PASTURE PLANT-BACK PERIODS FOLLOWING APPLICATION OF SIMAZINE TO CONTROL *VULPIA* SPP.

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Abstract

Winter cleaning with low rates of the soil active herbicide simazine (0.5 to 0.75 kg a.i./ha) removes vulpia selectively from annual and perennial pastures but often results in extensive areas of bare ground. This situation can be exploited by direct drilling perennial grasses to achieve longer term vulpia control, provided safe pasture plant-back periods are selected for the particular soil type. On lightly buffered sandy loams with low organic matter, simazine rates below 0.75 kg a.i./ha and plant-back periods of 8 weeks are indicated. On higher organic matter soils, up to 1 kg/ha a.i. simazine and plant-back periods of 4-6 weeks gave satisfactory establishment, especially if mean soil temperatures are above 10?C (mean daily air temperatures of 6 to 8^{o}C) when simazine is applied.

Key words: cocksfoot, fescue, perennial ryegrass, phalaris, simazine degradation, subterranean clover, white clover, winter cleaning.

The presence of the annual grass *Vulpia* spp. (hereafter called vulpia) has increased in pastures in recent years and it is now a major component of degraded pastures (4). It has low productivity, suppresses legumes in pastures when dense and is the most common cause of failed perennial pasture establishment. The use of low rates of simazine has been shown to selectively remove vulpia from annual and perennial pastures (3) but longer term control relies on the presence of a competitive grass (5). Direct drilling pasture seed into paddocks ?winter cleaned? with simazine may be an option to achieve longer term control and increase pasture productivity whenever long, cool springs permit successful pasture establishment from winter sowings and provided safe pasture plant-back periods can be established.

The length of the plant-back period will depend on the sensitivity of the pasture species to simazine residues and the speed of simazine degradation. The literature (1, 2, 6, 7) revealed simazine degradation is determined by application rate, soil type and organic matter (OM) level, climate (rainfall and temperature) and uptake by plants. Field and ?glasshouse? experiments were conducted to determine the relative tolerance of several temperate pasture species to various rates of simazine and establish minimum plant-back periods for them in different soils under winter conditions of southern Australia.

The ?glasshouse? was open sided to ensure exposure to outside winter temperatures. To simulate field conditions as closely as possible, a large pie cutter was used to enable undisturbed 30 x 60 x 8 cm deep sods to be placed in similar sized seedling trays. Pasture seed was direct drilled in both the field and the trays using a narrow inverted ?T? sowing boot. To remove weed competition as a factor, total control was achieved with heavy rates of the non-residual herbicide Roundup CT? (45% glyphosate) applied 10 days prior to sowing. Pasture seedlings were counted after germination and three months post sowing, to provide a bioassay of the effect of residual simazine on specific pasture species.

Results

The first field experiment was conducted on a sandy loam with 2% OM. Simazine at four rates 0, 0.5, 0.75 and 1 kg/ha a.i.was applied sequentially to provide a range of plant-back periods from 2 to12 weeks. Four grasses were sown in separate, replicated plots. In the unsprayed control there was no residual control of vulpia and further germinations occurred after sowing reducing pasture establishment, despite achieving total weed control prior to sowing with 2.4 l/ha Roundup CT?. There was a significant ($P<0.01$) species x rate effect (Fig. 1). Phalaris (*Phalaris aquatica*) establishment was significantly reduced ($P<0.05$) with 1 kg a.i./ha simazine. In contrast to the other three species, fescue (*Festuca arundinacea*) seedling density at 1 kg a.i./ha was significantly ($P<0.05$) greater compared to nil simazine. All species showed a positive correlation with plant-back period.

The first tray experiment, examined the tolerance of four perennial grasses and four legumes to three rates of simazine (0, 0.5 and 1 kg a.i./ha) and plant-back periods of 2, 4, 6 and 8 weeks in two soils with contrasting organic matter levels. Seedling emergence of all species was similar irrespective of simazine rate, plant-back period or soil type and plant numbers for each species at 15 weeks were similar on both soils in the absence of simazine (Fig. 2). However, when simazine was used plant numbers were significantly higher ($P<0.05$) on the basaltic clay loam (7.8% OM) compared to the granitic sandy loam (2.2% OM). On the basalt soil 1 kg a.i./ha simazine reduced grass establishment by 10% and legume establishment by 21% compared to nil simazine treatments. A similar comparison on the granite soil showed far greater reductions - 34% for grasses and 62% for legumes.

