TOLERANCE OF WHITE CLOVER TO SOME PHENOXY HERBICIDES AND MIXTURES

T.K. JAMES, A. RAHMAN and P. SANDERS

AgResearch, Ruakura Agricultural Centre, Private Bag, Hamilton

SUMMARY

The tolerance of white clover (*Trifolium repens*) to some phenoxy herbicides and mixtures was evaluated in three field trials and one pot experiment. MCPA and 2,4-D were much less damaging than the mixtures of 2,4-D with either dicamba, mecoprop or clopyralid. The damage from clopyralid alone was intermediate to the above. Of the mixtures, 2,4-D plus either clopyralid or dicamba was less damaging than 2,4-D plus mecoprop. Most of the mixtures affected white clover for at least 20 weeks. The least damaging of these treatments could possibly be used for broadcast spraying of difficult to control weeds in pasture.

Keywords: phenoxy herbicides, white clover, herbicide tolerance, dicamba, clopyralid

INTRODUCTION

Since their development in the 1940's, the phenoxy herbicides have been the backbone for chemical weed control in New Zealand pastures (Lynch 1954). However, the repeated use of these herbicides has led to the emergence of weeds that are tolerant to them e.g. nodding thistle (*Carduus nutans*) and giant buttercup (*Ranunculus acris*) (Bourdôt *et al.* 1989). In order to combat this problem farmers require more effective herbicides or combinations that can be used as broadcast applications. Clopyralid was found to be effective against MCPA-tolerant nodding thistle, but this herbicide was too damaging to clovers to be used as a broadcast application in pasture (Harrington *et al.* 1988). In the Waikato however, clopyralid is being used at a reduced rate and in combination with 2,4-D for control of phenoxy-tolerant nodding thistle.

Phenoxy herbicides are damaging to the white clover component of pasture, with some members of the group being recommended for spot application only in order to minimise this damage (Meeklah 1958; Honore *et al.* 1980). For much of the year clovers usually comprise less than 15% of the available dry matter of pasture and some short term suppression of clovers may not be critical. However, if the clover component of the pasture is more severely suppressed then pasture production is also lost due to insufficient fixation of nitrogen (Lewis 1957; Lynch 1954). The use of phenoxy herbicides either at higher than normal rates or in combination with other herbicides is likely to result in an unacceptable amount of pasture damage.

This paper reports on the damage to white clover from some of the phenoxy herbicides and mixtures that are possible candidates for control of phenoxy-tolerant weeds.

MATERIALS AND METHODS

Field trials

White clover damage was evaluated in three field trials in the Waikato. Trials 1 and 2 were established in nodding thistle infested pastures on 24.5.91 and 4.7.91 respectively while Trial 3 was established on a nearly weed-free pasture on 11.6.91. The treatments (Tables 1 and 2) were applied with a CO₂ powered precision sprayer in 300 litres water/ha at 200 kPa using flat fan nozzles approximately 10 days after grazing. Trial 1 was sprayed on a foggy morning followed by a fine day, while Trials 2 and 3 were sprayed on fine days following frosts. The nodding thistles in Trial 1 were large

Proc. 46th N.Z. Plant Protection Conf. 1993: 288-291

rosettes at the time of treatment while those in Trial 2 were seedlings and very small rosettes. Trial 1 was subject to regular grazing by cattle while Trials 2 and 3 were grazed by sheep. All trials were randomised blocks with six replicates and 2 x 10 m plots.

For Trials 1 and 2 white clover damage was assessed regularly by three or four observers. Initially the assessments included estimates of both physical damage and the level of white clover suppression compared to untreated control. After the physical damage symptoms had disappeared (about 6 weeks) the assessments were simply an estimation of the amount of white clover present compared to untreated. Data on the efficacy of nodding thistle control was also recorded from these trials and will be reported elsewhere. In Trial 3 the regular visual assessments were augmented with dry matter production and herbage dissections, determined by mowing two 9.0 x 0.5 m strips from each plot. After recording the green weight, subsamples were taken for dry matter determination. Separate subsamples were taken for the herbage dissection.

Pot experiment

Two cultivars of white clover, viz, Pitau and Kopu, were planted in 150 mm diameter pots on 15.4.91 and 7.5.91 respectively. The plants were thinned to six per pot soon after emergence and the pots were maintained in the glasshouse for the first 2 months. They were kept outdoors without shade or cover for the rest of the study. During this period the white clover plants were trimmed as required and regularly supplied with a nutrient supplement. On 5.8.92 (15 months later), eight pots of each cultivar were selected at random and sprayed with herbicides (Table 3) using the same equipment as for the field trials. A further eight pots were set aside as untreated controls. The pots were left undisturbed for 24 hours before being returned to a randomised layout. The top growth of the white clover was then harvested, dried and weighed at monthly intervals.

