EFFECTS OF PRONAMIDE ON VARIOUS PASTURE GRASS SPECIES

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Summary

A report is presented on the effect of pronamide on ryegrass/white clover pastures at various times and rates of application. Trial data are included illustrating the effect on the balance of component species in the pasture resulting from the pronamide treatment. By reference to these data, and other trials, the effect of the chemical on individual grass species is discussed.

INTRODUCTION

SINCE its herbicidal properties were discovered by Rohm and Haas Co., Philadelphia, in 1965, pronamide has demonstrated post-emergent activity against a wide range of grass species, and pre-emergence activity against both grasses and broad-leaved plants. Whether applied pre- or post-emergence, the largest portion of pronamide enters the plant by root uptake. Downward movement from foliar treatment is negligible (Anon., 1971).

While the precise mechanism of activity is not known, sensitive species, particularly grasses, characterize pronamide toxicity by marked inhibition of growth in the meristematic regions; this is accompanied by lateral swelling and necrosis. These changes have been correlated with increases in DNA, RNA and protein in the meristematic cells, and by dramatic increases in the levels of cellulase (Smith *et al.*, 1971). Visual symptoms of post-emergent activity are slow to appear, the first normally being arrested growth. The plant may go through a period when it is darker green, after which it gradually becomes chlorotic and then dies. Symptoms are particularly pronounced in chickweed (*Stellaria media*) and Yorkshire fog (*Holcus lanatus*), which exhibit marked reduction in internode length, with pronounced lateral swelling.

The persistence of pronamide in soil is dependent upon both temperature and soil moisture content. In a soil containing 12% moisture, the half-life was calculated to be 29 days at 23° C, 63 days at 15° C, and 140 days at 8° C (Walker, 1970).

Because of its cool-weather activity, and the marked tolerance of lucerne (Anon., 1971) and clover (Atkinson, 1970; Anon., 1971) pronamide has been developed for use in situations where its selectivity between grass species is of minor importance; the control of perennial grasses in lucerne, suppression of grasses in clover seed crops, control of barley grass (*Hordeum murinum*) in localized areas and the release of forest trees from grass competition.

Atkinson (1970) showed that 3.4 kg/ha pronamide, applied to a Waikato pasture in winter or early spring, was sufficient to remove most of the grass from the sward, leaving a pasture composition containing as much as 98% white clover. Unpublished data (Paxman) indicated that 1.7 kg/ha, also applied to a Waikato pasture, on September 30, 1969, while removing poa annua (*Poa annua*), poa trivialis (*Poa trivialis*) and barley grass from the sward, affected perennial ryegrass (*Lolium perenne*) only to the extent of a 20% reduction.

The trials reported and discussed in this paper indicate the effect of pronamide applied at different rates and times, on various pasture grass species. In addition, the effect on pasture composition and dry matter both in the presence and absence of grazing stock is discussed. The trials were laid as part of a feasibility study to evaluate pronamide for barley grass control as an overall treatment to pastures.

EXPERIMENTAL

TRIAL 110.069 (Fig. 1), Ashburton, mid-Canterbury. Plot size 12.6 m × 2.38 m, four replicates. Oxford Precision sprayer, water rate 225 litre/ha. Soil type: Waterton Gley (silt loam). Trial site fenced from stock from time of first application.

TRIAL 210.364 (Fig. 2), Morrinsville, Waikato. Plot size 1/494 ha, four replicates. Oxford Precision sprayer, water rate 340 litre/ha. Soil type: Tirau Sandy Loam. Trial site fenced from stock from time of first application.

TRIAL 70.121 (Fig. 3), Parawera, Waikato. Plot size 10.37 m × 2.44 m, two replicates. Application and assessment as for Trial 71.113. Data not analysed. Trial site grazed.

FIG. 1: Trial 110-069, mid-Canterbury. Yield cut 2/11/71.

FIG. 2: Trial 210-364, Waikato. Seasonal dry matter production (two cuts).

TABLE 1: EFFECT OF TIME AND RATE OF TREATMENT.
TRIAL 71.113, WAIKATO
(Pasture composition assessed 25/11/71. Data analysed by square root transformation. Barley grass seed-heads counted 12/1/72)

Rates & App. Dates	White Clover m%	Ryegrass m%	Bromus mollis m%	Poa spp m%	Barley Grass seed-heads per plot
0.3 kg/ha					
23/4/71	44.8**	45.8**	2.7**	1.9**	71.0**
26/5/71	44.2**	42.1**	3.8**	2.7**	31.0**
2/7/71	42.1**	40.2*	6.7*	4.2**	65.0**
6/8/71	37.1**	45.4**	6.5**	5.7*	44.3**
4/9/71	44.2**	39.6NS	7.1*	4.4**	44.7**
27/9/71	41.7**	34.8NS	8.7NS	8.8NS	41.0**
0.4 kg/ha					
23/4/71	47.5**	47.0**	0.8**	0.0	37.0**
26/5/71	53.3**	39.8NS	0.6**	1.0**	20.0**
2/7/71	46.9**	44.1**	2.0**	1.4**	22.7**
6/8/71	50.8**	37.0NS	3.7**	1.9**	29.0**
4/9/71	42.7**	47.5**	3.8**	1.0**	20.3**
27/9/71	42.5**	45.8**	5.3**	2.6**	19.3**
0.6 kg/ha					
23/4/71	56.7**	37.8NS	0.5**	0.0	22.3**
26/5/71	57.5**	38.5NS	0.2**	0.0	10.3**
2/7/71	53.8**	41.0*	0.3**	0.0	12.7**
6/8/71	51.9**	39.9*	1.4**	0.0	6.3**
4/9/71	47.7**	43.5**	3.5**	0.0	13.3**
27/9/71	47.1**	41.9*	5.1**	0.0	10.3**
Control	26.4	32.7	16.8	11.5	142.6

* $P < 0.05$; ** $P < 0.01$.

