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Ragwort control with herbicides and fertilisers: first year's results

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ABSTRACT Several combinations of N, P and K fertilisers and the herbicides 2,4-D or glyphosate were tested in conjunction with conservation tillage for ragwort *(Senecio jacobaea)* control in a low fertility hill country pasture. The trial started in March 1988 and assessments have been made for 12 months. Results so far have shown that development of a dense competitive sward by adequate fertiliser is essential to minimise the ragwort infestation. The combination of 2,4-D and phosphate fertiliser resulted in the best sward composition and growth, and allowed the least re-invasion of ragwort into the pasture.

Keywords *Senecio jacobaea,* 2,4-D, glyphosate, fertilisers, NPK, chemical control, herbicides, dairy pastures, pasture renovation

INTRODUCTION

As with other weeds of high fertility soils, ragwort *(Senecio jacobaea)* has become a serious problem in the last few decades. It is toxic to most classes of stock and displaces much valuable pasture. Ragwort occurs over a wide range of soil types and fertility levels. Control by any one method is difficult and often unsuccessful, mainly because the soil seed bank is large and the multi-rosette regrowth plants are persistent (Martin *et al.* 1986; Thompson 1980). In addition, some herbicides used for ragwort control seriously damage clovers, reducing pasture quality and quantity (Thompson & Saunders 1984).

Recommendations for control of ragwort usually stress the importance of pasture competition to reduce the emergence and survival of young seedlings. Thompson & Saunders (1986) found that stimulating the growth of pastures greatly reduced the number of ragwort seedlings. Fertilisers, particularly phosphate and potash, and more recently nitrogen in the form of urea, are routinely applied to promote pasture growth. But little information is available about the relationship between fertiliser application and ragwort seedling survival in low fertility pastures, or about the way fertiliser treatments affect the response of ragwort to herbicides applied for its control.

Because of the poor success of any single control method, the development of an integrated control method is desirable. The objective of this project was to develop a management system to control ragwort and also suppress or control its re-invasion of the resown pasture. Various combinations of fertilisers and herbicides were used with direct drilling of pasture seed to achieve this aim.

MATERIALS AND METHODS

The trial site, near Whatawhata, was on a low fertility dairy pasture with a long history of ragwort infestation. At the time of treatment in March, ragwort plants were mainly vegetative regrowths after mowing in early January. The soil was a Dunmore silt loam, with soil Quick test results before treatment of pH 5.8, K level of 8, and Olsen P of 8.4.

The trial was of a split-plot randomised block design with 4 replications. The main plot treatments were existing pasture treated with 2,4-D butyl ester at 2.2 kg ai/ha or glyphosate at 2.2 kg ai/ha, and both treatments direct drilled with a mixture of Ellett perennial ryegrass *(Lolium perenne)* (16 kg/ha) and 'Grasslands Pitau' *white* clover *(Trifolium repens)* (3 kg/ha). The subplot factorial fertiliser treatments consisted of:

a. Urea — Nil and 50 kg/ha of N one month alter sowing plus 50 kg/ha N in spring.
b. Superphosphate — Nil and 60 kg/ha P as single superphosphate at sowing plus 40 kg/ha P in spring.
c. Muriate of potash — Nil and 50 kg/ha K at sowing plus 50 kg/ha K in spring.

The herbicides were applied with a hand-held CO, powered precision sprayer in 300 l/ha water at 210 kPa. The 2,4-D plots were treated on 24.2.88, glyphosate was applied on 3.3.88, and seed drilled on 15.388. The first P and K application was the day after drilling, while the N was broadcast a month later. All three nutrients were applied a second time on 23.9.88. The size of each subplot was 6 x 4 m.

The trial area, as part of a large paddock, was grazed under the normal dairy farm management by the farmer. Effects of treatments were measured by plant counts and cover assessments of ragwort and by seasonal herbage cuts and herbage dissection to determine relative pasture production and compositional changes. Results were analysed by analysis of variance, and for those in Table 2 by analysis of variance as log (n + 1). Least **significant** ratios (5%) are given in Table 2 and treatments are **significantly** different from each other if the ratio of **the** larger to the smaller value exceeds the LSR.

RESULTS

Addition of N and P increased total pasture yield including ragwort by 24% and **22%,** respectively (Table 1). The corresponding increases in the pasture yield excluding ragwort were 24% and 25% respectively. Application of K or the herbicides did not significantly affect the pasture yield and therefore the data are not included in Table 1.

Table 1 Effect of fertiliser treatments on **herbage** yield (kg **DM/ha):** total of four seasonal cuts.

Fertiliser[1]	Including ragwort	Excluding ragwort
- Nitrogen	3191	2885
+ Nitrogen	3945	3575
LSD (5%)	198	199
- Phosphate	3210	2871
+ Phosphate	3926	3589
LSD (5%)	198	199

‘Application of K (or herbicides) did not significantly **affect** pasture yield.

Results on ragwort seedlings establishing in the new pasture (Table 2) show that at the time of first cut, 24-D treated plots had 87% fewer seedlings than the glyphosate plots. This trend persisted also at the following cuts but was not statistically **significant.** Addition of either N or P reduced the number of ragwort seedlings, although this reduction was significant only for **the** 4th cut for N (4 1%) and the first cut for P (39%). A **significant** interaction between N and P was also recorded at cut 1, where the addition of P or N, or **both,** suppressed the **re-**invasion of ragwort. Again this trend was consistent but not significant in the following cuts. At cut 2 an interaction occurred between P and herbicide, where P reduced ragwort numbers significantly on the glyphosate but not the 2,4-D plots.