TABLE 1: Visual assessments of white clover damage as percentage of untreated in Trials 1 and 2 after treatment with phenoxy herbicides and mixtures.

Treatment	Rate (kg ai/ha)	White clover damage ¹ (%)							
		Trial 1				Trial 2			
		Weeks after application	7	11	21	30	Weeks after application	8	13
2,4-D	1.1	35	7	5	0		7	9	0
2,4-D	2.2	44	13	10	0		23	25	0
MCPA	1.2	45	21	13	0		18	33	23
2,4-D + dicamba	1.1 + 0.05	74	63	33	12		73	67	27
2,4-D + dicamba	1.1 + 0.1	83	82	66	17		88	76	37
2,4-D + mecoprop	1.1 + 0.3	76	60	35	9		72	72	22
2,4-D + mecoprop	1.1 + 0.6	80	80	72	25		79	86	50
2,4-D + clopyralid	1.1 + 0.03	70	79	57	5		87	82	48
clopyralid	0.03	52	50	25	0		79	68	28
LSD (P<0.05) ²		13	12	19	22		14	19	25

¹Includes both physical damage and growth suppression.

²Excluding untreated, for testing significance against untreated (=0) use LSD/ $\sqrt{2}$. Herbicides used were; 2,4-D (2,4-D Ester 80 EC), MCPA (MCPA 400), dicamba (Banvel 200) mecoprop (non-commercial sample) and clopyralid (Versatill).

RESULTS

Field trials

All the herbicide treatments, except for the low rate of 2,4-D in Trial 3, significantly reduced the production of white clover for up to 8 weeks (Tables 1 and 2). The damage caused by MCPA was similar to that from the low rate of 2,4-D, with the high

rate of 2,4-D often being indistinguishable from them. However, those treatments that combined either dicamba, mecoprop or clopyralid with 2,4-D were considerably more damaging to white clover, with many of them still severely suppressing growth after 21 weeks.

In Trial 3 the 2,4-D plus high rate of mecoprop was still significantly reducing white clover production 1 year after treatment (Table 2). Clopyralid alone resulted in damage that was similar to that from 2,4-D at 2.2 kg/ha.

Pot experiment

Damage to the two white clover cultivars grown in pots was similar to that found in the field trials, with 2,4-D alone causing significantly less damage than the mixtures (Table 3). In this study the 2,4-D/mecoprop mixture was, in most instances, more damaging than the 2,4-D/dicamba mixture. The 2,4-D/clopyralid combination caused damage similar to that from the 2,4-D plus low rate of dicamba. After 20 weeks only the two highest rates of mecoprop plus 2,4-D treatments were producing significantly less dry matter than untreated was. In these treatments however, many of the white clover plants had been killed.

Although the relative responses to the treatments were the same for both cultivars, overall a t-test showed that Pitau was more susceptible than Kopu to the herbicides tested here.

TABLE 2: Dry matter production of white clover in Trial 3 after treatment with phenoxy herbicides and mixtures.

Treatment	Rate (kg ai/ha)	White clover production (kg DM/ha) Weeks after application			
		6	12	26	52
2,4-D	1.1	21.2	147.4	16.0	5.8
2,4-D	2.2	10.7	53.8	9.6	5.5
MCPA	1.2	13.7	100.3	13.8	6.1
2,4-D + dicamba	1.1 + 0.05	5.2	35.7	7.8	5.7
2,4-D + dicamba	1.1 + 0.1	3.6	4.0	2.2	4.8
2,4-D + mecoprop	1.1 + 0.3	5.0	14.4	4.5	5.3
2,4-D + mecoprop	1.1 + 0.6	2.0	7.3	0.9	3.2
2,4-D + clopyralid	1.1 + 0.03	9.3	8.4	3.5	5.6
clopyralid	0.03	16.8	39.5	6.1	4.4
untreated	-	42.8	137.1	15.3	5.1
LSD (P<0.05)		8.3	27.5	2.6	1.5

DISCUSSION

The use of herbicide mixtures to achieve better weed control is not a new concept, although the rates used in the past were often higher than those tested here. For example, Thompson (1974) tested dicamba with 2,4-D (0.3 + 1.2 kg/ha) for control of ragwort (*Senecio jacobaea*) and still noted severe clover suppression more than 1 year later. Mitchell and Meeklah (1986) used mecoprop with 2,4-D (1.0 + 1.0 kg/ha) for control of daisy (*Bellis perennis*) but the treatment halved the dry matter production from clover over a 4 month period after application. In the trials reported here, the use of dicamba at a lower rate resulted in much less clover damage than that reported by Thompson (1974) and could be a valuable treatment for use on the more difficult to control pasture weeds without excessive damage to clovers. Only the lowest rate of mecoprop used in these trials gave better clover tolerance than that found by Mitchell and Meeklah (1986), with the higher rates giving long term clover damage. When clopyralid was mixed with 2,4-D, the clover damage reported here was slightly more persistent than that reported by Rutherford *et al.* (1981) who used it at the same rate with MCPB. However, as the level of damage from 2,4-D plus clopyralid was similar to that from 2,4-D plus the low rate of dicamba, it could also be considered a useful combination.

