Relation of Sugar-Beet Root Maggot Control by Insecticides to Sugar Beet Yield[1]

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Several insecticides have been applied to the soil or seed to control the sugar-beet root maggot, *Tetanops myopaeformis* (Roed.). Jones et al. (5)[4] reported that sugar beet yields were increased by a broadcast application of aldrin, dieldrin, or heptachlor mixed with fertilizer. Callenbach et al. (1) and Gojmerac (3) obtained similar results in North Dakota, when these insecticides were sprayed on fertilizer which was drilled in with the seed. They found that, at high rates of insecticides, the formulations were phytotoxic but careful thinning reduced differences in beet stand to a great extent.

Seed treatments of aldrin at ½ pound and heptachlor at ¼ pound respectively, applied dry per 100 pounds of seed were found effective by Jones et al. (5). But Callenbach et al. (1) found these insecticides were not effective unless the seed was pelleted (2) with wettable powders, to give one pound of toxicant per 100 pounds of seed.

This paper reports tests on sugar-beet root maggot control made in the light soil area near Altona, Manitoba, in 1957. The methods of formulation and application of the insecticides are considered in relation to larval control, beet stand, and size and yield of beets.

Methods and Materials

For soil treatments, insecticide-impregnated fertilizer, and insecticide-fertilizer mixtures were formulated to contain 1.25 percent toxicant. The following formulations were used. Those prepared to specification by Chipman Chemical Company, Winnipeg, Manitoba, contained the following ingredients in pounds:

Heptachlor-impregnated fertilizer: technical heptachlor (72%), 1.40; heavy aromatic naphtha, 1.40; fertilizer 77.20.

Aldrin-impregnated fertilizer: technical aldrin (95%), 1.04; heavy aromatic naphtha, 1.04; urea, 1.60; fertilizer, 76.32.

Heptachlor (9% granular)-fertilizer mixture: technical heptachlor (72%) 1.40, heavy aromatic naphtha 2.08, Velsicol deactivator H. 0.62, attaclay (8/15), 7.16; fertilizer 68.74.

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[4] Numbers in parentheses refer to literature cited.

Aldrin (10% granular)-fertilizer mixture: technical aldrin (95%) 1.06, heavy aromatic naphtha 1.06, urea 0.38, attaclay (8/15), 7.50; fertilizer 70.0.

Heptachlor-impregnated fertilizer (commercial formulation) was prepared by Consolidated Mining and Smelting Company, Trail, British Columbia.

For seed treatments 40 percent heptachlor, aldrin, and dieldrin on attaclay was applied to seed to give one pound of toxicant per 100 pounds of seed. Each pound of seed was mixed with the required amount of powder and 10.0 ml. of 1.0 percent Methocel until all the power was taken up.

Plots were arranged in randomized blocks replicated eight times; each plot consisted of four 60-foot rows and guard rows were provided. Kleinwanzleben-N seed, treated with Captan, was sown on each plot at 6.0 pounds per acre and fertilizer (11-48-0) was applied at 80 pounds per acre. They were applied together on May 24, with an International four-row beet drill fitted with a V-belt metering device calibrated for precise delivery.

The seedling stand on each plot was estimated by counting the number of beet-containing inches in 200 inches of row on June 20, the day before thinning. Phytotoxicity was calculated by comparison with the untreated plots. The stand was evaluated again on July 5, to establish the uniformity after thinning. At harvest, the number of beets in 100 feet of row was recorded.

The larval infestations were estimated from the plots in four blocks in mid-September by counting the larvae in 6 soil samples, 8 by 8 and 16 inches deep, per plot. Each sample was taken from an outside row, from the soil directly beneath beets.

The yield and number of large and small beets were determined on September 30. The mean weights and standard errors for large and small beets were 1.61 ± 0.03 and 0.68 ± 0.02 lb., respectively. Two 50-foot lengths from the central rows were harvested from six blocks. Beets were washed before weighing. Percentage sugar was determined by the Manitoba Sugar Company.

The data on beet stand, number of larvae, yield, and beet size were examined by analysis of variance and the multiple range test (Duncan (4)).

Results and Discussion

In 1957, abundant rainfall throughout the growing season influenced the type of plant injury caused by the sugar-beet root maggot. Rainfall was 14.7 inches from May 1 to September

30 compared to a normal of 11.5 inches. The larvae did not kill seedling beets or cause wilting during the growing season but affected the size of beets.

The distribution of the egg deposit was observed June 29 and July 6, by examining throughout the plots 50 and 200 plants, respectively. Egg clutches were found in the soil adjacent to 68 and 84 percent of these plants. Adult emergence had begun by June 22, and flies were abundant June 29.

Table 1 shows that seedling stands were reduced on all treated plots in comparison to the untreated ones, the multiple range test showing this to be significant at the 1 percent level. The commercial heptachlor impregnated fertilizer was the most phytotoxic formulation, and caused a 60 percent reduction of seedlings. There was no significant difference in phytotoxicity between heptachlor and aldrin applied as impregnated fertilizers or as granulars mixed with fertilizer; these formulations were prepared with the same solvent. The seed treatments were significantly less phytotoxic than the soil treatments and the insecticides used gave similar seedling losses.

