A NEW POST-EMERGENCE HERBICIDE FOR BEETS

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Summary

Results are presented of field trials for post-emergence weed control in beets using phenmedipham alone, and in various combinations, in comparison with pyrazon. Evaluated under a wide range of soil and climatic conditions, phenmedipham alone at rates of 0.75 to 4 lb/acre generally gave superior broadleaf weed control to pyrazon at 4 lb/acre, with a high degree of crop selectivity. Some weed species showed tolerance to phenmedipham but addition of 2,2-DPA at 2 lb/acre in some cases improved the spectrum of weed control. From a field survey, the performance of phenmedipham under farmer usage was similar to that obtained in the trials.

INTRODUCTION

Up to 4,000 acres of fodder beet and mangolds are grown in New Zealand annually. While not a crop of great national importance, high yields of nutritive feed make beets a useful and economic crop, even on small areas of one to two acres. The main beet-growing areas of New Zealand are found in the cooler dairy farming districts such as Southland, South Otago, South Canterbury, Canterbury and Manawatu. The beet varieties grown in New Zealand originated from the wild sea beet, first discovered on coastal regions of Europe. Fodder beet is a cross between the sugar beet and mangold, combining the high palatability, food value, and dry matter characteristics of sugar beet, with the high root yield of the mangold (Davies, 1961). The added characteristic of the mangold in forming most of the root above ground is also inherited in fodder beet, making harvesting and feeding-off easier and more complete.

The high return possible from beet crops apparently justifies the considerable expense involved in hand-thinning and weeding which is carried out on small areas. Because of their slow initial growth, crops of the beet family are very sensitive to early weed competition (Thompson, 1966). With the advent of precision drilling and the planting of larger individual acreages, the need for a broad spectrum post-emergence herbicide has become even more important. A common weed control treatment in the past has been the application of sodium nitrate or sodium chloride as a post-emergent spray. The sodium chloride treatment is still practised by some farmers, but in recent years band spraying of pyrazon, pre-emergence or early post-emergence, has been the main chemical control treatment. In 1968, phenmedipham, a substituted carbamate, was commercially released in New Zealand as a selective post-emergent treatment for annual broadleaf weeds in beets. This paper presents results of trials conducted during the 1968-9 season and observations on the results of farmer usage.

EXPERIMENTAL

Replicated small plot broadcast applications were made with an Oxford Precision sprayer applying 30 to 60 gal/acre of water to 1/400 acre plots (15 ft 6 in. $\times$ 7 ft) at 30 lb/sq. in. and 3 mph. All application rates are expressed in lb a.i./acre. Sowings which were made in 20 in. to 21 in. spaced ridges were later than usual because of the wet spring weather, which resulted in an uneven germination of crops, often accompanied by an uneven weed germination. After treatment, some co-operators carried out hand-thinning and up to three inter-row cultivations of the trial areas in accordance with normal farm practice. The number of cultivations was governed by the extent of the top growth of the crop and the weed infestation present.

Visual weed control evaluations were carried out by at least two independent observers, up to three months from treatment date, using a 0 to 10 rating scale, 0 indicating no control, 10 indicating complete weed control.

In Trials 1 and 2 only, pyrazon was applied with a nonionic surfactant (0.25%). At harvest, 5 ft of the centre two rows from each plot were pulled, counted and weighed. The bulbs were separated from the tops, weighed and recorded separately.

In the analysis of yield data, only mangold bulb weights are recorded. The total plant weight of the fodder beet trials was recorded, all yields being expressed in tons fresh weight per acre.

RESULTS AND DISCUSSION

WEED CONTROL

Trial 1: Fodder beet — Newbury, Manawatu (heavy alluvial clay)

At treatment on December 10, 1968, the fodder beet was at an early cotyledonary stage with the weeds just emerged. An evaluation made after 4 weeks showed that phenmedipham alone and with 2,2-DPA or pyrazon had given very adequate control of the weeds, which were predominantly fathen (*Chenopodium album*) and black nightshade (*Solanum nigrum*). In comparison, marginal control was obtained with pyrazon alone (Table 1). In the untreated plots, inter-row cultivation had not given adequate weed control.

