THE EFFECT OF FERTILISER ON RAGWORT IN PASTURE

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SUMMARY

By stimulating growth in low fertility pastures both phosphate and nitrogen significantly reduced the numbers of ragwort (*Senecio jacobaea*) seedlings and small plants which were able to establish in the fertilized swards. Phosphate appeared to increase the resistance to 2,4-D of established ragwort plants.

INTRODUCTION

Ragwort occurs as a pasture weed over a wide range of soil types and fertility levels. Recommendations for its control usually stress the importance of pasture competition as a defence against its ingress. Cameron (1935) found that the density of pasture cover greatly influenced the survival of ragwort seedlings in experimental sites in England. Harper (1956) stated that the competitive ability of ragwort increased greatly as the plant developed, so that only tall and dense pasture could suppress established rosettes. In glasshouse studies Martin (pers. comm.) noted that ragwort seedlings and regrowths from root fragments showed a positive response to phosphate fertilizer. Fertilizers, particularly phosphate and nitrogen, are routinely applied to promote pasture growth, but little information is available about their effect on the survival and establishment of ragwort in the fertilized pasture. Nor have there been any reported studies of the way fertilizer treatments affect the response of ragwort to 2,4-D applied to control it.

Since 1982, four trials have been conducted to measure the interrelated effects of phosphate, nitrogen and 2,4-D applications on the survival of ragwort in pasture.

MATERIALS AND METHODS

Seedling and juvenile ragwort

Two trials were conducted to measure the effect of phosphate, nitrogen and 2,4-D on seedling and juvenile ragwort in pasture. In Trial 1 a pasture on clay soil near Whatawhata received phosphate treatments of 0 or 70 kg P/ha in August 1982. Nitrogen at 0 or 50 kg N/ha was applied as a split plot dressing over the phosphate main plots.

In Trial 2 phosphate at 100 kg P/ha was applied to pasture on a pumice soil near Waimiha in October, 1982. Factorial treatments of nitrogen at 0 or 100 kg N/ha, and boom sprayed 2,4-D (Ethone D.S. butyl ester) at 0 or 1.5 kg ai/ha were applied in October 1982 or April 1983 to the phosphate treated pasture. Small areas without phosphate, nitrogen or 2,4-D treatment were reserved as controls.

At both sites when the trials commenced in spring 1982 the ragwort plants were all small, mainly under 5 cm diameter, and had germinated in autumn 1982. When autumn treatments were applied at Waimiha in April, 1983 the majority of juvenile rosettes were approximately 10 cm in diameter. Pasture assessments at both sites were by point analysis. Ragwort plants were counted in March, September and November 1983.

Established ragwort

Two trials are being conducted to investigate the interaction of phosphate applications and 2,4-D treatments on mature populations of established ragwort in pasture. In August, 1984 at Patetonga (Trial 3) and Wharepapa South (Trial 4) factorial trials of two rates of phosphate (0 or 50 kg P/ha) and three rates of boom sprayed 2,4-D (1.0, 2.0 or 3.5 kg ai/ha) plus untreated controls, began on pastures containing mainly regrowth ragwort. Phosphate treatments were repeated in autumn and spring, 1985 and 2,4-D treatments in June, 1985 in Trial 3 and August, 1985 in Trial 4. Ragwort plants

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which survived these 2,4-D treatments were spot sprayed in December 1984 and December 1985. Treatment results were assessed by pasture herbage cuts, point analyses and ragwort plant counts.

When the trials commenced soil phosphate levels at all sites were low (10-15 on the Olsen P scale). Phosphate was applied as superphosphate and nitrogen in the form of urea. Trial 2 in Waimiha was grazed by farmed deer. The other sites were grazed by dairy cattle. Site 1 was closed for hay during December 1982. Fertilizer and 2,4-D treatments were in randomised blocks replicated four or eight times. Plot sizes were between 60 m² and 200 m².

TABLE 1: Effect of nitrogen and phosphate on ragwort survival, Trial 1.

Phosphate (kg/ha, 20.8.82) Nitrogen (kg/ha, 20.8.82)	Ragwort plants/100 m ²			
	0		70	
	0	50	0	50
Small plants (assessed 11.3.83)	388	323	123	128
Established plants (assessed 25.11.83)	291	329	156	188

P main effect significant ($P > 0.05$). No N effect.

