THE TOLERANCE OF ESTABLISHED 'GRASSLANDS MAKU' LOTUS TO FOUR HERBICIDES

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Summary

Established 14 month old lotus major (*Lotus pedunculatus* cv. 'Grasslands Maku') tolerated up to 4 kg/ha of ethofumesate and propyzamide applied in winter and spring, and 4 kg/ha of asulam and 2,4-DB in spring. Despite short-term depression of growth, complete recovery of lotus from all treatments had occurred by early summer. This level of tolerance should ensure effective control of most weeds in established lotus stands grown for seed.

INTRODUCTION

Lotus pedunculatus is a legume well suited to low fertility soils. Seed crops, however, must be produced in arable areas where soil fertility is usually higher and other legumes and weeds are far more competitive than lotus (Brock and Charlton 1978), often resulting in major weed control problems. In the production of certified lotus seed white clover (*Trifolium repens*) and sheep's sorrel (*Rumex acetosella*) are particular problems because they have a similar seed size to lotus. Other weeds such as annual and perennial grasses, thistles, docks (*Rumex* spp) and flatweeds can reduce stand establishment, vigour and consequently seed yields.

Previous work (Ivens 1975; Brock and Henderson 1976) has concentrated on establishing lotus, where control of most weeds with selective pre-emergence or early post-emergence herbicides can be achieved.

The removal of mature weeds requires greater concentrations of selective herbicides or herbicides which establishing lotus cannot tolerate. Mature lotus may be more tolerant of herbicides and consequently a small plot evaluation of the tolerance of established lotus to herbicides was conducted.

METHOD

The evaluation was carried out at the Aorangi Research Area of Grasslands Division, D.S.I.R., in the Manawatu, using a 1 year old 'Grasslands Maku' lotus stand from which a seed crop had been taken. Soil type was a Kairanga silt loam (total N, 0.37%; Olsens available P, 33 ppm; pH 5.0). Herbicides used were ethofumesate, propyzamide, asulam and 2,4-DB applied by small pressure sprayer in 280 litres/ha at 200 kPa. Rates were 0, 0.7, 1.3, 2.0, 2.7 and 4.0 kg/ha.

Two experiments were conducted. The first was in winter (applied 6 June 1976) and used ethofumesate and propyzamide only, applied immediately following defoliation. The second, in spring (applied 3 September 1976) used all four herbicides applied to a complete cover of herbage 10-15 cm high. A randomized factorial layout with three replicates was used. Individual plot size was 1.5m². Herbicide effects were estimated by making visual assessments (% cover) of lotus and white clover (the only evenly spread problem weed present) content in all plots on 19 August (Experiment 1 only), 12 October and 10 December.

Proc. 33rd N.Z. Weed and Pest Control Conf.

RESULTS AND DISCUSSION

Experiment 1

Fig 1 Experiment 1. Mean relative effect (Control = 100) of winter applications of (a) ethofumesate and propyzamide on lotus content, and (b) ethofumesate on white clover content 18 weeks after application.

All treatments had severe effects on lotus by mid winter (July), particularly the high rates of propyzamide. After 10 weeks these effects had decreased, but all rates of propyzamide except the lowest continued to depress lotus, compared with only the highest rate of ethofumesate (Fig. 1). By 18 weeks all visible effects on lotus had disappeared. As anticipated propyzamide had no effect on white clover. Ethofumesate reduced white clover greatly and eliminated it at rates over 2 kg/ha.

Experiment 2

TABLE 1: Experiment 2. The effect of herbicides on lotus content (% cover) 6 weeks after spring application.

Herbicide	Rates kg/ha						Mean
	0	0.7	1.3	2.0	2.7	4.0	
ethofumesate	83	53	37	37	47	33	42 b
propyzamide	83	60	43	33	40	33	49 b
2,4-DB	83	50	30	27	43	27	43 b
asulam	83	63	40	20	20	13	40 b
Mean	83 a	57 b	38 c	38 c	29 cd	38 ed	27 d

Six weeks following application all herbicides had caused a reduction in lotus content with an increasing effect of rate (Table 1). Asulam and 2,4-DB tended to be more severe at the higher rates but the rate x herbicide interaction was not significant. By 14 weeks all herbicide effects had disappeared and all plots were in the early flowering stage.