TABLE 1: WEED CONTROL EVALUATIONS FOR MANGOLDS AND FODDER BEET

Treatment (lb)	Trial No.									
	1		2		3			4		5
	4		2		Weeks after Treatment			4		10
phenmedipham 0.75		—	—	—	—	—	7.4	6.4	—	—
phenmedipham 1.0		7.8	2.4	5.1	0.8	—	—	2.1	—	—
phenmedipham 1.5		8.1	—	—	—	8.0	5.9	—	—	—
phenmedipham 2.0		—	5.4	6.2	1.2	8.3	7.7	4.9	6.9	4.0
phenmedipham 4.0		—	7.1	8.1	2.7	—	—	7.1	—	—
phenmedipham 1/ 2,2-DPA 2		7.4	6.8	8.6	5.5	—	—	5.6	—	—
phenmedipham 1/ pyrazon 2		8.5	6.3	6.8	3.6	—	—	4.9	6.0	3.2
pyrazon 4.0		4.6	2.8	4.5	1.1	3.8	1.8	0.3	0.7	0
unsprayed control		2.4	0	0.3	0	3.6	0	0	0	0

Trial 2: Mangolds — Woodville, South Hawke's Bay (heavy clay loam)

Applications were made on December 10, 1968 to mangolds in the advanced 2-leaf stage, with a dense even weed stand of willow weed (*Polygonum persicaria*), fathen and black nightshade all in the 1- to 4-true-leaf stage. Weed control evaluations at 2, 4 and 14 weeks after treatment are presented in Table 1. After 2 and 4 weeks, the weed control ratings clearly demonstrated the additive effect of 2,2-DPA or pyrazon in combination with phenmedipham, especially on willow weed. Phenmedipham 1 lb plus 2,2-DPA 2 lb was as effective as phenmedipham at 4 lb. After 14 weeks, in the absence of any inter-row cultivation, the crop had become infested with the second weed germination, all treatments being insufficiently residual to control late emerging weeds.

Trial 3: Fodder beet var. Korsroe — South Taranaki (Egmont volcanic loam)

At treatment on December 20, 1968, the fodder beet was at the 4- to 6-true-leaf stage. There was a medium infestation present of a wide variety of broadleaf weeds including willow weed, fathen, black nightshade, red-root (*Amaranthus hybridus*) and twin cress (*Coronopus didymus*), all in the 3- to 6-leaf stage and up to 3 in. in height. One inter-row cultivation had already been carried out prior to treatment. An evaluation 4 weeks after treatment showed that phenmedipham at rates up to 2 lb had given commercially acceptable weed control. Pyrazon alone showed little effect compared with the untreated control (Table 1).

Trial 4: Mangolds — Stanway, Manawatu (clay loam)

The rather uneven germination of mangolds present at treatment (December 11, 1968) was in the cotyledonary to advanced 2-leaf stage. The weeds consisted predominantly of spurrey (*Spergula arvensis*) with some chickweed (*Stellaria media*) already up to 5 in. in height, forming a dense competitive cover with the crop.

After 10 days, an evaluation of knockdown of spurrey was made. Phenmedipham at 4 lb gave acceptable knockdown, while the mixture of phenmedipham 1 lb with 2,2-DPA and with pyrazon improved weed control markedly over phenmedipham 1 lb alone.

Trial 5: Mangolds — Waikuku, North Canterbury (alluvial silt loam)

Applications were made on November 2, 1968 to mangolds in the late cotyledonary to early 2-true leaf stage of growth. The weed population was mainly nettle-leaved fathen (*Chenopodium murale*) and wild turnip (*Brassica campestris*) with 2 to 3 true leaves. An evaluation after 10 weeks showed that only phenmedipham alone and in mixture with pyrazon had given any weed control. Results from pyrazon 4 lb could not be distinguished from those in untreated control plots.

CROP YIELDS

Trial 3

With this late treatment, any increase in yield over untreated control would appear to have been due to the level of weed control obtained (Tables 1 and 2). Phenmedipham at 2 lb significantly increased beet yield compared with pyrazon at 4 lb and the untreated control.

