WEED CONTROL IN SUGAR BEET

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SUMMARY

Several herbicides and their combinations were tested for weed control in sugar beet (*Beta vulgaris*) over two years in Hamilton, Reporoa and Gisborne. Cycloate was found to be an effective herbicide for the initial weed control in all trials. Lenacil was not as active on the weeds present and also damaged the crop. Ethofumesate, phenmedipham/desmedipham, metamitron and chloridazon were all effective follow-up treatments depending on the weed spectrum, weather conditions and growth stage of the crop and weeds. Alloxym-sodium and fluzifop-butyl were effective against the grass weeds encountered at some trial sites.

INTRODUCTION

Effective control of weeds is of critical importance to successful production of sugar beet as the young seedlings are particularly sensitive to competition from weeds. A large number of selective herbicides are available for use in this crop (MAFF 1979, USDA 1980) and the choice would depend on the weed spectrum, soil type, weather conditions and the crop following in the rotation. For successful weed control one would have to rely on a correct 'programme' of chemicals involving sequential herbicide applications and/or herbicide mixtures (Mitchell 1978, Schweizer 1980).

Some weed control trials in beets have been carried out in New Zealand in the past by Cox (1969), Dunn (1971) and Meeklah (1966). However, because of the interest in growing beet for ethanol production and because sugar beet had not been grown previously to any great extent in the area, the present work was initiated to establish a satisfactory herbicide programme for control of weeds in this crop in the Waikato, Central Plateau and Gisborne regions.

MATERIALS AND METHODS

Seven trials were conducted over two growing seasons between 1980 and 1982. The locations and some aspects of the trial sites are given in Table 1. Trial sites 3 and 4 were out of pasture while the others had previously been under a crop.

Sugar beet seed (cv. Vytomo in 1980 and Monoire in 1981) were planted in 50 cm rows with a Nodet precision seeder at 116-200 000 seeds/ha. The herbicides used and timing of their application are listed in Table 2. These were applied in 350 litres/ha of water at 210 kPa with a hand held precision sprayer. Cycloate was incorporated to a depth of 7-10 cm with a rotary hoe in all trials except Trial 4 where discs were used in two directions.

In 1980 (Table 3) the trials were of a split-plot design with non-randomised sub-plot treatments while in 1981 (Table 4) the trials were simple randomised blocks. Individual plots were 4-10 m long and 2-4 m wide and all treatments were replicated four times.

Throughout the growing season assessments were made at regular intervals of the weed control achieved and the beet vigour. Beet populations were recorded by counting plants in the middle two rows during December and at harvest time. Data on dry matter weights of weeds were collected by harvesting duplicate 0.1 m² samples from each plot. Bulb yields at the end of the season were measured by harvesting 5-12 m² of each plot and washing and drying the bulbs.

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TABLE 1: Details of trial sites.

Trial No.	Trial location	Soil type	pH	Organic C (%)	Planting date
1	Hamilton	Ohaupo silt loam	5.7	6.2	29.9.80
2	Hamilton	Horotiu sandy loam	6.0	9.6	26.9.80
3	Reporoa	Tokiaminga peaty silt loam	5.0	16.2	1.10.80
4	Gisborne	Matawhero heavy silt loam	6.0	3.8	10.9.81
5	Reporoa	Taupo silt loam	5.9	5.5	15.10.81
6	Hamilton	Hamilton clay loam	5.5	5.2	20.10.81
7	Hamilton	Horotiu sandy loam	5.6	9.5	17.9.81

TABLE 2: Chemicals used, their abbreviations and rates.

Time of application	Chemical	Abbrev.	Rate (kg/ha)
PPSI	cycloate		6.0
Pre-em	propham/chlorpropham/fenuron	PCF	1.43/0.33/0.28
	metamitron	meta	5.5
	chloridazon	chlor	5.0
	lenacil		2.0
Post-em broadleaf (1-2 true leaves)	phenmedipham/desmedipham*	phen/des	0.23/0.23
	phenmedipham/desmedipham	phen/des	0.46/0.46
	ethofumesate	etho	2.0
	metamitron/oil**	meta/oil	4.2/2.0
	chloridazon	chlor	3.2
	lenacil		2.0
Post-em grass (2-6 true leaves)	alloxydim-sodium/oil	allox/oil	2.0/4.0
	diclofop-methyl	diclofop	2.0
	fluazifop-butyl/wetter	fluaz	1.0/0.3%
	2,2-DPA		3.0

* when used as a split application or with ethofumesate the lower rate was applied at each application.