Uniform thinning removed to a large extent the differences in stand (Table 1). There was no significant difference in the average number of beets per plot at harvest.

Table 1.—Effects of Insecticides, Formulations, and Method of Application on Stand of Sugar Beets at Altona, Manitoba, 1957.

Insecticide[1]	Beet Stand Inches[2] Before Thinning	After Thinning	Percentage Phytotoxicity	Mean Number of Plants per 100 Foot of Row at Harvest
		Impregnated Fertilizer		
Heptachlor (Commercial)	23.5	14.5	60.0	79.8
Heptachlor	35.7	16.0	39.0	81.1
Aldrin	38.1	16.0	34.8	83.5
		Granular Insecticide Plus Fertilizer		
Heptachlor	29.5	15.5	49.5	77.5
Aldrin	37.6	18.9	35.6	82.2
		Seed Treatment		
Heptachlor	46.1	18.2	20.5	88.3
Aldrin	45.1	19.0	22.5	88.8
Dieldrin	47.5	17.4	18.5	91.8
Untreated fertilizer	58.5	18.6	.....	81.0

[1] One pound of toxicant per acre for soil treatment, one pound per 100 pounds of seed for seed treatment.

[2] Average number of beet-containing inches in 200 inches of row.

Table 2 shows that the insecticide-fertilizer treatments reduced the number of the sugar-beet root maggot by 50 to 80 percent. The heptachlor-fertilizer treatments were not shown to be more effective than the aldrin-fertilizer treatments, nor were the numbers of maggots in the seed treated plots significantly different from the untreated plots. However, there appeared to be an association between the number of larvae found in mid-September and yield. Furthermore, the differences in mean yield appeared to depend on the percentages of large beets produced, for all the treatments that gave significant increases in the size of beets also gave significant increases in yield. This association is definite for the heptachlor and aldrin fertilizer treatments at 1.0 pound of toxicant per acre that reduced larvae by 59 to 80 percent. The heptachlor seed treatment similarly increased yield but the 35 percent reduction in the number of larvae in comparison to the untreated plots was not significant. However, such differences could not be shown with the small number of samples taken per plot. It was estimated that four times as many samples per plot would probably be required to determine means within 10 percent with a confidence interval of 95 percent.

Sugar content of the beets from treated and untreated plots was not significantly different.

Table 2.—Effects of Insecticides, Formulations, and Method of Application on Number of Larvae, Size of Beets and Yield at Altona, Manitoba, 1957.

Insecticide[1]	Reduction in Number of Larvae[2], Percentage	Percentage of Beets Large	Mean Root Yield per Acre (Tons)
Impregnated Fertilizer			
Heptachlor (Commercial)	80.0*	59.7*	12.8*
Heptachlor	70.0*	62.1*	12.4*
Aldrin	50.0*	57.9*	12.0*
Granular Insecticide Plus Fertilizer			
Heptachlor	68.5*	60.2*	12.2*
Aldrin	53.0*	48.9	10.6
Seed Treatment			
Heptachlor	35.0	55.5*	12.7*
Aldrin	12.5	45.6	11.1
Dieldrin	0.0	37.7	10.1
Untreated fertilizer		44.0	9.9

[1] One pound of toxicant per acre for soil treatment, one pound per 100 pounds of seed for seed treatment.

[2] 20.0 larvae per plant in untreated plots.

*Differences significant from untreated plots at 5 percent level.

The results suggest that, under conditions of adequate soil moisture, heptachlor or aldrin applied with fertilizer at one pound of toxicant per acre may cause a 35 to 60 percent reduction in seedling stand, which may not affect the stand of beets at harvest. It is remarkable that, although root maggots caused negligible loss of stand, a 60 to 80 percent reduction in their number resulted in an increase in yield of 2 to 3 tons per acre, by favoring the production of large beets.

Summary

At Altona, Manitoba, tests were completed in 1957 on sugar-beet root maggot control. Soil moisture was adequate during the growing season and the maggots did not cause loss of stand.

1. Sugar beet yields were increased by 2 to 3 tons per acre after application of heptachlor or aldrin fertilizer mixtures that contained one pound of toxicant per acre.

2. Sugar beet yields were not increased by aldrin and dieldrin seed treatments, although a heptachlor seed treatment increased yield. The insecticides were applied at one pound of toxicant per 100 pounds of seed.

3. Seedling stand was reduced significantly by all treatments but thinning removed the differences in stand.

4. The number of root maggots per plant was significantly reduced by heptachlor or aldrin fertilizer mixtures but not by heptachlor, aldrin or dieldrin seed treatments.

5. The reduction of the number of root maggots was shown to be associated with an increase in beet size and yield; but sugar content was not affected.

Literature Cited

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