THE EFFECT OF PASTURE DENSITY AND COMPOSITION ON VULPIA

A R Leys[1], P M Dowling[2] and B Plater[3]
NSW Agriculture
[1] Locked Bag 21, Orange NSW 2800, Australia
[2] Agricultural Research & Veterinary Centre, Forest Road, Orange NSW 2800, Australia
[3] Agricultural Research Institute, PMB, Wagga Wagga NSW 2650, Australia

Summary. A field experiment was conducted at Wagga Wagga in southern New South Wales, Australia to quantify the effects of subterranean clover, *Trifolium subterraneum*, density and pasture composition on the seed production and regeneration of vulpia, *Vulpia bromoides*. Increasing the density of subterranean clover from 140 to 1,800 plants/m^2 substantially reduced the reproductive capacity of vulpia in the first year, but by the third year of the experiment there was no difference between treatments. A mixture of subterranean clover and annual ryegrass, *Lolium rigidum*, significantly reduced seed production (*cf.* various densities of subterranean clover alone) and subsequent regeneration and establishment of vulpia throughout the three years of the experiment. The results show that the inclusion of a companion grass (in this case annual ryegrass) was necessary to maintain the vulpia content of pastures at a low level.

INTRODUCTION

Vulpia, *Vulpia bromoides* and *V. myuros*, is a common component of subterranean clover, *Trifolium subterraneum*, based pastures throughout southern Australia where it reduces productivity, contaminates wool, injures livestock, and helps carryover pathogenic fungi such as *Gaeumannomyces graminis* var. *tritici* from one crop phase to the next. As a result of a farm survey which suggested an inverse relationship between the incidence of vulpia and competition from other pasture plants (1), a field experiment was conducted at Wagga Wagga in southern New South Wales to quantify the effects of pasture density and pasture composition on the build-up of vulpia.

METHODS

Four pastures [three subterranean clover (SC) densities and one subterranean clover plus annual ryegrass mixture (SC+RG)] were established on a medium textured red-brown earth soil at Wagga Wagga. Each of the pasture treatments were sown with two densities of vulpia, *V. bromoides*, and with (high fertility) and without (low fertility) the addition of lime and fertiliser. In the high fertility treatment lime and fertilizer rates were chosen to ensure soil fertility was not limiting subterranean clover growth. Lime (1.75 t/ha) and a range of fertilizers were applied and incorporated into the soil one week before pastures were sown on 21 May 1990. Molybdenum superphosphate (400 kg/ha) and disodium tetraborate (7 kg/ha) were hand broadcast, while copper sulphate (15 kg/ha), and zinc sulphate (15 kg/ha) were applied by boom sprayer. Molybdenum superphosphate (400 kg/ha) was re-applied every year just after sampling for soil analyses in early autumn. At the start of the experiment the site had a pH of 4.6 ($CaCl_2$) and 7 *ug* P/g soil (Olsen method). When sampled in March 1992, the addition of lime had increased the pH to 5.4 and the addition of superphosphate had increased the soil phosphate level to 12 *ug* P/g soil.

Low, medium, and high SC densities were obtained by sowing 1, 25, and 100 kg/ha SC cv. Junee in small plots (2x6 m^2) on 21 May 1990. The SC+RG mixture was established by sowing

25 kg/ha SC plus 20 kg/ha RG. The layout was a split-plot design (2 fertility levels as the main plots, with the 4 pastures x 2 vulpia densities fully randomised within each fertility level) replicated 4 times.

Plant densities were determined by counting all plants in 20 cores (4.5 cm diam.) taken at random from each plot in August 1990 and 1991, and in late May 1992. Early counting was necessary in 1992 because in June half the plots were sprayed with simazine to continue another experiment.

Panicle densities were determined by counting all panicles in 10 quadrats (7.5 cm x 7.5 cm) harvested at maturity each year. To determine seed production 50 panicles were randomly selected from those harvested for panicle measurements. All spikelets on each of the 50 selected panicles were counted and the average number of spikelets per panicle calculated for each plot. A sub-sample of 10 panicles were randomly selected for estimating seeds per spikelet. Viable seeds were counted in three randomly selected spikelets on each of the 10 panicles, and the average number of seeds per spikelet calculated for each plot. Seed production for each plot was then calculated by multiplying panicles/m^2 x spikelets/panicle x seeds/spikelet.

RESULTS AND DISCUSSION

Averaged over all pasture treatments and fertility levels, 240 and 1,140 vulpia plants/m^2 had established by August 1990 in the low and high vulpia treatments, respectively. Vulpia seed production and plant densities varied with season and pasture treatment, but were not affected by fertility, and eventually numbers for the two vulpia sowing rates were similar. For these reasons the data presented are the means of both fertility levels and both vulpia sowing rates.

The results obtained for vulpia plant density and seed production in 1990 and 1991 and subsequent regeneration in 1992 are presented in Table 1. Compared with the low SC density, the medium and high SC densities reduced vulpia seed production in 1990 by 50 and 78%, respectively. Similar results were obtained for regeneration of plants in 1991 (reductions of 41 and 61%, respectively).

The mixed SC+RG pasture had the greatest effect on vulpia, reducing seed production in 1990 by 83%, and establishment of plants in 1991 by 81%, when compared with the low SC density.

Increasing the density of subterranean clover had no effect on seed produduction of vulpia in 1991. The regeneration of vulpia in 1992 was also unaffected by subterranean clover density. However, the inclusion of annual ryegrass in the sward continued to restrict ingress by vulpia. The SC+RG treatment reduced seed production in 1991 by 60%, and regeneration of vulpia in 1992 by 73%.

Increasing the density of subterranean clover substantially reduced the reproductive capacity of vulpia in 1990, but by 1992 there was no difference between treatments. These results show that vulpia very quickly invades subterranean clover pastures, even when growing in dense stands (mean subterranean clover densities in 1991 were: 1,102, 2,827, and 3,904 plants/m^2 in the low, medium, and high subterranean clover density treatments, respectively). The inclusion of a companion grass (in this case annual ryegrass) was necessary to reduce the growth and seed production, and subsequent regeneration of vulpia. This supports the results obtained from the farm survey (1) which showed that vulpia densities were least where pastures contained a significant grass component.

Table 1. Effect of pasture density and composition on vulpia invasion in pastures sown at Wagga Wagga in 1990

Pasture density and/or composition	Vulpia plant density and seed production/m^2				
	1990		1991		1992
	Plants	Seeds	Plants	Seeds	Plants
Low sub clover density	720	1,071,300	22,610	432,000	9,200
Med sub clover density	860	536,200	13,370	399,700	7,700
High sub clover density	550	239,300	8,890	386,100	9,720
Sub clover + rye grass	640	179,400	4,290	173,300	2,530

ACKNOWLEDGMENTS

This research was funded by a grant from the Wool Research and Development Corporation.

REFERENCES

1. Dowling, P.M., Leys, A.R., and Plater, B. (1993). Proc. 10th Aust./14 Asian-Pacific Weed Sci. Soc. Conf., Brisbane. In press.