THE EFFECT OF PICLORAM ON CLOVER

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Summary

Results obtained both overseas and locally show that pasture legumes and especially clovers (*Trifolium* spp.) are highly susceptible to picloram. Residues after weed control in pastures and crops have not been fully evaluated, but results indicate that they may be a problem.

This research note evaluates the susceptibility of two strains of white clover (*Trifolium repens*) by germinating seedlings in various concentrations of picloram and 2,4-D. Measurements of root radicle length indicate that wide differences occur. This was most pronounced in the relative toxicities of 2,4-D on each strain, with the Spanish strain being many times more susceptible than the Government strain. A threshold value for picloram was established, and this value was approximately the same for both strains.

Overall, the Spanish strain white clover was found to be less susceptible to the higher rates of picloram applied; a practical application of this phenomenon could be the use of less susceptible strains of clover after weed control with picloram.

INTRODUCTION

Pengelly and Ferguson (1964) indicated clearly that picloram is extremely toxic to pasture legumes, and that residues are a problem with broadcast applications in these locations.

Picloram, now for its third year of field assessment, can be evaluated in its residual effects on the growth and regeneration in new and established pastures.

Several trials carried out within the Department of Agriculture showed that rates of picloram of 3 oz a.i./acre eliminated clover from the pasture for 6 to 8 months and that after 12 months there was still a reduction of 80% in the amount of clover present as compared with control (Patterson, 1965).

Mason (1964) pointed out residual effects on succeeding clover pastures after weed control in brassica crops, and suggested that only the minimum dosage for adequate weed control should be applied.

For control of pasture weeds such as Californian thistle (*Cirsium arvense*) and docks (*Rumex* spp.) spot application appears to be the only method if clover damage and residues are to be avoided.

The purpose of this study with picloram was to test for any differences that might be present between two strains of white clover in its sensitivity to this chemical and to 2,4-D.

EXPERIMENTAL

Solutions were made up from technical material in distilled water to give a series of two interlaced logarithmic scales starting at 1 and 5 parts per billion*. Also included was 2,4-D at 1,000 ppb, and

* 1 billion = 10^9 .

Fig. 1: The effect on radicle length of white clover of various picloram concentrations.
(Treatment 10 in the figure is the 2,4-D treatment)

Fig. 2: Both sets of data from Fig. 1 plotted on a logarithmic scale.
(Treatment 10 in the figure is the 2,4-D treatment)

a distilled water control. The tests were made in 9 cm Petri dishes containing seed testing filter paper with 10 ml of each solution. The seeds were scarified and vernalized and grown in a temperature between 15 and 25°C. Measurements were made for 21 days, and from these data the figures recorded after 12 days from the start of germination were used as being a representative example. Four replications were made, and the results were treated statistically.

RESULTS

Table 1 shows the sum of the mean radicle length in millimetres from 4 replications after 12 days for various concentrations applied on two strains of white clover.

TABLE 1: TOTAL RADICLE LENGTH (MM) AT 12 DAYS

					<i>White Clover</i>	
					<i>Govt. Strain</i>	<i>Spanish Strain</i>
Picloram (ppb) :						
10,000	.....	.....	.....	.....	11	17
1,000	.....	.....	.....	.....	15	20
500	.....	.....	.....	.....	16	23
100	.....	.....	.....	.....	21	18
50	.....	.....	.....	.....	25	20
10	.....	.....	.....	.....	41	35
5	.....	.....	.....	.....	52	44
1	.....	.....	.....	.....	64	45
0	.....	.....	.....	.....	47	45
2,4-D (ppb) :						
1,000	.....	.....	.....	.....	20	8

Graphs were prepared to detect if there were any irregularities in the linearity of the long log linear trend, as it appears that a discontinuity existed between 10 and 50 ppb. Figures 1 and 2 enable a graphical comparison to be made between two methods of assessment.

Figure 1 plots concentration, against the arithmetic totals of the four replications—*e.g.*, N.Z. Government strain at 5 ppb picloram.

Rep.	1	13 mm
	2	13 mm
	3	12 mm
	4	14 mm
Total		52

The length quoted for each replicate is the average length of 25 radicles.

Figure 1 indicates clearly that, using this metameter as an indicator, a discontinuity exists, and that perhaps a "threshold" value for picloram on clover is in the area between 10 and 50 ppb. An alternative model is tested in Fig. 2. Instead of the sum, the product of the four replications is used as a metameter—*e.g.*, N.Z. Government strain at 5 ppb.

Rep	1	13
	2	13
	3	12
	4	14
		<hr/>
		28,392

These points were plotted with a logarithmic scale of both axes. A simple linear relationship is still obscure and several discontinuities exist; this is especially marked in the Spanish strain between the concentrations of 10 and 50 ppb. This would verify that a threshold value probably exists.

A concentration of 2,4-D at 1,000 ppb is included in Fig. 2 for a comparison of relative potencies, and from these data it appears that the Spanish strain is more sensitive to this chemical than to picloram. The observed relative potency using this metameter shows that 2,4-D is more than 10 times as toxic as picloram. However, the reverse is the case with the Government strain, where it is found that picloram is more than 10 times as toxic as 2,4-D.

A possible stimulatory effect due to 1 ppb of picloram was examined, and statistical analysis showed that the increase in radicle was not quite significant at the 5% level. The apparent stimulation occurred only in the Government strain and was not observed in the Spanish strain.

DISCUSSION

By the use of more sophisticated statistical techniques than used by Newton (1964), it is shown that there is an apparent discontinuity in linearity between 10 and 50 ppb plotted on either an arithmetic or logarithmic scale. This discontinuity would suggest that a "threshold" value for picloram on white clover exists between these rates. It would be possible to determine this value more accurately by a detailed study of the area between 10 and 100 ppb using the same techniques as described here. It also appears that this value is approximately the same for both strains of white clover.

A possible stimulatory effect was noticed at 1 ppb. This was tested for significance and found to be slightly below the 5% level. The effect, if real, is essentially similar to other growth-regulating hormones, where at low rates stimulation of growth occurs, whilst at higher rates they are toxic—*e.g.*, indole acetic acid.

The relative potency of 2,4-D was compared with picloram for both strains. A high toxicity for 2,4-D on the Spanish strain was noted, whilst the effect on the Government strain showed that 2,4-D was 10 times less toxic than picloram. This is in agreement with Haymaker *et al.* (1963). From this study it is also apparent that the high rates of concentration—*i.e.*, 10,000, 1,000 and 500 ppb are less damaging to the Spanish strain than to the Government strain. This reduction in sensitivity may have some bearing on the use of less susceptible strains in suitable situations of pasture establishment after the application of picloram.

CONCLUSIONS

From the results presented, the following conclusions can be drawn:

- (1) Differences between Spanish strain and Government strain white clover in relationship to relative susceptibility to picloram are small.
- (2) A threshold value in the same range for both strains was observed.
- (3) The observed relative potency for 2,4-D varied widely in each strain, the Spanish strain being 10 times more sensitive to 2,4-D than picloram and the Government strain being 10 times more sensitive to picloram than 2,4-D at similar concentrations.
- (4) In an overall picture, the Spanish strain was less susceptible to the higher rates of picloram and this may indicate that less sensitive strains could prove useful after weed control with picloram.

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