The Effect Of Non-Selective Herbicides On Pasture And Animal Production

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Summary. The effects of non-selective herbicides on the productivity and composition of grazed subterranean clover annual grass based pasture are presented. Paraquat applied at the six leaf growth stage of subterranean clover (winter clean) limited dry matter production immediately following herbicide application and reduced annual grass density in both years. Spray-topping did not reduce available herbage in either year but did decrease annual grass regeneration densities in the years following application. Despite a short term loss in grazing capacity from the winter clean treatments, over the longer term there was no difference in liveweight between treatments.

INTRODUCTION

In southern Australia the majority of cereals are grown on mixed livestock/cropping farms. The pasture phase allows producers to diversify into livestock enterprises and viability is not dependant solely on the cropping phase. In traditional systems where pastures are integrated into crop rotations, there is no widely used method for reducing the annual grass carry-over from the pasture phase. Annual grasses are the most serious weed in southern Australian cropping systems (4). The annual cost to Victorian agriculture in lost production and control was estimated at $37.4 million in 1990 (1).

Of the soil-borne cereal root diseases in wheat, Take-all, *Gaeumannomyces graminis* var. *tritic*, is the most serious in southern Australia (8). To effectively control Take-all, the use of legume break crops or the removal of grasses during the last one or two years of the pasture phase is recommended (5, 6). The relationship between the level of grasses in the pasture and level of Take-all in the following wheat crop has clearly been demonstrated (7). The removal of grasses from the pasture phase prior to return to crop is essential to reduce the survival of Take-all hosts. Manipulating pasture composition is reported to have a number of other advantages (11), including increasing soil nitrogen levels and reducing grass seed bank carry-over into crops. With the elimination grass from pasture there is a potential to lower total dry matter production and associated loss of feed for stock (9, 11).

Conservation farming practices rely on grass selective herbicides to control in-crop volunteer grasses. The heavy reliance on selective herbicides has increased the development of herbicide resistant annual ryegrass (2) which is closely related to the intensity and pattern of herbicide use. Spray-topping and winter cleaning provide effective management techniques that can be used to manipulate pasture composition. This paper details the results from a field experiment at Rutherglen, in North East Victoria on the effects of manipulating grass composition in the pasture phase with non-selective herbicides on pasture and livestock production. Further studies not reported here are quantifying the flow-on benefits into the cropping phase, for two crop rotations through changes in soil N, weed levels, soil structure, root disease incidence and wheat yield and grain protein.

METHODS

The experiment was conducted at Rutherglen Research Institute and comprised five pasture management treatments replicated four times. The site was sown to *Trifolium subterranean* cvv Trikkala and Karridale on 26 April 1991, with opening rains occurring on 7 June 1991. The experiment was fenced into 0.6 ha plots and stocked with two year old merino wethers at 10 DSE/ha (dry sheep equivalent), 2 DSE greater than the district average. The wethers remained on the plots for the duration of the pasture phase (1991 and 1992) and were weighed at fortnightly intervals to determine liveweight changes.

Four grass control herbicide treatments were applied to the pasture to provide different composition of grasses and were compared to a nil herbicide treatment (control). The treatments were designed to reflect various options that are available to producers (Table 1).

Table 1. Pasture treatments (1991 and 1992).

Treatments	1991	1992
1	No removal	No Removal
2	Low removal (ST)	Low removal (ST)
3	Low removal (ST)	High removal (WC)
4	High removal (WC)	High removal (WC)
5	No removal	High removal (WC)

A non-selective herbicide (Paraquat) was used for both the high and low grass removal treatments [Winter clean (WC) and Spray-top (ST)] in preference to a grass selective herbicide to minimise the development of herbicide resistance. The high removal (WC) treatments were designed to produce a legume dominant pasture that is optimal for crop production. The low removal treatment (ST) were applied to reduce grass seed production but retain grass herbage for livestock production. The herbicide rates and plant development stage of application were;

1) No herbicide treatment

2) Spray-top with Paraquat @ 0.15 kg a.i /ha (750 mL/ha) on 14 November 1991 and November 1992 when annual ryegrass was showing signs of haying off.

