The impact of herbicides on the production, composition and quality of annual pasture at kapunda, South Australia

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Summary. The impact of grass removal from a subterranean clover-based pasture by Simazine/Gramoxone and Simazine/Fusilade at different application times and rates was assessed using pasture production, final herbage availability, botanical composition and protein production as parameters. All herbicide treatments reduced pasture production and protein production relative to the unsprayed control during the observation period. Early applications of all herbicides significantly reduced the proportion of grass and increased the proportion of legumes with a Simazine/Fusilade mixture achieving best results.

Introduction

The removal of grasses from pastures has been shown to produce significant increases in cereal yields in subsequent years (6, 8). This has been attributed to a number of factors such as reduced cereal root disease carryover via pasture grass hosts and improved soil nitrogen levels. This makes the removal of grasses and consequent legume dominance an attractive concept. However, benefits are not achieved easily. For example, to control Cereal Cyst Nematode it has been shown that a two year break (the presence of no hosts) is required regularly in the rotation. Furthermore, to be effective. the grasses need to be removed from pastures before August (7).

To control Take-all grasses must be removed from pastures by the end of July and it has been suggested that grasses must not contribute more than 5% of the subsequent pasture composition if this is to be successful (3, 7). These figures emphasize the need for a very high level of grass control if cereal disease carry-over is to be successfully controlled.

Grasses in pasture have also been shown to reduce soil nitrogen accretion (4). This occurs due to the reduced amount of nitrogen fixed by the legumes through competition and by the grasses utilising some of the nitrogen for their own growth (4). There is also strong evidence to suggest that removal of grasses can greatly increase pasture legume seed production which is crucial to the on-going regenerative ability and density of pasture legumes (I).

The removal of grasses can have detrimental effects by reducing pasture production in the year of spraying (8). However, other studies (2, 5) have shown that despite possible decreases in pasture production there are compensating factors. The improved nutritional status of the pasture and the reduction in grass seed problems to sheep meant that grass control caused no decrease in sheep production and improved the health and value of lambs. Previous experiments in the Kapunda area (3) clearly showed that neither Gramoxone nor Fusilade controlled silver grass, *Vulpia myuros,* but Simazine was very effective in killing this grass.

This paper details the effects of two herbicide mixtures, Simazine/Gramoxone and Simazine/Fusilade used to control grasses in legume-based pastures. These herbicides have great potential for grass control in pastures based on subterranean clover, *Trifolium subterraneum.* Results were assessed in terms of factors which relate to the value of the pasture both as livestock feed and as an important phase in a cropping rotation.

Methods

The experiment was conducted on a red brown earth (soil type classified as Dr 2.3 by Northcote) near Kapunda, South Australia during 1992 on a paddock previously maintained as a long-term pasture. Rainfall in 1992 totalled 826 mm which was well above the 495 mm annual mean.

The grazed pasture comprised a mixture of annual grasses, subterranean clover and a range of broad-leaved weeds. The most prevalent grass was barley grass, *Hordeum leporinum,* and the most common broad-leaved weed was capeweed, *Arctotheca calendula.*

Throughout the 1992 growing season the experiment was communally grazed with Merino sheep as part of the total property management. Pasture growth was exceptionally good. however, during wet weather there was some treading damage to the pasture and some loss of subterranean clover with apparent fungal root rots.

The design was a randomized complete block design, consisting of 9 treatments each with four replications. The treatments were as shown in Table I.

Table 1. Treatments used and the dates of spraying herbicide.