** when used as a tank mix with ethofumesate no oil was added.

RESULTS AND DISCUSSION

The weed spectrum varied considerably between districts and this is reflected in the level of weed control achieved by the various treatments.

At Gisborne (Trial 4) the main weeds were fathen (*Chenopodium album*), redroot (*Amaranthus powellii*) and black nightshade (*Solanum nigrum*) while at Reporoa (Trials 3 and 5) the principal weed was willow weed (*Polygonum persicaria*). At Hamilton all these broadleaf weeds were encountered, along with twincrest (*Coronopus didymus*) and the warm-zone grasses viz. summer grass (*Digitaria sanguinalis*), smooth witchgrass (*Panicum dichotomiflorum*) and crowfoot grass (*Eleusine indica*).

Table 3 shows the 16 best treatment combinations from the 1980 trials. Cycloate was found to be the best among the main-plot treatments. PCF was generally poor as it did not control willow weed or the warm-zone grasses. Lenacil likewise did not give control of redroot, a predominant weed of most trials, and was also poor on the warm-zone grasses. In addition, lenacil adversely affected crop emergence resulting in significantly reduced populations in all trials (Table 3). Among the sub-plot treatments phenmedipham/desmedipham + ethofumesate provided the best weed control

although most treatments involving phenmedipham/desmedipham were adequate. In combination with cycloate, post-emergence application of chloridazon or metamitron also resulted in good weed control, but pre-emergence use of these two chemicals gave poor results.

TABLE 3: Results from the 16 best treatments of the 1980 trials.

Treatment	Sub	Trial 1			Trial 2			Trial 3
		Weeds	Beet	Bulb	Weeds	Beet	Bulb	Weeds
Main		15.1.81	12.2.81	12.2.81	18.12.80	22.6.81	22.6.81	6.1.81
cycloate	phen/des + phen/des	1330	54.4	5.4	25	55.4	11.5	120
cycloate	phen/des + phen/des/etho	170	53.4	9.1	0	61.0	13.4	0
cycloate	phen/des + phen/des/chlor	1410	55.9	8.0	5	61.0	12.7	130
cycloate	phen/des + phen/des/diclofop	2490	52.9	4.7	30	54.7	9.3	20
cycloate	chlor*	3500	60.0	3.3	105	46.0	8.1	2110
cycloate	chlor/etho	1140	47.5	5.1	5	51.0	10.9	90
cycloate	chlor/2,2-DPA	3250	59.4	4.3	30	45.0	8.2	220
cycloate	meta*	3300	50.4	4.2	85	74.4	11.2	910
cycloate	meta/oil	2070	52.3	6.7	10	43.2	11.1	150
PCF	phen/des + phen/des	1420	66.0	5.9	1300	48.8	7.5	1410
PCF	phen/des + phen/des/etho	910	62.9	9.6	55	47.9	11.0	210
PCF	phen/des + phen/des/chlor	1530	75.0	7.5	40	56.6	9.1	700
lenacil	phen/des + phen/des/etho	430	41.5	8.5	75	16.0	4.1	280
lenacil	phen/des + phen/des/chlor	1080	45.4	6.8	145	19.4	3.9	110
untreated	phen/des + phen/des/etho	1130	61.7	8.9	240	45.4	9.2	400
untreated	phen/des + phen/des/chlor	2640	72.9	7.2	130	47.9	8.3	1090
LSD 5%		2210	28.0	3.2	300	20.1	3.3	610
CV%		72	44	49	111	55	62	97

*pre-em; + different applications; / tank mixes

Weeds = DM (kg/ha); Beet = pop ('000s/ha); Bulb = DM (t/ha)

For the 1981 season, the best of previous years' treatments were retained and others modified and new combinations included (Table 4). As in the previous season, cycloate, phenmedipham/desmedipham, and ethofumesate gave very good weed control with the result that any treatment involving one or more of these chemicals was usually superior to other combinations. Exceptions to this were PCF plus ethofumesate in which the PCF failed to give adequate initial weed control in all trials. In addition several treatments involving cycloate failed to control the heavy infestations of willow weed at Reporoa (Trial 5). As in 1980 chloridazon and metamitron gave better weed control when applied post-emergence as opposed to pre-emergence but neither of them controlled a sufficiently wide range of broadleaf weeds. Thus, when used alone or in combination with post-emergence grass weed herbicides, the overall weed control was very poor (Table 4).

