EVALUATION OF ETHOFUMESATE IN RED BEET CROPS

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A series of four field experiments carried out in 1973 confirmed the value of ethofumesate for the control of redroot (*Amaranthus hybridus* and *A. retroflexus*) and black nightshade (*Solanum nigrum* complex) in red beet crops. In one experiment, where a fine, firm seedbed was obtained, redroot was well controlled by a pre-emergence spray. Generally however, under variable seedbed conditions, post-emergence applications gave better results. Ethofumesate had a useful complementary effect with phenmedipham and a mixture of 1 kg/ha of each was very successful.

INTRODUCTION

Little progress has been made in chemical weed control in red beet crops since the introduction of phenmedipham. In use, residual herbicides remain unreliable, especially in Hawkes Bay where the main area is concentrated. In 1968 and 1969 work carried out with phenmedipham confirmed some important limitations of this chemical (Coles and Johns, 1969; Cox, 1969). In particular, *Amaranthus* spp which are resistant and *Solanum* spp only moderately susceptible often constitute the most difficult weed problems in the crop.

At about the same time, ethofumesate was announced (Pfeiffer, 1969) and during subsequent investigation as a sugar beet herbicide it became clear that it was active against these same species.

Hence, in 1973, a series of experiments was conducted to evaluate ethofumesate, alone and in combination with phenmedipham, in red beet. One experiment was at Levin Horticultural Research Centre and three were on growers' properties in Hawkes Bay.

METHODS and MATERIALS

The experiments were set up to compare the treatments listed in Table 1. Table 2 gives details of soil type, dates of sowing and intervals to spray applications, assessments and harvest. Experiment 1 was resown after pre-emergence treatments had been applied, as dry seedbed conditions resulted in very poor beet establishment. These crops were grown to fulfil the processors' requirements, that is, to produce maximum beet yields in a 6 to 9 cm size range. Graded seed was precision drilled in four-row plots 6 m long and approximately 1.7 m wide. Herbicides were applied in a spray volume of 350 litres/ha using a propane sprayer. No spray compatibility problem was encountered when it was required to mix the commercial formulations of ethofumesate (20% ec) and phenmedipham (16.7% ec).

Assessment was by weed counts (taking random quadrats covering 1 to 2 m²/treatment), weed 'ground cover' scores and beet yields from two centre plot rows. The occurrence of the desired problem weeds varied considerably from site to site but where results are presented it can be assumed that the density of the species lay in the range 50 to 150/m².

Crops — Herbicides

TABLE 1: DETAILS OF TREATMENTS
Herbicide rates in kg/ha

Treatment No.	Crop pre-emergence	Crop post-emergence
0	—	—
1	ethofumesate 1	—
2	ethofumesate 2	—
3	ethofumesate 3	—
4	—	ethofumesate 1
5	—	ethofumesate 2
6	—	phenmedipham 1
7	—	ethofumesate 1 + phenmedipham 1
1a*	ethofumesate 1	ethofumesate 1 + lenacil 0.8
8a*	ethofumesate 1	ethofumesate 2 + phenmedipham 1
8	ethofumesate 1	phenmedipham 1
9	ethofumesate 2	phenmedipham 1

* Experiment 1 only

TABLE 2: OPERATIONAL DETAILS

Expt.	Location and Soil type	Date Sown	Pre-em Spray	Weed Counts	Post-em Spray	Weed Scores	Harvest
			No. of days after sowing				
1	Levin, silt loam	23.11.73	42 before*	23 before*	24	35	83
2	Hastings, Pakipaki clay loam	15.10.73	2	—	39	60	94
3	Hastings, Kaiapo clay loam	17.10.73	1	36	22	59	98
4	Hastings, Twyford sandy loam	13.10.73	5	26	27	40	102

* Experiment re-sown after pre-em spray applications; figures refer to second sowing.

RESULTS

Results for the most frequently occurring species, redroot (*Amaranthus hybridus* and *A. retroflexus*) black nightshade (*Solanum nigrum* complex) and fathen (*Chenopodium album* agg) are given in Fig. 1.

Ethofumesate at 2 and 3 kg/ha was very active against redroot in Experiment 3, especially when applied before emergence. Although dry, the seedbed here was fine and firm. In Experiment 2, under dry and cobbly seedbed conditions, best results were obtained from the post-emergence treatments and in Experiment 4, although early pre-emergence results looked promising, none of the treatments gave long-lasting control of redroot.

In Experiments 3 and 4 black nightshade was most effectively controlled by post-emergence treatments, especially the mixture of ethofumesate 1 kg/ha plus phenmedipham 1 kg/ha. A pre-emergence application of ethofumesate 2 kg/ha followed post-emergence by phenmedipham 1 kg/ha was also successful. In Experiment 1 similar combinations and mixtures of the two herbicides, also ethofumesate plus lenacil, gave the best control of black nightshade.

FIG. 1: Effect of treatments on weed density and ground cover

Crops — Herbicides

Fathen occurred in Experiments 1 and 2 and was controlled by post-emergence treatments. Best results were obtained from mixtures and combination treatments which included phenmedipham.

Information gained on the susceptibility of other weeds to pre-emergence applications of ethofumesate showed spurrey (*Spergula arvensis*) to be very susceptible, a speedwell (*Veronica* sp.) and another nightshade (probably *S. sarrachoides*) moderately susceptible and willow weed (*Polygonum persicaria*) moderately resistant.

Since yield differences between the various treatments were small and possibly composed of inseparable chemical and weed competition effects they are not presented here. There was no tendency for ethofumesate at 2 kg/ha either pre- or post-emergence to reduce yields. High yields were also obtained from ethofumesate and phenmedipham combinations.

DISCUSSION

This work confirms that ethofumesate, with its activity against redroot, black nightshade and fathen, is a useful addition to the existing range of beet herbicides.

It gave variable results as a pre-emergence treatment where seedbed conditions were less than ideal but where good conditions existed control of redroot was most successful. Post-emergence applications gave more consistent results, providing a reasonable control of all three major weeds. Generally, however, combination treatments, either pre- followed by post-emergence, or post-emergence mixtures, gave the best overall result and as a wide spectrum prescription the mixture ethofumesate 1 kg/ha plus phenmedipham 1 kg/ha can be picked out as the most successful treatment.

Crop safety seemed to be satisfactory but in this kind of trial small yield depressions caused by the herbicide could go undetected when compounded with weed competition.

Further work should be carried out to investigate crop tolerance at various growth stages in the absence of weeds, especially if the higher rates of ethofumesate (i.e. 2 to 3 kg/ha) are to be considered. A glasshouse experiment (Cox, 1974) suggests that large differences in ethofumesate activity could occur on different soil types. As well as showing that generalisations should not be made regarding use as a soil applied herbicide, these differences suggest that soil activity should also be investigated from the point of view of persistence and possible dangers to following crops.

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