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TABLE 2: Experiment 2. Effect of ethofumesate on white clover content (% cover), 6 and 14 weeks after spring application.

Rates (kg/ha)	Clover content	
	6 weeks	14 weeks
0	50 a	27 b
0.7	13 c	23 bc
1.3	23 bc	13 c
2.0	23 bc	00 d
2.7	13 c	00 d
4.0	10 c	00 d

Ethofumesate is relatively slow-acting and at 6 weeks, although reduced, white clover was still present in all treatments. By 14 weeks white clover had recovered at rates below 2 kg/ha but had disappeared at 2 kg/ha and higher.

DISCUSSION

The results indicate that mature lotus can tolerate much higher rates of these herbicides than can establishing lotus (Brock and Henderson 1976; Ivens 1976). Despite initial damage, in all treatments lotus appeared to have recovered completely by early summer.

In the Manawatu both ethofumesate and propyzamide would appear satisfactory for use on established lotus, but care may be required in their winter use, particularly in cool regions, as both herbicides are more active at low temperatures. There have been instances of heavy damage to lotus when these two herbicides have been used in combination during winter in the South Island, particularly if applied sequentially with an interval of several weeks (D.L. Ryan; E.W. Vartha, pers comm). This interaction of temperature and tolerance needs further investigation.

Herbicidal effects of spring applications of asulam have been observed on establishing lotus (Brock and Henderson 1976), but in this study no visual symptoms developed. It was not expected that 2,4-DB would have detrimental effects on lotus. However, it has been shown that *L. corniculatus*, unlike many legumes, can degrade 2,4-DB to the toxic 2,4-D to some degree and suffer herbicidal damage (Garcia and Jordan 1969). Should *L. pedunculatus* have similar properties, this could account for part of the depression observed in this study.

The spring results on white clover indicate that management has a role. Between the October and December observations, the white clover content of the control plots fell 50% (Table 2). Over this period temperatures increased rapidly which would cause a relatively greater increase in lotus growth than white clover (Mitchell 1956; Mitchell and Lucanus 1962). This suggests that a vigorous stand of lotus is able to exert some control of weeds, particularly lower growing species, as at the time of seed harvest in the following autumn (March) there was little white clover evident in the crop canopy or the seed taken.

With sufficient planning and care, clean seed crops of lotus should be able to be established. Should problem weeds develop later, provided they can be held in check, they would be more readily controlled when the crop is mature using the herbicides evaluated in this study.

REFERENCES

- Brock, J.L. and Charlton, J.F.L., 1978. *Lotus pedunculatus* established in intensive farming. *Proc. N.Z. Grassld Assoc.* 39: 121-9.
 Brock, J.L. and Henderson, J.D., 1976. Control of legume weeds in lotus seed crops by ethofumesate. *Proc. 29th N.Z. Weed and Pest Control Conf.*: 93-6.

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- Garcia, M.M. and Jordan, D.C., 1969. The action of 2,4-DB and dalapon on the symbiotic properties of *Lotus corniculatus* (birdsfoot trefoil). *Plant and Soil* 30: 317-34.
- Ivens, G.W., 1975. Preliminary evaluation of pre- and post-emergence herbicides in 'Maku' lotus. *Proc. 28th N.Z. Weed and Pest Control Conf.*: 31-4.
- Mitchell, K.J., 1956. Growth of pasture species. III. White clover (*Trifolium repens*), subterranean clover (*T. subterranean*) and lotus major (*Lotus uliginosus*). *N.Z. J. Sci. Tech.* 37A: 395-413.
- Mitchell, K.J. and Lucanus, R., 1962. Growth of pasture species under controlled environment. III. Growth at various levels of constant temperature with 8 and 16 hours of uniform light per day. *N.Z. J. Agric. Res.* 5: 135-44.