TABLE 3: Dry matter production of two white clover cultivars grown in pots after treatment with phenoxy herbicides and mixtures.

Treatment	Rate (kg ai/ha)	Mean dry matter/pot (g)							
		Pitau white clover				Kopu white clover			
		Weeks after application				Weeks after application			
		6	11	17	20	6	11	17	20
2,4-D	1.1	4.15	5.47	7.77	4.19	5.01	6.83	8.12	4.31
2,4-D + dicamba	1.1 + 0.04	3.70	3.93	6.41	3.72	4.56	3.38	6.84	3.88
2,4-D + dicamba	1.1 + 0.07	3.17	1.29	3.44	2.71	4.94	1.49	5.22	3.39
2,4-D + dicamba	1.1 + 0.1	3.80	1.20	3.64	2.39	4.64	1.76	4.72	3.71
2,4-D + mecoprop	1.1 + 0.3	1.80	0.43	2.86	2.51	3.31	1.19	4.46	3.63
2,4-D + mecoprop	1.1 + 0.45	1.69	0.09	0.99	1.42	2.89	0.21	1.32	2.29
2,4-D + mecoprop	1.1 + 0.6	1.98	0.01	0.36	0.58	2.85	0.08	0.52	0.62
2,4-D + clopyralid	1.1 + 0.03	4.0	2.33	5.64	3.66	4.25	0.98	1.90	2.13
clopyralid	0.03	5.11	3.70	6.66	3.37	5.82	2.55	5.31	3.84
untreated	-	9.90	6.45	7.32	3.47	9.68	6.76	7.24	3.50
LSD (P<0.05)		0.75	0.74	1.36	1.08	0.80	0.88	1.32	1.39

Results from these trials show that in situations where weeds resistant to phenoxy herbicides are a problem, there are some possible herbicide combinations which could be used for control. The two combinations that resulted in the least damage to white clover were 2,4-D plus dicamba and 2,4-D plus clopyralid.

ACKNOWLEDGEMENTS

The authors wish to thank David Peake for provision of field trial sites and Judy Mellsop for assistance with the pot experiments.

REFERENCES

- Bourdôt, G.W., Harrington, K.C. and Popay, A.I., 1989. The appearance of phenoxy-herbicide resistance in New Zealand pasture weeds. *Proc. Brit. Crop Prot. Conf. - Weeds*: 309-316.
- Harrington, K.C., Popay, A.I., Robertson, A.G. and McPherson, H.G., 1988. Resistance of nodding thistle to MCPA in Hawkes Bay. *Proc. 41st N.Z. Weed and Pest Control Conf.*: 219-222.
- Honore, E.N., Rahman, A. and Dyson, C.B., 1980. Effects of winter application of phenoxy herbicides on white clover and pasture production in lower Northland. *Proc. 33rd N.Z. Weed and Pest Control Conf.*: 55-58.
- Lewis, K.H.C., 1957. The effect of spraying on fat lamb production. *Proc. 10th N.Z. Weed Control Conf.*: 44-47.
- Lynch, P.B., 1954. Control of pasture weeds in relation to clover tolerance. *Proc. 7th N.Z. Weed Control Conf.*: 28-31.
- Meeklah, F.A.H., 1958. Comparison of the substituted phenoxyacetics and phenoxybutyrics on a white clover-perennial ryegrass sward. *Proc. 11th N.Z. Weed Control Conf.*: 61-67.
- Mitchell, R.B. and Meeklah, F.A., 1986. Daisy control in pastures using herbicides and nitrogenous fertilizers. *Proc. 39th N.Z. Weed and Pest Control Conf.*: 192-195.
- Rutherford, G.R., Bell, P.D. and Forgie, C.D., 1981. 3,6-dichloropicolinic acid/MCPB for control of nodding thistle in pasture. *Proc. 34th N.Z. Weed and Pest Control Conf.*: 122-125.
- Thompson, A., 1974. Herbicide effects on ragwort and pasture. *Proc. 27th N.Z. Weed and Pest Control Conf.*: 90-93.