Phalaris was the most sensitive of the four grasses with seedling numbers significantly lower ($P<0.01$) for all plant-back periods with 1 kg a.i./ha simazine on the granite soil but on the basalt there were no significant differences at any rate. In contrast to phalaris, fescue was unaffected by rate or plant-back period on either soil. Ryegrass was relatively tolerant and cocksfoot was relatively senstitive (not shown). Legumes appear more sensitive than grasses and there were significant ($P<0.01$) soil x simazine rate x plant-back period effects. *Trifolium subterranean* (subclover) was the most tolerant with white clover (*Trifolium repens*) the most sensitive and affected on both soils. Legume plant-back period responses were less clear than rate responses.

A second tray experiment was restricted to the granite soil and aimed to define with greater precision plant-back period x species interactions. The same rates of simazine were used but species comparisons were restricted to a tolerant (ryegrass and subclover) and a sensitive (phalaris and white clover) grass and legume with plant-back periods of 2, 3, 4, 5, 6, 8 and 10 weeks. The species x herbicide rate x plant-back period comparisons for percent survival at twelve weeks of age all showed a similar trend in each species with greater reductions at the higher rate/shorter plant-back periods (Fig. 3).

White clover and phalaris survival at 1 kg a.i./ha was significantly ($P<0.05$) reduced with all plant-back periods up to and including 8 weeks. At 0.5 kg a.i./ha, percent survival these two sensitive species was suppressed with plant-backs up to and including 6 weeks. Ryegrass survival was only significantly ($P<0.05$) less with 2 and 3 week plant-back periods and the high rate of simazine, while sub clover survival was significantly ($P<0.05$) lower at 1 kg a.i./ha with plant-back periods up to and including 6 weeks. The significantly better ($P<0.05$) survival of subterranean clover at the high simazine rate with a 5 week plant-back period is difficult to explain in light of the poor survival with a 6 week plant-back period.

To verify the tray experiment data, a final field experiment on the granitic sandy loam used in the two tray experiments, examined the effects of four simazine rates (0, 0.5, 0.75 and 1 kg a.i./ha) and five plant-back periods (2, 4, 6, 8 and 12 weeks) on the establishment of phalaris. There was a significant ($P<0.05$) 2-way interaction between plant-back period and simazine rate (Fig. 4). Compared to nil simazine, 0.5 kg a.i/ha simazine had no significant effect at any plant-back period but with 0.75 and 1 kg a.i./ha and plant-back periods of 2, 4, 6 and 8 weeks, phalaris numbers were significantly reduced ($P<0.05$).

Discussion

This research supports other research (1, 2, 6) that soil type and organic matter are important factors in simazine degradation. However, degradation rates appear to be more rapid than would be predicted from the limited research that has examined degradation under cold conditions(2, 7). It is suggested this may well be due to removal of some simazine via root uptake by weeds, a factor not present in the overseas research where simazine is applied to bare ground. In the first tray experiment, dry conditions post spraying - pre sowing was also evaluated. No significant differences were found in seedling numbers established between rainfall regimes of 12 mm/week and 3 mm/week (unpublished data).

The various experiments provided similar data on the sensitivity of the various pasture species *viz*. fescue<ryegrass<<cocksfoot=phalaris and sub clover=lucerne<<white clover. The greater density of

perennial ryegrass compared to the other three grasses at all rates of simazine in the first field experiment probably reflects its greater seedling vigour.

Weed competition, suppressed establishment in nil simazine plots in the first field experiment when sowing occurred in June and mid July. This did not occur to the same extent in the other experiments. It is suggested this may be due to the later (August/September) sowing dates in all other experiments by which time there was little remaining seed to germinate. Better establishment in the first field experiment could also have been assisted by the high vulpia density present, resulting in greater removal of simazine residues via plant uptake. This situation also applied to both tray experiments whereas in the final field experiment, vulpia density was 50% lower. This may partly explain the apparantly greater amounts of simazine residue present.