FIG. 3: Trial 70-121, Waikato. Pasture composition % assessed 28/1/71.

TRIAL 71.113 (Table 1), Parawera, Waikato. Plot size 10.37 m $\times$ 2.44 m, three replicates. Sprayer propane powered, water rate 250 litre/ha, via 4 Monarch 32 fan jet nozzles. Assessments of pasture composition made by visual observation using 0.046 m² quadrat, making eight counts per replicate. Soil type: Otorohanga Silt Loam. Trial site grazed.

RESULTS

The effects of pronamide treatments on the botanical composition and dry matter yields for the four trials are presented in Figs. 1, 2 and 3, and Table 1. The post-emergent effect on individual species is given in Table 2.

DISCUSSION

The major information that emerges from the trial work is the difference in activity of pronamide between times of application. It appears to be characteristic that the tolerance of ryegrass to pronamide, particularly to rates in excess of 0.5 kg, increases markedly during a short space of time in the early spring.

The behaviour of clover (*Trifolium* spp.) is predictable, in view of its complete tolerance to pronamide up to 3.4 kg. In terms of pasture composition, the level of clover increases to balance the percentage of grass species removed. The increase in the amount of clover as dry matter, while in some cases reaching an amount 5 times that of the clover component of the control, usually is insufficient to replace the total amount of dry matter lost. The results for the lower rates in Trial 210.364 (Fig. 2) suggest that this is not inevitable: in several cases seasonal production has matched that of the control plots owing to increased growth later in the season. In Trial 110.069 (Fig. 1) the removal of bromus mollis (*Bromus mollis*) and barley grass has stimulated cocksfoot (*Dactylis glomerata*), the increase of which has prevented the anticipated increase in the amount of clover.

Rates in excess of 0.75 kg/ha applied in August-September, or 0.5 kg between May and July are likely to be too severe on the desirable grass species in most pastures to be acceptable. However, a rate of 0.3 to 0.5 kg applied in August-September appears to reduce the dry matter production

by no greater amount than that represented by annual grass species. Round-Turner (1970) showed that the long-term decline of pasture dry matter production was associated with the ingress of weed grasses, including *Poa annua*, *Poa trivialis* and *Bromus mollis*, possibly because of their competition with white clover (*Trifolium repens*). It is probable that the drop in dry matter production in the first season will be offset by an improvement in pasture quality and palatability. There is no doubt the increased clover content is ideal for fat lamb production.

The foregoing comments require qualification in that results from Canterbury, Otago, Marlborough and Hawke's Bay are not so predictable, with respect to the effect of pronamide on ryegrass. It is considered that the tolerance of ryegrass is dependent on several factors which affect its ability to recover from the pronamide treatment. The effect of soil moisture and temperature on the activity of pronamide has already been referred to. In addition to these factors, it is clear that pronamide is also affected by pasture length, surface trash, soil organic matter, and the amount and timing of rainfall following application of the herbicide. These factors will be quantified in future trials and/or surveys.

TABLE 2: POST EMERGENT EFFECT ON INDIVIDUAL SPECIES

(The figures are the rates of pronamide in kg/ha that will give 90 to 100% control of the species when applied under close-grazed conditions in the period May-July)

Group 1, Very Sensitive:

Holcus lanatus (Yorkshire fog) 0.3
Poa annua (poa annua) 0.3
Poa trivialis (poa trivialis) 0.3
Vulpia spp. (vulpia hair grass) 0.3

Group 2, Sensitive:

Anthoxanthum odoratum (sweet vernal) 0.5
Bromus unioloides (prairie grass) 0.75
Cynosurus cristatus (crested dogtail) 0.75
Festuca arundinacea (tall fescue) 0.75
Hordeum jubatum (squirrel tail grass) 0.5
Hordeum murinum (barley grass) 0.75
Phalaris canariensis (canary grass) 0.75

Group 3, Moderately Sensitive:

Agrostis tenuis (browntop) 1.25
Lolium perenne (perennial ryegrass) 1.25
Phleum pratense (timothy) 1.25
Poa pratensis (poa pratensis) 1.25

Group 4, Moderately Resistant:

Agropyron repens (couch) 1.75
Dactylis glomerata (cocksfoot) >2.0
Eleusine indica (crowfoot grass) >2.0

Group 5, Resistant:

Cynodon dactylon (Indian doab) >3.0
Nassella trichotoma (nassella tussock) >3.0
Paspalum spp. (paspalum) >3.0
Pennisetum clandestinum (Kikuyu grass) >3.0

CONCLUSIONS

There appears to be a safe rate and time of application of pronamide to achieve selective control of annual grasses in ryegrass/white clover pastures. Future work, in the form of trials and surveys, will be necessary to determine the extent of the variation in safe rate and time for each area. This will lie in the range 0.25 to 0.5 kg/ha applied in the period from July to September. The reduction, or even removal, of ryegrass may not be critical in cases where it can be subsequently replaced. As an example, it is suggested that browntop might be removed from hill pastures by means of the herbicide, with ryegrass being aerially seeded the following autumn.

The tolerance of cocksfoot is interesting and warrants a further study of this species, both in pastures and in mixed stands with lucerne.

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