ryegrass at high fertility did not lodge. It also competed strongly for light while associated fireweed plants showed typical symptoms of shading (10). Those at low fertility, in contrast, were erect and had grown well above the ryegrass canopy.

The most rapid decrease in yield of fireweed at both low and high fertility occurred at densities between 1 and 100 plants/m^2. Reductions at levels above 100 plants/m^2 were non-significant (P=0.05) (Fig. 1a). As a percentage of the ryegrass free control, yield was significantly lower under high fertility than low fertility conditions (P=0.05) (Fig. 1b).

Capitula production also decreased with increasing ryegrass density (significant at P=0.05), but on a percentage basis the fertility effect was not significant. Over both fertility levels capitula production was reduced to 51.5% of the control at a density of 50 plants/m^2 and 38.9% at a density of 100 plants/m^2.

At each density, the mean ryegrass yields were 0, 0.52, 0.68, 0.94 and 1.03 t/ha and 0, 3.13, 3.83, 4.27 and 4.40 t/ha at low and high fertility respectively.

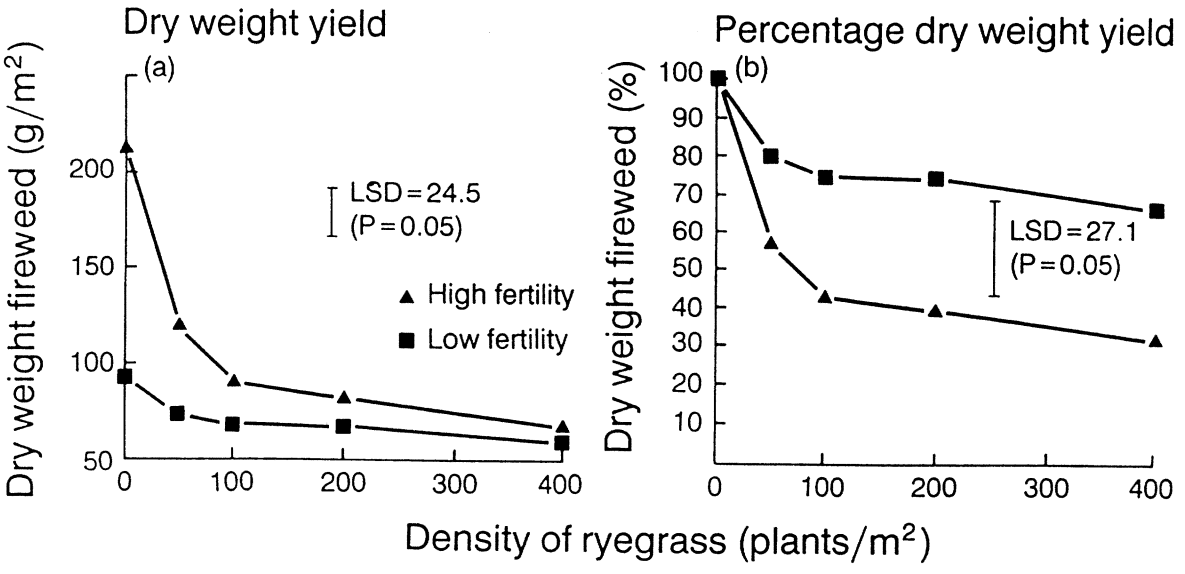

Figure 1. Effect of increasing density of Concord ryegrass on (a) the dry weight yield, and (b) the percentage dry weight yield, of fireweed at low and high soil fertility. The l.s.d. in (a) is for comparisons of treatments at the same fertility level, and (b) between fertility levels.

Experiment 2 An increase in fireweed density from 0 to 40 plants/m^2 did not significantly affect ryegrass dry matter production (P=0.05) at either the first or second simulated grazings. In high fertility plots, Concord ryegrass formed a dense canopy and shaded fireweed heavily. As a result fireweed plants were succulent and weakly lignified. Plants died due to severe competition and increased disease incidence and slug damage. The average number of deaths occurring at high fertility (30.9%) was nearly seven times that which occurred during competition with Concord ryegrass at low fertility (4.6%) (highly significant at P=0.01 on a square root (x + 0.5) transformed scale).