The discrepancy between the results of the first field experiment and the other work can also be partly explained by the time of the simazine spraying and the resultant soil temperatures when simazine began degrading. In the first experiment, early rains meant simazine spraying began in late April when soil temperatures at 2 cm ranged from 14?C then down to 10?C by early June. In all other experiments simazine was applied later due to later autumn rains and to coincide with the later sowings, and colder soil temperatures (below 8^{o}C) would have slowed the rate of simazine degradation. In the final field experiment and the tray experiments, the highest residues apparently occurred with plant-back periods of 4 and 6 weeks and the highest simazine rate. However these 4 and 6 week plant-back treatments were always sprayed when the coldest soil temperatures occurred and these would have slowed simazine degradation and removal of residues from the soil, reducing pasture establishment. This situation and marginal soil moisture when simazine was applied in the final field experiment probably explains the discrepancy between the results of the two field experiments despite similar lightly buffered, low organic matter soils.

Conclusions

There are good data on the relative tolerance of the four perennial grasses to simazine and while the situation with legumes is less clear, they were more sensitive than the grasses. Simazine effects were far less marked on the more fertile basaltic soil reflecting the importance of organic matter in simazine degradation. Less severe effects can also be expected if simazine application occurs earlier in the year when warmer soil and air temperatures result in faster simazine degradation or in locations with less severe winter temperatures.

When over-sowing is carried out, the length of plant-back period will need to take account of the overall fertility of the soil, particularly the OM level, the rate of simazine used, the prevailing weather conditions, including the current soil moisture level and the sensitivity of the species being sown. While it was not possible to develop precise recommendations for pasture plant-back periods following winter cleaning on soils with a low cation exchange capacity some general principles have been developed where pasture species are to be sown following winter cleaning with simazine:-

• ? First, restrict this technique to paddocks that support a dense cover of vulpia.

• ? Use lower rates (0.5 to 0.625 kg a.i. simazine/ha) on lightly buffered, sandy soils and the highest registered rate of 0.75 kg a.i./ha only on heavier soil types with higher OM.

• ? Winter clean early in the winter while soil temperatures are reasonably high.

• ? Do not apply simazine to very dry or waterlogged soils.

• ? Ensure a plant-back period of at least 6 weeks on heavy soils and 8 wks on lighter sandy loams.

Acknowledgments

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Figure 1: The effect of five rates of simazine on the seedling density of perennial ryegrass, phalaris, fescue and cocksfoot 12 weeks after sowing. The vertical bar indicates l.s.d. (P>0.05).