Trial 4

Yield increases were undoubtedly a direct result of those treatments which controlled spurrey and allowed crop survival. Beet was virtually absent in the control plots. All phenmedipham treatments except pyrazon alone gave a significant increase in yield over the untreated control. The addition of 2 lb 2,2-DPA to 1 lb of phenmedipham did not significantly reduce crop yield (Table 2).

Trial 5

Phenmedipham alone and in mixture with pyrazon gave a significant increase in yield compared with pyrazon alone (Table 2).

Trial 6: Fodder beet — Waiukuku, North Canterbury (alluvial silt loam)

Fodder beet was in the advanced 4- to 6-leaf stage at treatment on December 13, 1968. Hand-weeding and thinning was carried out by the co-operator two days after treatment, so that a tolerance trial evolved. No visual differences in crop tolerance appeared, and subsequent yield data indicated no significant difference between the hand-weeded control and phenmedipham 2 lb (Table 2).

TABLE 2: YIELD RESULTS OF TRIALS ON MANGOLDS AND FODDER BEET

Treatment (lb)	Trial No.			
	3+	4	5	6*
phenmedipham 0.75	74.1 ab	—	—	—
phenmedipham 1.0	—	4.0 c	—	44.6 a
phenmedipham 1.5	65.9 ab	—	—	52.0 a
phenmedipham 2.0	80.4 a	5.7 bc	43.1 a	46.3 a
phenmedipham 4.0	—	12.2 a	—	—
phenmedipham 1/ 2,2-DPA 2	—	9.2 ab	—	—
phenmedipham 1/ pyrazon 2	—	8.5 ab	41.0 a	—
pyrazon 4.0	53.8 b	1.8 cd	3.4 b	—
Unsprayed control	51.1 b	0 d	0.6 b	49.9 a
CV	23.3%	40.4%	36.7%	19.7%

+ plus inter-row cultivation within one week.

* plus hand-weeding within one week.

FIELD PERFORMANCE

A survey of farmers to evaluate the field performance of phenmedipham in beets has shown a wide level of acceptance for phenmedipham applied at 1.5 lb. A lack of residual activity, and only limited control of certain weeds such as redroot (*Polygonum aviculare*), wireweed, willow weed and black nightshade was observed.

Red Beet

Field use of phenmedipham 1.5 lb on red beet in Hawke's Bay gave satisfactory broadleaf weed control with the exception of redroot. Where phenmedipham treatment is made at the late cotyledonary stage of the crop under cool, slow growth conditions, temporary crop suppression may occur.

Silver Beet

Phenmedipham when applied at rates up to 3 lb under moist, fertile soil conditions, has shown adequate selectivity to this garden variety of beet, therefore, when used up to the recommended rate of 1.5 lb.

WEED SUSCEPTIBILITY TO PHENMEDIPHAM

General observations in New Zealand have shown some broadleaf weeds to be tolerant to phenmedipham. These species require a very early stage treatment to obtain any practical degree of weed control. These observations are confirmed by overseas trials (Laufersweiler, 1969; Holmes, 1969). Weeds commonly found in beet in New Zealand are recorded in Fig. 1 with species listed in approximate order of susceptibility to 1.5 lb phenmedipham.

FIG. 1: Susceptibility of common broadleaf weeds to phenmedipham (1.5 lb/acre).

CONCLUSIONS

Phenmedipham has proved a reasonably effective weedkiller for post-emergence control of broadleaf weeds in beets. A high degree of crop selectivity has been evident under New Zealand conditions at rates up to 4 lb. Phenmedipham applied at 1.5 lb has adequately controlled many broadleaf weeds at the 2- to 4-true-leaf stage. However, certain tolerant species such as redroot, willow weed, wireweed and cornbind (*Polygonum convolvulus*) have shown tolerance for which additives to phenmedipham are necessary. The addition of 2 lb of 2,2-DPA to 1 lb of phenmedipham increased herbicidal activity to be equivalent to 2 to 4 lb phenmedipham alone on willow weed, without serious loss of crop tolerance. Where the

mixture is applied to beets at the cotyledonary stage, some initial crop retardation may occur. Addition of pyrazon 2 lb to phenmedipham 1 lb may improve the degree and spectrum of control of certain species. No increase in residual control of weeds could be observed by the addition of pyrazon 2 lb. Further evaluation of phenmedipham mixtures with other herbicides is required.

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