The chemicals diclofop-methyl, alloxym-sodium and fluzifop-butyl were included specifically to control the warm-zone grasses in Trials 6 and 7. At Reporoa (Trial 5) however, these chemicals were used, despite the absence of grass weeds, to determine their effect on the crop. Visual observations showed no effect on the beet plants, but no yield data were obtained due to dense infestations of willow weed in these plots. At Hamilton alloxym-sodium and fluzifop-butyl were more effective than diclofop-methyl (Trial 6) but did not give adequate residual control and if canopy cover was not complete then a new infestation of grasses soon appeared (Trial 7).

Dry matter yields of sugar beet bulbs were determined in five of the seven trials and all the data showed trends similar to those reported in Tables 3 and 4. There was a highly significant correlation between beet yield and weed dry matter, which is evident from Table 4 although not so obvious in Table 3 where only the best 16 of 48 treatments are reported. With the exception of lenacil, as previously noted, the decrease in beet production can be attributed to an increase in the amount of weeds present. Although

occasional symptoms of chemical damage e.g. crinkling of the leaves with cycloate and leaf burning with phenmedipham/desmedipham and with metatriton/oil were noted, the visual signs disappeared quickly and many of these treatments resulted in the highest yields.

TABLE 4: Results from the 16 best treatments of the 1981 trials.

Treatment	Trial 4		Trial 5	Trial 6	Trial 7
	Score 12.12.81	Bulb 20.4.82	Weeds 22.1.82	Weeds 9.12.81	Weeds 11.12.81
cycloate + phen/des + phen/des	0	24.3	400	10	60
cycloate + phen/des	0	23.0	4240	80	10
cycloate + phen/des/lenacil	0	25.2	730	10	10
cycloate + phen/des/etho	0	23.4	220	0	270
cycloate + etho	0	23.9	3190	0	220
cycloate + chlor	2.2	20.2	3640	110	400
cycloate + meta/oil	1.2	21.3	2010	100	20
PCF + etho	4.4	13.0	1340	710	930
meta* + etho	1.6	19.3	260	400	560
chlor* + etho	3.2	15.9	3710	560	1230
chlor/etho	3.8	13.7	3880	570	1340
phen/des + phen/des/etho	0	21.8	1660	610	360
meta/etho	1.6	19.5	100	230	1130
meta/oil + diclofop	-	-	4720	310	1480
meta/oil + allox/oil	-	-	2970	10	1960
meta/oil + fluaz	-	-	4750	20	780
LSD 5%	1.1	3.1	2260	245	600
CV%	36	12	71	79	82

*pre-em; + different applications; / tank mixes

Score = weed score 0 = complete weed control, 10 = no control;

Weeds = DM (kg/ha); Bulb = DM (t/ha)

These results are in agreement with much of the overseas information where cycloate is used as a basic treatment, and where ethofumesate, phenmedipham/desmedipham, metatriton and chloridazon have given good results as complementary herbicides (MAFF 1979, Schweizer 1979, 1980). In the South Island J.H.B. Butler (unpublished data) also found that metatriton and chloridazon gave better results when applied post-emergence as opposed to pre-emergence. However cycloate did not prove as effective and the damage from lenacil was not as severe as in the trials reported here.

The data from these trials suggest that good initial control of weeds can be achieved with cycloate. This can then be followed with ethofumesate, phenmedipham/desmedipham, metatriton or chloridazon depending on the weeds present, weather conditions and the growth stage of the crop and the weeds. While successful weed control was achieved with a number of herbicide combinations, considerable difficulty was experienced in establishing the crop in several locations due to disease, insect and nematode problems.

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