CONTROL OF LEGUME WEEDS IN LOTUS SEED CROPS BY ETHOFUMESATE

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Summary

White clover *(Trifolium repens)* is a serious contaminant of lotus major *(Lotus pedunculatus)* seed crops, but ethofumesate has shown selectivity between these species. Control of white clover in 'Grasslands Maku' and 'Grasslands 4703' lotus was achieved by 0.25-0.5 kg/ha applied pre-emergence (autumn) and 1-2 kg/ha applied post-emergence (early spring). Suckling clover (*T. dubium*), another potential contaminant, was more resistant and required higher rates for adequate control. 'Maku' was more tolerant of ethofumesate than 'G4703.' Of the other two legumes tested, lotus corniculatus (*L. corniculatus*) was similar to 'G.4703', while lucerne (*Medicago sativa*) was reduced by all treatments.

INTRODUCTION

When 'Grasslands Maku' lotus major (*Lotus pedunculatus*) was released for commercial seed multiplication (Armstrong 1974) it appeared to have a role for revegetation work in high country and forestry (A. H. Nordmeyer pers comm) and in wetter hill country development. Other important attributes such as grass grub and porina resis ance (Farrell and Sweney 1973; Farrell and Jones 1974) and its non-bloating properties in cattle (Jones *et al* 1970) would also give it a potential value in some lowland intensive farming situations. As a result there is now a considerable demand for this cultivar, but a major problem in seed production is contamination of the crop by white clover *(Trifolium repens)* which has similar sized seed. Suckling clover *(T. dubium)* is also in this category, some of its seed being small enough to be a problem in diploid lotus seed production.

Most agricultural land in New Zealand already has large populations of buried legume seed, but the advent of the herbicide ethofumesate appears to offer a solution to the problem. In experiments on barley grass control in mixed pastures using ethofumesate, clovers *(Trifolium* spp) were severely depressed or eliminated (Allen *et al* 1974). Other preliminary work by M. P. Rolston (pers comm) and W. L. Kain (pers comm) showed a degree of selectivity between lotus major and white clover and the present experiment examines this aspect. Lotus corniculatus *(Lotus corniculatus)*, which may have a place in New Zealand agriculture, and lucerne (*Medicago sativa)* were also included.

METHODS

The trial was sown at Palmerston North on 29 April, 1975 on an area of Manawatu silt loam.

Treatments were:

Rates. Ethofumesate at 0, 0.25, 0.5, 1.0 and 2.0 kg/ha.

Application times. Pre-emergence on 30 April 1975, or post-emergence on 22 September 1975.

Species: a) Monocultures of lotus major cv 'Grasslands Maku' and 'Grasslands 4703' (diploid), lotus corniculatus, cv 'Franco', cv white clover cv 'Grasslands Huia,' suckling clover and lucerne cv 'Wairau.'

b) Two mixtures of 'Huia' white clover and suckling clover with either 'Maku' or 'G.4703' lotus in equal proportions.

Three replications of a split plot design were used with rates x application times as main plots (2.5 x 1.3 m) and the six monocultures and two mixtures randomised as sub-plots (0.6 x 0.6 m). Seed rates were adjusted to 1 seed/6 cm^2 (approx. 10 kg Huia/ha).

All plots were sprayed with 2,4-DB at 2 kg/ha on 8 September 1975, to reduce the severe broad-leaved weed competition that had developed, before the post-emergence application, and again with asulam at 2 kg/ha on 21 November 1975 to control a heavy infestation of broad leaved docks *(Rumex obtusifolius)*. As asulam affected lotus major (growing points turned white and growth was checked), yields and botanical composition were determined on all plots on 9 December 1975 by ground level cuts. Lotus subsequently recovered completely and grew well.

RESULTS

Monocultures (Table 1)

Ethofumesate, pre-emergence, completely eliminated 'Huia' at rates above 0.25 kg/ha while suckling clover required much higher rates (1-2 kg/ha) for effective control. Post-emergence treatments also gave good control though not as effective as the pre-emergence treatments.

Of the two lotus major cultivars, 'Maku' showed greater tolerance than 'G.4703' and the effect of increasing application rates was more severe for pre- than post-emergence treatments. Lotus corniculatus showed similar results to 'G.4703.' In all cases increasing rates decreased lucerne yields.

Most treatments had some effect on weeds but by the time of measurement these and the effects of the 2,4-DB had worn off, particularly with the pre-emergence treatments. Main weeds were twincress *(Corynopus didymus)*, mouse-eared chickweed *(Cerastium glomeratum)*, scarlet pimpernel *(Anagallis arvensis)* and ox-tongue *(Picris echoides)*.