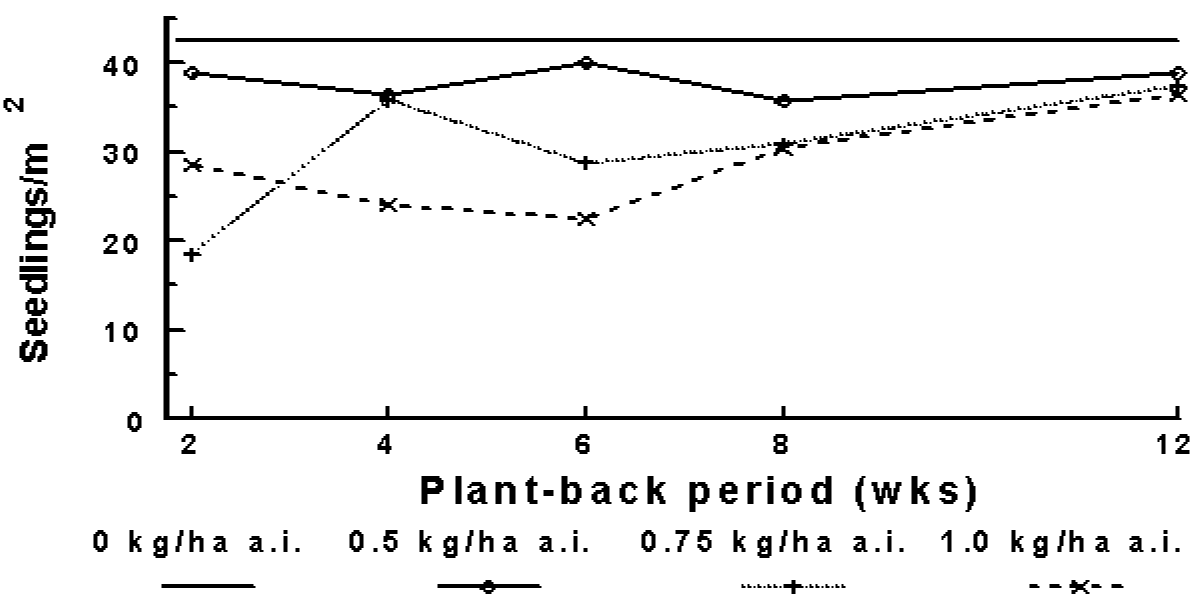
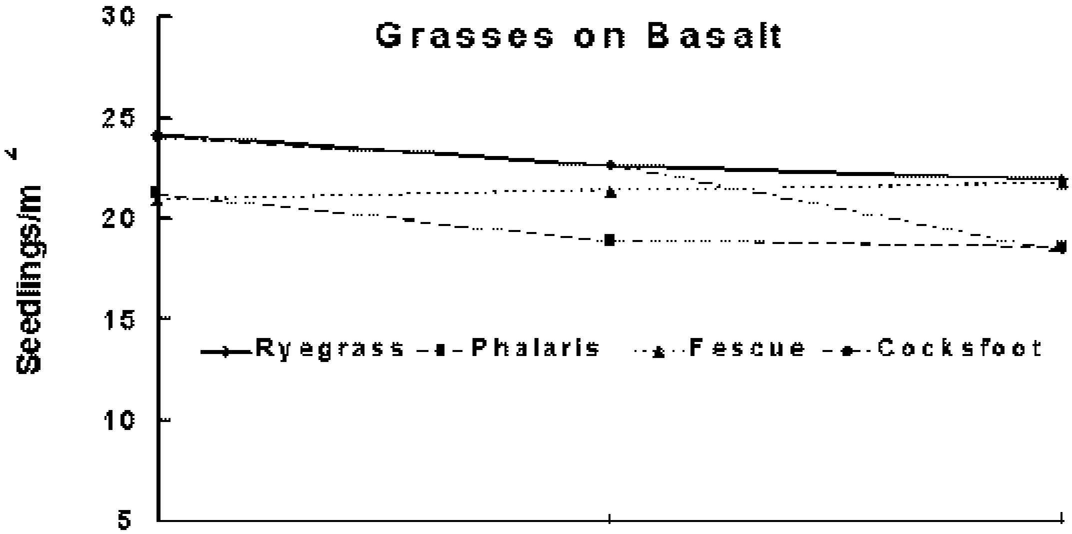
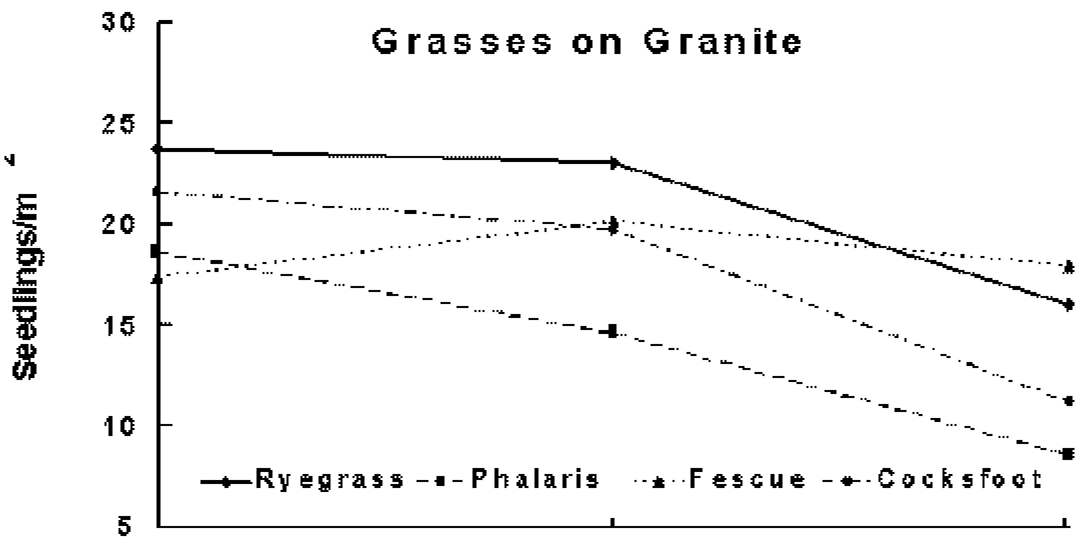