3) Winter clean with Paraquat @ 0.3 kg a.i /ha (1.5 L/ha) on 19 August 1991 and 15 July 1992 when subterranean clover had reached the six true leaf growth stage.

The initial pasture sward consisted of subterranean clover (*Trifolium subterranean)* and predominantly annual ryegrass (*Lolium rigidum*), silver grass (*Vulpia spp*) and other annual grasses in small quantities, barley grass (*Hordeum leporinum*), winter grass (*Poa annua*) and wild oats (*Avena fatua*).

Pasture production was measured using a calibrated rising plate pasture meter (3). Measurements were collected over 4 to 6 week intervals during the growing season measuring pasture height and constructing a height/available relationship using the dry matter yield of a number of quadrants cut to ground level.

RESULTS AND DISCUSSION

The two years of the study contrasted markedly in seasonal rainfall (Table 2). In 1991 there was a dry start and unusually early finish to the growing season. In 1992 there was a wet start to the season a wet spring and early summer. Initial emergence occurred on 11 June 1991 and 27 April 1992. The timing of the autumn break controlled the pasture production and therefore the timing of the WC herbicide applications. The 1991 WC treatment was applied six weeks later than the corresponding time for 1992. As a consequence, the recovery period for the WC pastures in 1991 was shortened and spring herbage production was significantly less than the control. The summer rain and subsequent pasture growth for 1992/93 was well above average and is reflected in the pasture and liveweight growth during this period.

Table 2. Season rainfall (mm) for 1991, 1992 and long term average (81 year mean).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Av.
1991	97	1	10	12	4	133	54	66	65	10	12	52	515
1992	40	25	20	55	66	47	41	107	140	124	107	129	903
LTA	38	35	39	43	54	58	63	63	55	60	43	46	597

LTA = long-term mean

The available herbage was significantly reduced with the WC treatments in both 1991 and 1992 compared to the control (Fig 1). The reduced competition in spring allows the subterranean clover plants to sufficiently recover providing improved quality of feed on offer to the stock. The pure legume pastures had a longer growing phase at the end of spring, presumably due to conserved moisture in late winter/early spring. The ST treatment did not reduce available herbage in either year as timing for annual ryegrass control coincided with peak herbage availability.

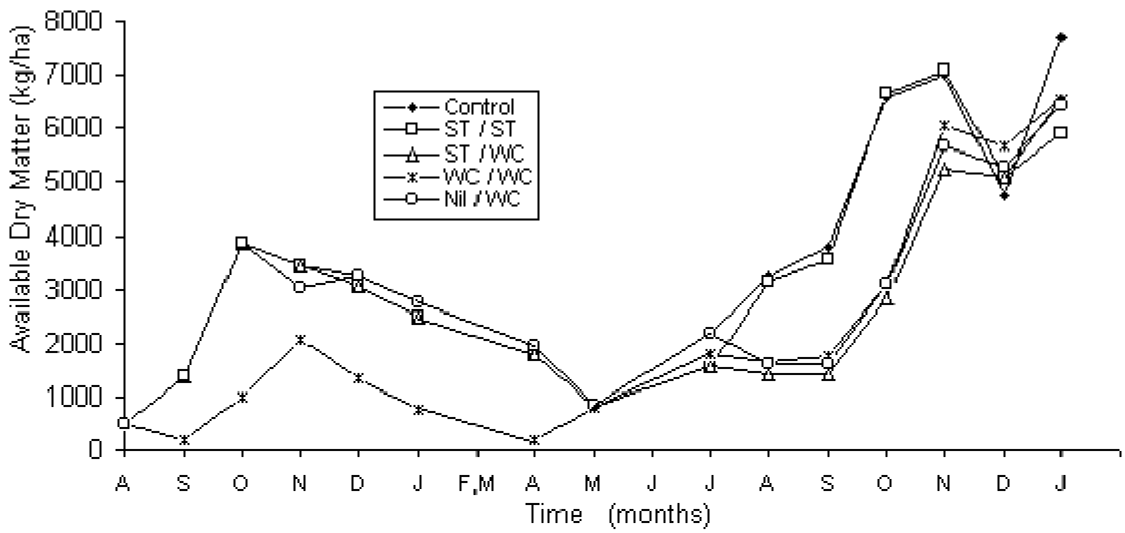

Figure 1. Available herbage (kg/ha) in response to herbicides applied in 1991 and 1992.