At the third harvest fireweed density did significantly affect ryegrass dry matter production (P=0.05), but only at low fertility and only at densities of 10 plants/m^2 or greater. Ryegrass under high fertility conditions had poor regrowth possibly because of its more advanced stage of growth. The yield of fireweed at this third harvest was not significantly different between high and low fertility treatments (P=0.05), presumably due to plant deaths and, to some extent, competitive suppression of fireweed at high fertility. At 10 and 40 plants/m^2 fireweed yielded 237 and 936 kg DM/ha respectively (averaged over fertility levels).

Total ryegrass dry matter production (combined data for the three harvests) was not significantly affected by fireweed density (P=0.05). Grown alone, ryegrass yielded 2.56 and 5.35 t/ha under low and high fertility treatments respectively. Harvest 3 contributed 18% of the total yield at low fertility but only 6% at high fertility.

General The newly introduced diploid Italian ryegrass cv. Concord proved to be a particularly strong competitor of fireweed, substantially reducing its vigour (Figs. 1a,b). It is also a highly impressive forage producer showing strong early growth in the autumn and flowering late in the season (Launders, pers. comm.). Compared with other Italian ryegrasses, Concord has a large seed size which may help to determine its competitive early growth, as in other annual species (2,1).

Unlike Saia oats (9), Concord ryegrass appeared to have the competitive advantage over fireweed with increasing fertility (Fig. 1b). Likewise, it was highly resilient to the competitive effects of fireweed. If used as a forage crop, Concord ryegrass at a density of 100 plants/m^2 is likely to exert good control of fireweed. Because Concord tends to be a shy seeder (Launders, pers. comm.), lower plant densities may be required to encourage the production of more seed (5).

Pastures composed entirely of annuals are particularly sensitive to climatic fluctuations, especially the effectiveness of opening rains, soil fertility levels, grazing management and to insect damage (12). Their density may fluctuate violently from year to year (4) and hence also their competitive influence (13). For these reasons annual grasses are not often intentionally used for weed control alone (7). They are, however, sometimes sown as forage crops for 1 or 2 years prior to sowing a perennial pasture to reduce the seed population of unwanted plants (3). They may also be included in pasture mixtures to provide quick cover and check the development of seedling weeds (6,14,15). In both these situations Concord ryegrass shows great potential for fireweed control, with or without the use of a selective herbicide.

REFERENCES

1. Aspinall, D., and Milthorpe, F.L. 1959. Ann. Appl. Biol. 47, 156-72.
2. Black, J.N. 1957. Aust. J. Agric. Res. 8, 335-51.
3. Campbell, M.H. 1974. Proc. Weed Soc. N.S.W. 6, 16-9.
4. Donald, C.M. 1951. Aust. J. Agric. Res. 2, 355-76.
5. Donald, C.M. 1954. Aust. J. Agric. Res. 5, 585-97.
6. Hexter, G.W. 1950. J. Dept. Agric. Vic. 48, 217-8.
7. Michael, P.W. 1970. 'Australian Grasslands', pp. 349-60. Australian National University Press, Canberra.
8. Sindel, B.M. 1986. Plant Prot. Q. 1, 163-72.
9. Sindel, B.M. 1987. Proc. 8th Aust. Weeds Conf. pp. 171-4.
10. Sindel, B.M. 1989. The Ecology and Control of Fireweed (*Senecio madagascariensis* Poir.). Ph.D. Thesis, University of Sydney.
11. Sindel, B.M., and Michael, P.W. 1988. Plant Prot. Q. 3, 22-8.
12. Tiver, N.S., and Crocker, R.L. 1951. J. Brit. Grassl. Soc. 6, 29-80.
13. Wells, G.J. 1969. Aust. J. Exper. Agric. Anim. Husb. 9, 521-7.
14. Whittet, J.N. 1968. 'Weeds'. New South Wales Government Printer, Sydney.
15. Whittet, J.N. 1969. 'Pastures'. New South Wales Government Printer, Sydney.