Figure 2: The effect of three rates of simazine on establishment of seedlings of four grasses and four legumes grown on two soils. The vertical bars indicate l.s.d. (P>0.05).


Grasses on Basalt
Seedlings/m 2
30
25
20
15
10
5
Ryegrass
Phalaris
Fescue
Cocksfoot


Grasses on Granite
Seedlings/m 2
30
25
20
15
10
5
Ryegrass
Phalaris
Fescue
Cocksfoot

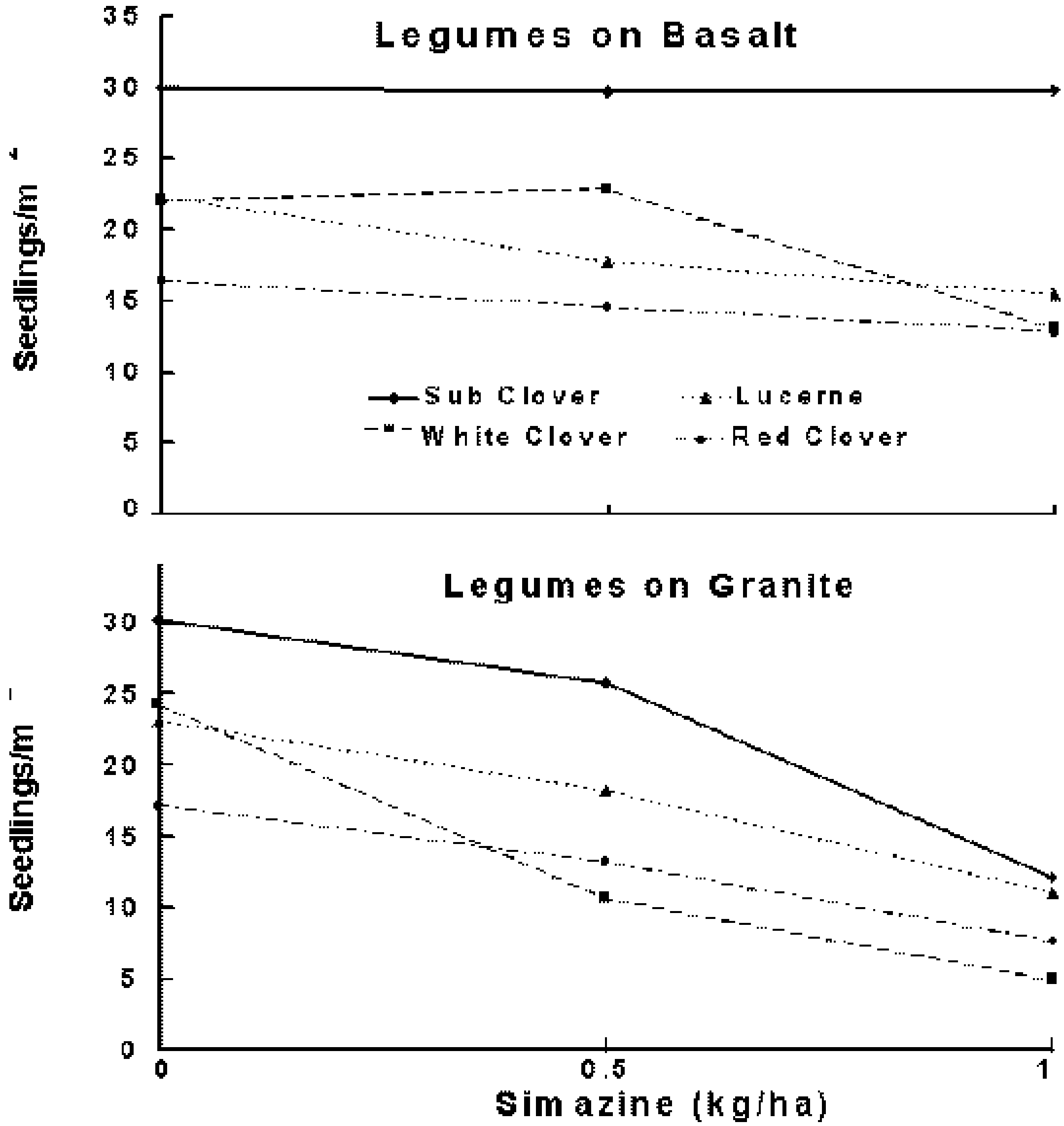
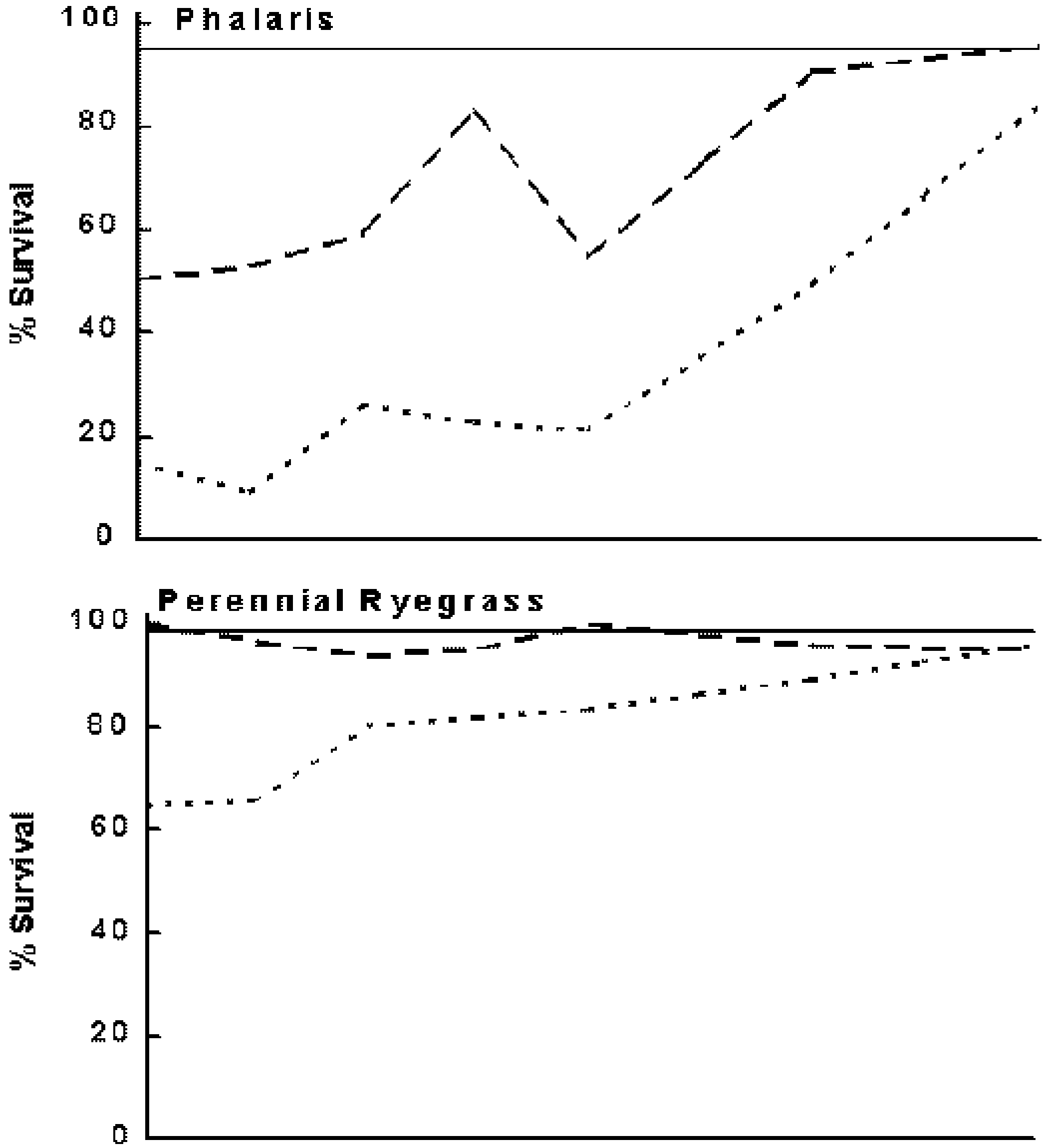