Change in pasture composition

The initial plant density on 1 July 1991 consisted of 752 subterranean clover plants square meter and annual grasses of 7856 plants square metre. Two years of WC significantly reduced grass densities to less than 2% of the total sward at the autumn break in 1993 as compared to 61% annual grasses in the control. Two years ST reduced annual grass densities down to 31%, while the remaining two treatments reduced grass populations down to under 10%.

Changes in liveweight

Throughout the trial, sheep on the control treatment had similar or higher liveweight than all other treatments (Fig 2). The sheep on the WC treatment recorded reduced liveweight differences of up to 7 kg/head when compared to the control during September and October 1991 and August, September and October 1992 through reduced available herbage. By spring, the subterranean clover plants recovered in the WC treatments and increased liveweight gains were recorded. Between October 1991 and August 1992 there was no difference in liveweight between treatments. The ST treatments resulted in similar liveweights to the control over the duration of the experiment

There were no difference in liveweight over the 1991/92 summer between treatments. This occurred despite the pasture residues on the WC treatment (subterranean clover dominant) being significantly less than the other treatments. Sheep were maintained on subterranean clover leaf, stem and burr. There is a concern with the lack of ground cover over summer and the possibility for soil erosion with the limited amount of trash on the surface.

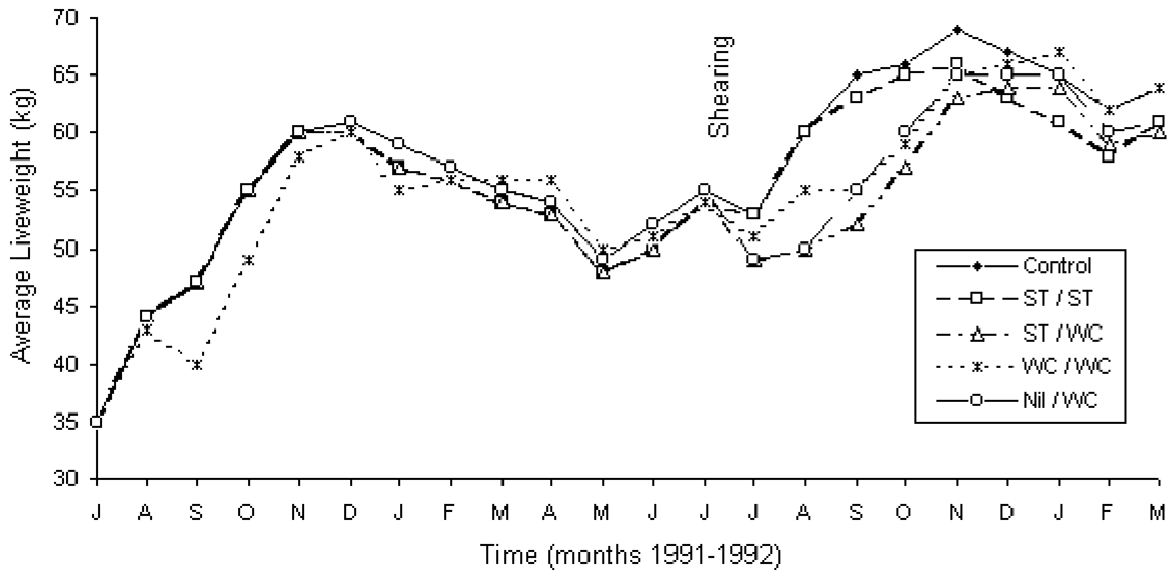

Figure 2. Sheep liveweight (kg/head) in response to pasture herbicide treatments during 1991 and 1992.

The study found the use of non-selective herbicides as a management technique to manipulate the pasture composition to achieve a pure legume dominant pasture can be achieved. The advantages with removing grass in the last years of the pasture phase in terms of reducing the incidence of herbicide resistance, carry-over of soil borne cereal diseases and in crop weed levels far out weigh the short term loss in herbage production (10).

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