The **herbage** composition results show that glyphosate suppressed clover significantly compared with the 24-D treatment **-** by 7 1% and 54% at cuts 2 and 3 respectively (Table 3). Application of N also reduced clover content of the pasture at all three cuts but consistently increased the **ryegrass** percentage, which was significant at cut 4 (22%). Addition of P had no significant effect on ryegrass, but increased clover content 35% by cut 4. A significant interaction between N and P and between herbicide and P was also noted at cut 2. Addition of P increased the **ryegrass** content in the absence of N, but had no such effect in the presence of N. **Ryegrass** content was greatly increased by addition of P on glyphosate but not 24-D plots.

Little ragwort was present in **herbage** samples at cut 2. By the time of cut 3, the average amount of ragwort was **4%,** and this further increased to 20% at cut 4. Treatments had no effect on ragwort percentage, as shown by **herbage** dissection.

Table 2 Effect of herbicide and fertiliser treatments on ragwort population **(plants/m²).**

Treatment	**Cut 1** 2.6.88	cut2 14.9.88	cut 3 16.11.88	cut 4 15.2.89
Glyphosate	**6.9**			
2,4-D	**0.9**[2]	10.3 6.9	12.2 7.2	17.9 12.6
LSR (5%)’	**1.7**	1.8	1.8	1.6
- Nitrogen	3.4	9.1	11.2	**19.5**
+ Nitrogen	2.4	7.3	7.9	11.5
LSR (5%)	1.3	1.4	1.5	1.3
- Phosphate	**3.6**			
+ Phosphate	**2.2**	9.5.5	10.2 8.7	16.8 13.4
LSR (5%)	1.3	1.4	1.5	1.3
- N - P	5.1	11.6	12.7	25.0
- N + P	2.1	8.2	9.9	15.1
+ N - P	2.5	7.8	8.2	11.2
+ N + P	2.2	6.9	7.6	11.9
LSR (5%)	1.5	1.6	1.8	1.5
Glyp - P	**9.3**	14.1	14.9	18.9
Glyp + P	**5.0**	**7.4**	**9.9**	6.9
2,4-D - P	**1.1**	**6.4**	**6.9**	14.9
2,4-D + P	**0.7**	7.6	**7.6**	10.6
max LSR (5%)	**1.6**	1.7	1.8	1.5

[1]**Add** 1 to means before applying **LSR;** analysis **was** done using log (y + 1) transformation.
[2]**Means** in bold letters indicate significant (5%) results.

DISCUSSION

Three months after treatment, glyphosate plots had **significantly** more ragwort seedlings than 24-D plots, which reflects a common problem in pastures renewed by conservation **tillage.** Glyphosate suppressed established ragwort plants well, but a heavy infestation of seedlings followed in the new pasture. Infestation did not occur in 2,4-D plots because the initial vegetation removal was less severe. This emphasises the importance of pasture competition for suppressing the weed seedlings in the resown pasture. Both N and P also promoted pasture growth and the increased competition was responsible again for limiting establishment of ragwort seedlings.

Table 3 Effect of herbicide and **fertiliser** treatments on **herbage** composition **-** **%** species.

Treatment	cut 2 14.9.88		cut 3 16.11.88		cut 4 15.2.89	
	ryegrass	clover	**ryegrass**	clover	**ryegrass**	clover
Glyphosate	82.2	1.6’	**76.1**	3.1	25.6	14.5
2,4-D	75.1	5.5		**6.7**	22.8	16.9
LSD (5%)	15.0	3.7	11.5	**2.7**	9.4	5.0
- Nitrogen	77.6	3.8	75.3	6.7	21.7	19.9
+ Nitrogen	79.7	2.1	79.6	3.1	26.7	**11.6**
LSD (5%)	3.3	1.0	4.5	1.9	4.4	3.1
- Phosphate	77.8	3.5	15.7	4.8	23.6	13.5
+ Phosphate	79.5	3.0	79.2	4.6	24.8	**17.9**
LSD (%)	3.3	1.0	4.5	1.9	4.4	3.1

‘Means in bold letters **indicate significant** (5%) results.

The importance of fertilisers, particularly P, in suppressing ragwort seedlings is shown by the fact that a significant interaction was noted with glyphosate where many more young seedlings were present. This interaction did not occur on 2,4-D plots because seedlings were much fewer and many plants present may have been established plants. Martin et *al.* (1986) have reported that larger ragwort plants were more likely to survive 2, 4-D treatment.

Application of P eventually encouraged vigorous clover growth which may have been an important reason for the suppression of ragwort seedlings. Nitrogen, on the other hand, significantly suppressed clover growth but was still able to reduce ragwort numbers, mainly because of increased ryegrass growth. This was particularly evident in cut 4 where N resulted in 22% more ryegrass and 41% less ragwort. The effect was greatest at cut 4 because N applied in October enhanced the ability of ryegrass to suppress ragwort seedlings germinating the following autumn. The relatively low ryegrass content in the trial at cut 4 was due to the large amount of summer weed grasses and ragwort then present.

The interaction between herbicide and P for the ryegrass component at cut 2 suggests that newly sown ryegrass plants were better able to utilise P in the glyphosate plots with no existing vegetation. Addition of N and P suppressed ragwort seedlings by promoting growth and competitive ability of the total pasture -more specifically ryegrass with N and possibly that of clovers with P. Addition of K did not significantly affect pasture growth or ragwort numbers, presumably because its level in the soil was already adequate.

The results show that numbers of ragwort seedlings and small plants able to establish in low fertility resown pastures can be considerably modified by herbicides and fertilisers. Based on the results available so far, combined use of 2,4-D and phosphate fertiliser appeared to result in the best sward composition and growth, and limited the re-invasion of ragwort into the pasture. Treatments are being repeated to study their long term effects on the establishment and survival of ragwort.

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