Treatment	Date applied
1) Control	-
2) Simazine/Gramoxone - 0.9/0.3L/ha	25.6.92
3) Simazine/Gramoxone - 0.9/0.3 L/ha (no wetter used)	25.6.92
4) Simazine/Gramoxone - 0.75/0.25 L/ha	25.6.92
5) Simazine/Fusilade - 0.9/0.5 L/ha	25.6.92
6) Simazine/Fusilade - 0.9/0.5 L/ha	9.7.92
7) Simazine/Gramoxone - 0.9/0.3 L/ha	9.7.92
8) Simazine/Gramoxone - 0.9/0.3 L/ha	24.7.92
9) Simazine/Gramoxone - 0.9/0.3 L/ha	24.8.92

Data collection

Data for four main parameters are reported here: Pasture production. final herbage availability, botanical composition and protein production. Because of the very prolonged growing season. data on seed production of legumes and grasses is unavailable at this time (January 1993). Pasture production involved measuring total dry matter produced on an ungrazed area from 3 July for Treatments 1-5. from 3 August for Treatments 6-8 and from 16 September for Treatment 9 to the end of the experimental period (21 October 1992). Grazing exclosure cages were used to provide these ungrazed areas on each plot. Final herbage availability was measured by taking quadrat cuts to ground level from grazed areas at the end of the experimental period.

Botanical composition was estimated from Levy Point Quadrat data on Percentage Overlapping Cover complemented by hand-separation of harvested samples to give legume, grass and 'other species' components. Using pasture production and botanical composition data, total protein production was calculated by determining the nitrogen content of each of the pasture components and converting this to protein by the conversion factor of 6.25.

Results and discussion

Uniformity

Initial pasture availability and botanical composition measurements showed that there were no significant differences between plots. The pasture swards comprised 44% grass, 36% legume and 20% other species on 3 June, before the first herbicide spraying.

Pasture production and protein production

Both pasture production and protein production were reduced by all herbicide treatments relative to the control (Fig. I). The results show that protein production was reduced to a lesser degree in certain treatments. This can he attributed to the improved protein content of pastures with less grass and a greater percentage of pasture legumes, an important factor for both livestock grazing and the benefit of the pasture to cereal yields. This highlights the need for high pasture legume seed production and subsequent seedling density to compensate for production loss through grass removal.

Botanical composition of pasture and final availability

The range of effects of treatments on botanical composition (Fig. 2) show that later treatments including Gramoxone (Treatments 7 - 9) did not significantly reduce the proportion of grass in the pasture nor did they significantly increase the proportion of legumes in the pasture (statistically analysed as percentages). Treatment 6 was clearly the most successful treatment, increasing the final availability significantly above all other treatments, totally removing grasses and producing a final pasture legume content of 89% (Fig. 2). No treatment significantly reduced the proportion of 'other' weeds in the pasture. With free-grazing animals on the experiment site, the possibility of immeasurable selective grazing effects should be noted.

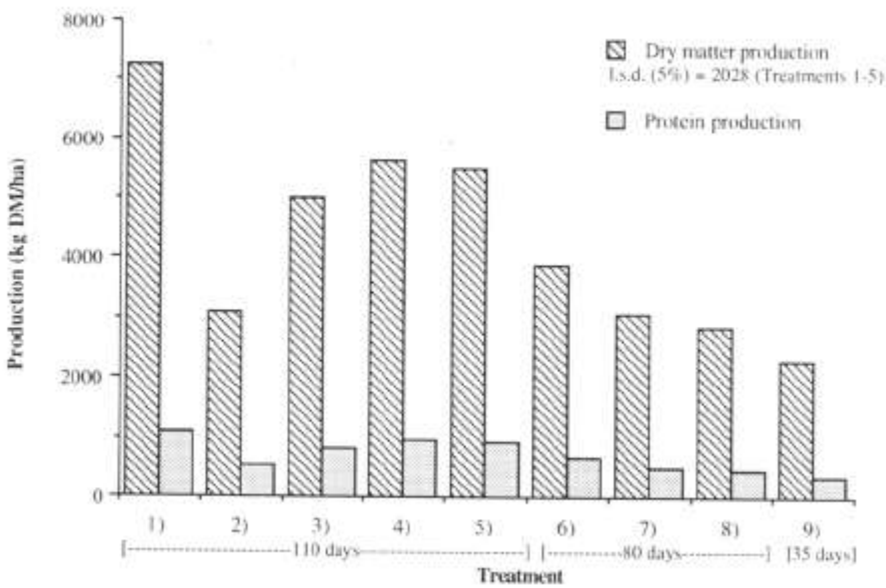
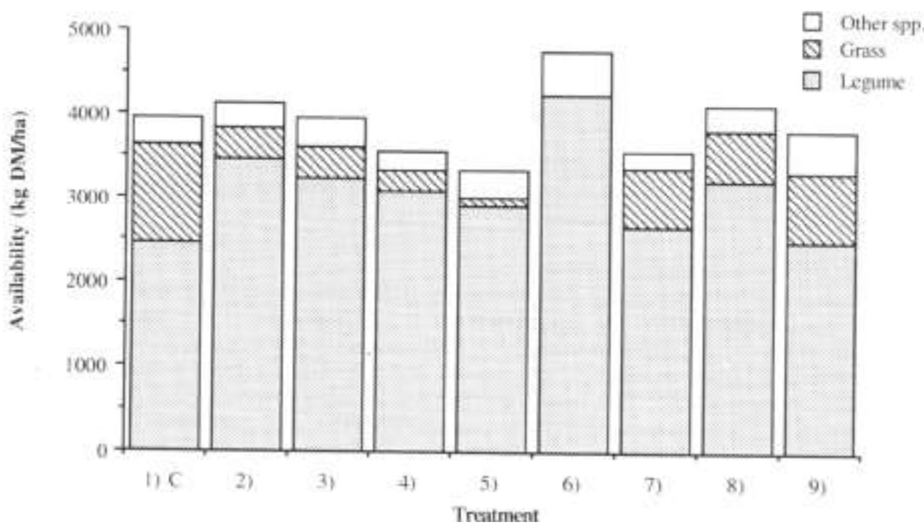