RESULTS AND DISCUSSION

Tables 1 and 2 summarise the effects of phosphate and nitrogen fertilizers in reducing the numbers of ragwort seedlings and juvenile plants able to establish in low fertility pastures. The sulphur content of the superphosphate would not have resulted in any major response because of the adequate levels of sulphur already present in these trial sites (M.B. O'Connor, pers. comm.). The fertilizer responses in Trials 1 and 2 indicated that competition from increased pasture growth was the factor most responsible for reducing ragwort numbers. However, shifts in pasture composition induced by the fertilizer treatments also contributed. In Trial 1 phosphate encouraged vigorous growth of the dominant clover component, reducing ragwort seedling survival by 65% in March, 1983. Where phosphate was applied the numbers of established plants at the pre-flowering stage in Trial 1 were still 48% lower in November, 1983, 15 months after phosphate application. Nitrogen suppressed clover growth, leaving the sward open and the ryegrass was unable to compete effectively with the developing ragwort plants. The finding by Thompson (1974) that clover exerted greater competitive pressure than ryegrass on gorse seedlings may apply also to ragwort. Closing the Trial 1 paddock for hay further enhanced the competitive ability of the phosphate treated pasture.

TABLE 2: Effect of nitrogen, phosphate and 2,4-D on ragwort survival, Trial 2.

Phosphate (100 kg/ha, 20.10.82) Nitrogen (100 kg/ha, 20.10.82 and 4.4.83)	Ragwort plants/100 m ² at 20.9.83				
	Nil	Spring	Spring	Spring	Spring & Autumn
	Nil	Nil	Spring	Autumn	Autumn
No 2,4-D	204 a	107 b	47 c	130 b	58 c
2,4-D 1.5 kg ai/ha 20.10.82	—	16 a	7 b	—	6 b
2,4-D 1.5 kg ai/ha 4.4.83	—	13 a	5 b	12 a	4 b

Values within 2,4-D treatments with different letters are significantly different ($P < 0.05$).

In Trial 2 the original pasture was grass dominant with a high proportion of browntop (*Agrostis tenuis*) and relatively less clover. Good pasture growth responses to phosphate were noted but the major response was to nitrogen applied in October at

twice the rate used in Trial 1. Point analyses indicated that where phosphate only was applied the clover content increased, and that nitrogen considerably increased the density of browntop. Where no 2,4-D was applied phosphate-induced pasture growth caused a 50% reduction in ragwort numbers, while spring applied nitrogen in combination with phosphate, eliminated approximately 75% of the ragwort population compared to unfertilized areas (Table 2). Nitrogen applied in autumn, when the ragwort was bigger and pasture responses less vigorous, did not significantly affect ragwort survival. The stimulation of pasture growth by nitrogen in spring significantly improved the control of immature ragwort by 2,4-D applied in spring or autumn. Nitrogen applied in autumn did not affect the response of ragwort to 2,4-D.

In the first year of Trials 3 and 4 the phosphate and 2,4-D treatments had no effect on the regrowth ragwort. In the second year phosphate increased pasture DM production by 18% and improved the clover content of both pastures. The increased pasture competition suppressed immature ragwort plants which had replaced the original population in both trials. After 18 months of phosphate treatments there were significantly fewer small plants in both sprayed and unsprayed plots (Table 3). Martin (pers. comm.) noted that ragwort plants exhibited a strong growth response to phosphate fertilizer and Martin *et al* (1986) also reported that as the plants increased in size they were more likely to survive 2,4-D treatment. These findings were confirmed by counts of surviving plants in Trials 3 and 4 in December, 1985 (Table 3). Survival of established regrowth ragwort sprayed with 2,4-D at 1.0 kg ai/ha was respectively 28% and 54% higher on plots which had received 100 kg/ha phosphate during the year before 2,4-D application than where no phosphate was applied. A similar but non-significant trend was shown for the 2.0 kg ai/ha rate of 2,4-D. Phosphate caused no differential response in regrowth ragwort to 2,4-D at 3.5 kg ai/ha.

TABLE 3: The effect of phosphate and 2,4-D on ragwort plant numbers, Trials 3 and 4.

2,4-D (kg ai/ha)	Phosphate (kg/ha)	Ragwort plants/100 m ²			
		Surviving regrowths December 1985		New plants April 1986	
		Trial		Trial	
		3	4	3	4
Nil	0	—		185	174
Nil	100	—		129*	73**
1.0	0	40	24	20	48
1.0	100	51*	37NS	14**	34NS

* — $P < 0.05$

** — $P < 0.001$

NS — Not significant

CONCLUSIONS

These trials have shown that the numbers of ragwort seedlings and small plants able to establish in low fertility pastures can be considerably modified by the application of phosphate and nitrogen fertilizers. These effects remain apparent through the life of the treated ragwort generation. The trials indicated that pasture competition is important in reducing ragwort infestation of grazed pastures and that the development of a dense competitive sward by adequate fertilizer inputs and careful pasture and grazing management is essential to minimise invasion by ragwort seedlings. However, it should be recognised that fertilizer and management are unlikely to give adequate ragwort control by themselves and that some herbicide treatment will usually be necessary. The trials have also indicated that the phosphate applied to promote pasture growth can also accelerate the growth of established ragwort plants and consequently, their resistance to 2,4-D.

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