TABLE 1: MEAN EFFECTS OF ETHOFUMESATE PRE- AND POST-EMERGENCE ON THE GROWTH OF SEVERAL LEGUMES (kg DM/ha)

ethofumesate (kg/ha)	white clover	suckling clover	'Maku' lotus	'G.4703' lotus	lotus corniculatus	lucerne
0	3015 a*	2100 a	2190 ab	2020 ab	1625 b	2405 a
Pre-emergence						
0.25	190 d	1040 c	2435 a	1750 bc	1750 ab	1235 b
0.5	0 d	995 c	2430 a	1400 de	1290 c	1040 cd
1.0	0 d	400 d	1740 c	490 f	1225 c	770 e
2.0	0 d	50 e	900 e	690 f	720 d	270 f
Post-emergence						
0.25	1415 b	1565 b	2135 ab	2180 a	2000 a	1330 b
0.5	655 c	1160 bc	2025 bc	1710 bcd	1480 bc	1185 bc
1.0	625 c	1380 bc	2105 ab	1110 e	940 d	850 de
2.0	215 d	950 c	1305 d	1490 cd	990 cd	655 e

Mixtures (Table 2)

Control of white clover was similar to that obtained in the monocultures in the pre-emergence treatments, but better in the post-emergence

owing to the marked increase in lotus major growth with the release of competition. Again 'Maku' showed better tolerance than 'G.4703.' Suckling clover was relatively unaffected except at the high pre-emergence treatments. However 'G.4703' did not respond fast enough to fill the gap left by the reduced white clover and allowed suckling clover to increase at the lower rates. As in the monocultures other weeds were not controlled sufficiently.

TABLE 2. MEAN EFFECT OF ETHOFUMESATE PRE- AND POST-EMERGENCE ON THE YIELDS (kg DM/ha) OF LEGUME SPECIES SOWN IN EQUAL PROPORTIONS IN MIXTURE

ethofumesate (kg/ha)	'Maku' lotus	white clover	suckling clover	others species	'G.4703' lotus	white clover	clover suckling	others species
0	420 d	2340 a	250 a	540 b	455 c	2025 a	275 b	815 b
Pre-emergence								
0.25	2305 a	0 d	235 a	1005 a	1720 a	10 d	700 a	1210 ab
0.5	1965 a	55 d	355 a	760 ab	920 bc	5 d	130 bc	1475 a
1.0	1490 b	0 d	200 a	1045 a	645 c	0 d	185 b	1115 ab
2.0	900 c	0 d	75 b	920 ab	570 c	0 d	5 c	1320 a
Post-emergence								
0.25	1170 bc	795 b	230 a	805 a	755 c	680 b	575 a	800 b
0.5	1077 bc	410 c	270 a	1030 a	790 c	350 c	225 b	1255 a
1.0	1255 bc	320 c	110 ab	965 a	1200 b	250 c	225 b	785 b
2.0	1365 b	15 d	240 a	595 b	625 c	85 d	255 b	795 b

DISCUSSION

Early results indicating selectivity between white clover and lotus major have been further substantiated, and although M. P. Rolston (pers comm) found pre-emergence ethofumesate treatments reduced early lotus major growth in the short term, such an effect was not evident following the long period between application and measurement in this experiment.

Clearly ethofumesate is a valuable tool for maintaining lotus major free of white clover, whether in seed crops or mixed pasture, although should the pastures contain susceptible species such as prairie grass (*Bromus catharticus*) (Henderson and Brock 1976) other approaches will be needed.

Barley grass (*Hordeum* sp) control by ethofumesate is better when applied in early winter (May/June) (Allen *et al* 1974) when cooler temperatures reduce breakdown rates by micro-organisms, resulting in a longer and higher period of activity. Although effective both pre- and post-emergence, Cox (1974a) found pre-emergence weed control in red beet was variable where seedbed preparation was less than ideal. In this experiment the seedbed was well prepared and the prolonged cold wet winter following application combined to give the very effective control of white clover obtained by 0.25 kg/ha. The poorer though still satisfactory control obtained by the early spring treatments may have been a reflection of the rising temperatures reducing effectiveness.

When lotus major seed crops are treated with ethofumesate, soil type will need to be considered, as it has been shown that soils with higher organic matter require higher rates (Cox 1974b; Hoogstraten *et al* 1974). The soil used in this experiment was a silt loam relatively low in organic matter and more developed soils may need higher rates.

Suckling clover was more resistant to ethofumesate and if it were the main contaminant could cause problems. Its early growth form is a dense mat and it has greater winter growth than lotus major (Brock

1973) which could result in severe competition from autumn sowings. Higher rates of ethofumesate at sowing would remove suckling clover provided the reduction in lotus growth was acceptable, particularly for the slower establishing diploid 'G.4703.' Alternatively, spring sowings may be better, provided adequate moisture is available to allow good establishment before any summer dry periods develop. Lotus corniculatus exhibited tolerance similar to that of 'G.4703,' but as a consequence of all treatments reducing lucerne growth ethofumesate is not suitable for use with this crop.

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