Figure I. Pasture production and protein production f07 post-treatment period shown.



Total availability I.s.d. (5%) = 582

Figure 2. Final botanical composition and availability of pasture (21 October 1992).

To assess the merits of each treatment, all effects must be considered together. Early treatments containing Gramoxone significantly reduced pasture production. but by omitting the wetting agent the effect on pasture production and protein production was reduced. Treatments 2 and 3, involving Gramoxone, achieved a reasonable reduction in grass content and did not reduce final pasture availability. Simazine/Gramoxone at reduced rates (Treatment 4) had the least effect on pasture production and protein production, successfully reduced the grass content and did not significantly reduce final availability. This was the most successful of all treatments containing Gramoxone.

The two treatments containing Fusilade were the most successful at removing grasses from the pasture. The earlier application (25 June) significantly reduced final availability whilst the later application (9 July) significantly increased it. This may be due to a higher initial legume component in Treatment 6 plots, although the difference was statistically insignificant.

On a pasture with a reasonable legume base such as the one used at Kapunda the use of Simazine/Fusilade as applied in Treatment 6 can achieve excellent grass removal and. given a reasonable legume base, improve pasture availability later in the season. Greatly increased legume seed production is anticipated on this treatment but this is unconfirmed as data collection is continuing.

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References

1. Carter, E.D. 1990. In: Pasture Symposium No. 2, Waite Agricultural Research Institute. The University of Adelaide. pp. 50-51.

2. Carter, E.D., Porter. R.G., Ababneh, M.H., Squella, F., Muyekho, F.H. and Valizadeh, R. 1992. Proc. 6th Aust. Agron. Conf., Annidale, NSW. p. 418.

3. Inwood, R.J., Roget, D.K., Rovira, A.D.and Carter, E.D. 1992. Proc. 6th Aust. Agron. Conf., Armidale, NSW. p. 606.

4. Leys, A.R. 1990. Proc. 9th Aust. Weeds Conf., Adelaide, SA. pp. 354-364.

5. Little, D.L., Carter, E.D. and Ewers, A.L. 1992. Proc. 6th Aust. Agron. Conf., Armidale, NSW. p. 597.

6. Macleod, W. and MacNish G. 1989. W.A. J. Agric. 30, 134-137.

7. Rovira. A. 1990. In: South Australian Cereal Farming Systems - Collected Papers. (S.A. Dept. of Agriculture).

8. Thorn, C.W. and Perry, M.W. 1983. W.A. J. Agric. 24, 21-26.