Figure 3: The effect of three rates of simazine and seven plant-back periods on the % survival of four pasture species. Vertical bars indicate l.s.d. (P>0.05).



Phalaris
% Survival
100
80
60
40
20
0
Perennial Ryegrass
% Survival
100
80
60
40
20
0

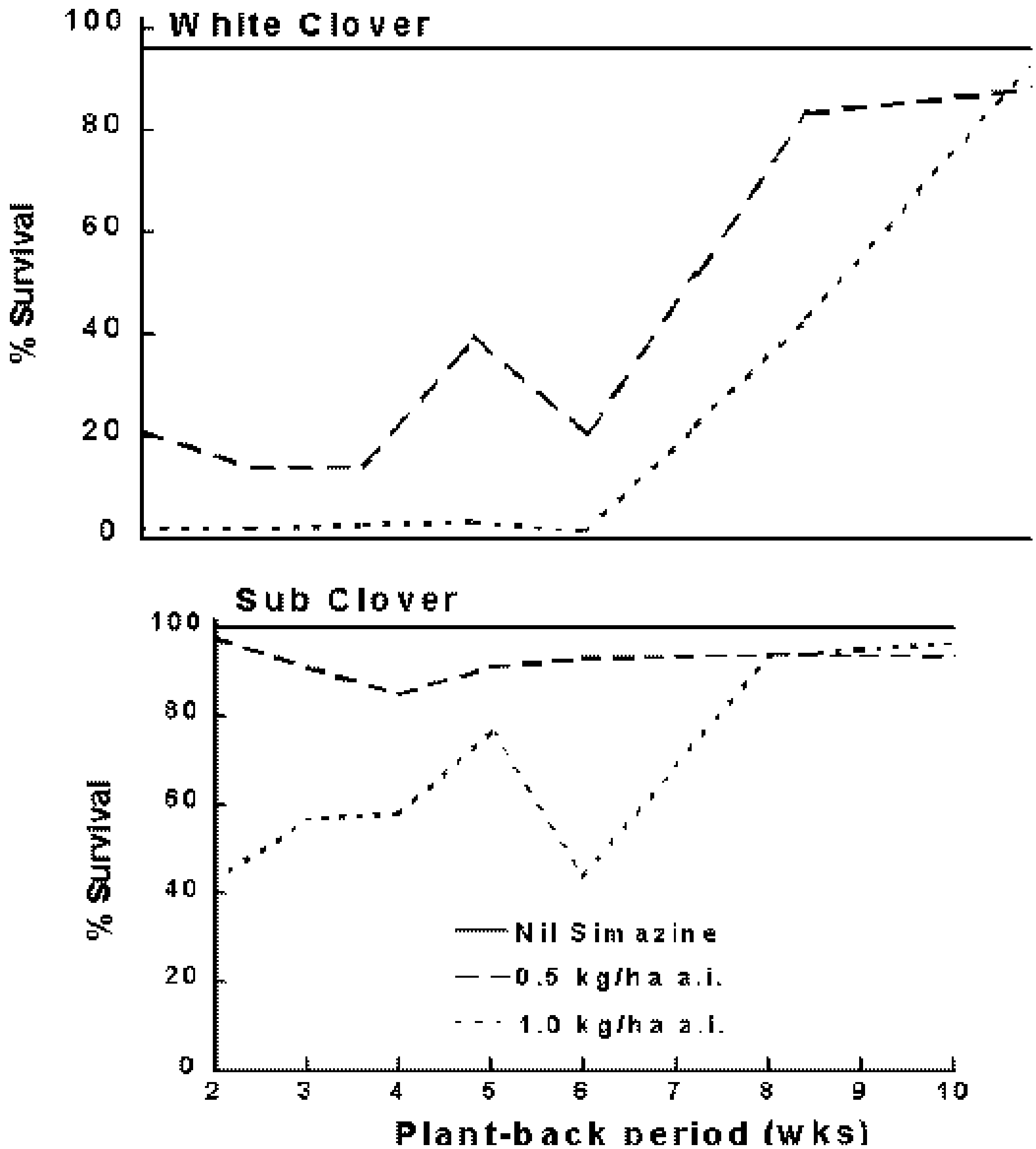
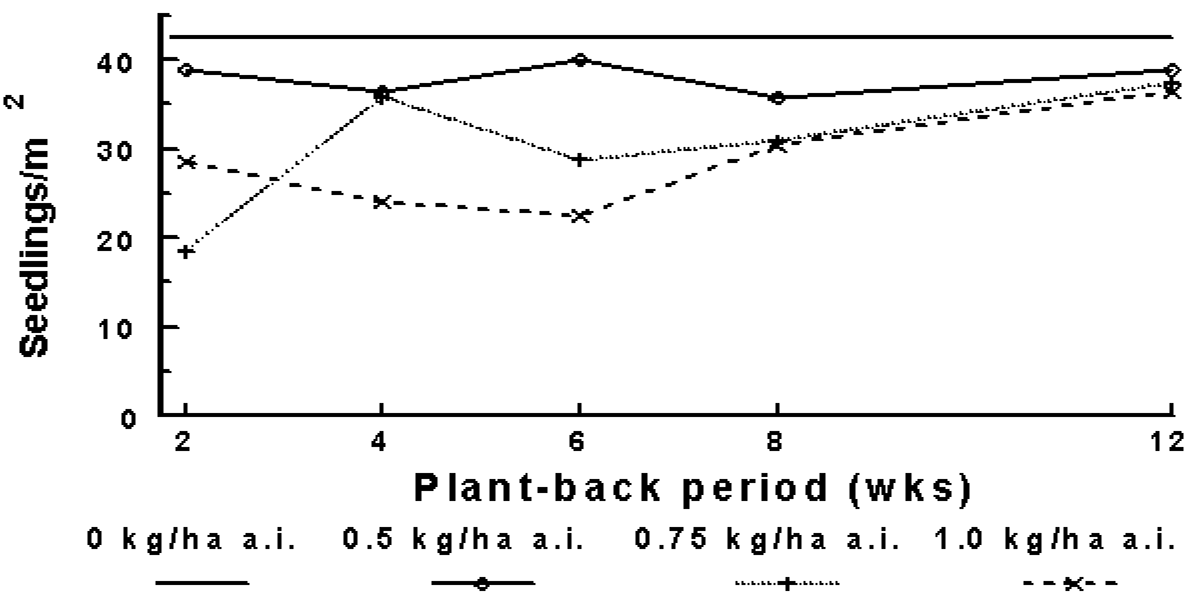


Figure 4: The effects of four rates of simazine and five plant-back periods on seedling density of phalaris 12 weeks after sowing. The vertical bar indicates l.s.d. (P>0.05).


Seedlings/m 2
40
30
20
10
0
2
4
6
8
12
Plant-back period (wks)
0 kg/ha a.i.
0.5 kg/ha a.i.
0.75 kg/ha a.i.
1.0 kg/ha a.i.