Sugar Beet Root Maggot

One Year's Trials in Red River Valley Show That Chemical Control is Feasible

By W. L. Gojmerac[1] and J. A. Callenbach[2]

The sugar beet root maggot, *Tetanops myopaeformis* (von Röder), has received considerable attention in North Dakota the last few years. It was estimated that this insect had caused approximately $150,000 damage in the Red River Valley of North Dakota in 1954, the damage being restricted primarily to the lighter soil areas north of Grafton. In 1955 it was estimated that it caused $95,000 damage in an area covering approximately 3000 acres in Walsh and Pembina Counties; no estimate of the damage was made in other areas where damage has also been observed.

The sugar beet root maggot is probably a native insect, its natural hosts being pigweed and lamb's-quarters. In North Dakota maggots have been found from central Traill County to the Canadian border; it has also been found on the Minnesota side of the river. Very few or no maggots are found in the very heavy soil in Cass County and along the Red River.

The sugar beet root maggot is the larval stage of a fly. The fly, which is about the size of a housefly, can be found in the sugar beet fields during June. These flies lay eggs in the soil at the base of sugar beet plants. After the eggs hatch, the maggots (or larvae) feed on the roots of the sugar beet plants. As the maggots grow and soil moisture recedes from the soil surface they move downward. If enough roots are severed and the weather is hot and dry, the beet will die. If a beet does survive the maggot attack, it will be smaller in size or deformed. The maggots remain in the soil until the following spring when they move toward the surface, pupate, and emerge as flies.

Adult Fly Control

Preliminary observations and reports of other workers suggested several means of control. It has been reported that there is a pre-oviposition period of approximately 10 days. It seemed possible that if a field were sprayed with a residual insecticide during this period the majority of the flies would be killed, thereby reducing infestation and damage.

Three fields, selected in areas where root maggot damage has been rather severe in past years, were divided into plots and sprayed with a series of insecticides. The insecticides were applied at the rate of 15 gallons per acre at 400 pounds pressure. The nozzles were adjusted so that the entire surface area of the plots was covered with insecticide. In several plots molasses was added as an attractant to encourage feeding on the spray deposit.

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[1]Assistant Entomologist. [2]Entomologist.

Effectiveness of the spray treatments was evaluated by stand counts. The total number of beets in four 50-foot rows near the center of each plot was counted. Five such counts were selected in each plot. Thus, counts were obtained from twenty 50-foot rows or 1000 feet of row in each plot. In most cases two replicates were used. Results of these experiments are summarized in tabular form below.

TABLE I.—**Stand count and percentage of small beets (average of two replicates).**

Treatment	Johnson Field		L. Haug Field		Kingsbury Field	
	Stand Count	% Small Beets	Stand Count	% Small Beets	Stand Count	% Small Beets
Aldrin ½ lb./acre	382	42	449	36	498	33
Aldrin ½ lb./acre and ½ gal. molasses	—	—	358	20	548	24
Endrin .4 lb./acre	344	39	414	26	536	24
Endrin .4 lb./acre and ½ gal. molasses	—	—	452	42	549	24
Heptachlor ½ lb./acre	370	30	394	15	528	31
AC 528 ½ lb./acre*	354	28	402	24	569	24
3911 ½ lb./acre**	—	—	—	—	542	15
Dieldrin ½ lb./acre	383	25	381	13	522	30
Check	351	26	384	14	543	15

*AC 528—An experimental insecticide furnished by Hercules Powder Co.
**3911—An experimental insecticide furnished by American Cyanamid Co.

The above data show that control by this method was unsuccessful. The total number of beets in 1000 feet of row was not significantly higher in the sprayed areas than in the unsprayed checks. While there is considerable variation between plots, some of this can be attributed to the large size of the plots and variations within the field. It was noted that stand counts were higher in the lower areas of the field than in the higher, well-drained regions of the same field. The per cent of small plants per plot was calculated because of the large variation in stand counts in the total number of beets. It can be noted that the percentage of small beets is also not significantly different between the sprayed and unsprayed plots. No yield data were obtained from these plots as it was felt that the time and cost of obtaining such information was not warranted.

Seed Treatment

Seed treated with insecticides has been used to protect certain crops from insect damage. This type of treatment, if successful, would be economical and all seed could be treated prior to delivery to the grower, thus assuring 100 per cent participation in the control program.

Aldrin, dieldrin, heptachlor, lindane, DDT, 3911, 12008[3], and AC 528 were used in this experiment. All insecticides were applied at ½ and ¾ pound per 100 pounds seed except DDT which was

[3]Another experimental insecticide supplied by American Cyanamid Co.

applied at rates of ½ and 1 pound. All insecticides were in the wettable powder form. Both Phygon-treated and untreated seed were used.

Germination and emergence did not appear to be affected by treating seed with insecticides. However, rows planted with Phygon-treated seed had higher stand counts than did the untreated rows.

After the beets were thinned, the total number of beets in each row was checked and all dead or dying beets were removed at weekly intervals. The remaining beets were counted on August 1, since maggot damage was completed by this date, and these numbers were used as a basis for a partial evaluation of results.

Although a great variation was observed in the number of beets lost, insecticides placed on the seeds did not protect the beets from maggots. There were as many dead or dying beets in rows treated with insecticides as in the untreated rows. As many as 21 per cent of the beets were lost in some of the plots after blocking and thinning.

Yield data also indicated seed treatments were of no value in protecting the beets from maggot damage. The weight of beets obtained from rows treated with insecticides was no greater than in untreated rows.

Insecticide-Fertilizer Mixtures

Insecticide mixed with fertilizer and applied in the rows with the seed is another possible method of controlling the sugar beet root maggot. This type of insect control would be practical since it requires no additional equipment or labor on the part of the farmer.

FIGURE 1.—*The field in the top picture illustrates the severe damage caused by the sugar beet root maggot. The field in the bottom picture had one pound of aldrin per acre mixed with fertilizer. Both pictures were taken the same day. Fields were approximately one mile apart.*

Experimental plots were established on four farms where, in previous years, the sugar beet root maggot was a serious problem. Three insecticides were selected for this particular experiment. Aldrin and heptachlor were in 25 per cent granular form. Ten per cent granules and 50 per cent wettable powder dieldrin were also used. The rates of application are stated in tabular form together with results (Table II).

Each treatment consisted of six rows. Treatments were replicated four times on each of four farms. Phygon-treated seed from the same seed lot was used throughout this experiment.

Effect of insecticides on germination was evaluated by stand counts. The number of beets was counted in three 100-inch portions of row. The 100 inches of row is a standard unit of measurement employed by the American Crystal Sugar Company in evaluating emergence and stand counts in their research. Emergence data were obtained on three of the four experimental plots. These data are summarized in Table II.

TABLE II.—**Stand counts on fertilizer-insecticide mixture plots to control root maggot (summary of all plots).**

Treatment	Initial Stand Count	Stand Count After Thinning	Stand Count August 1
Aldrin 1 lb./acre	1002	673	665
Aldrin 2 lbs./acre	1043	659	653
Heptachlor 1 lb./acre	1229	676	669
Heptachlor 2 lbs./acre	1123	648	642
Dieldrin 1 lb./acre	1094	677	671
Dieldrin 2 lbs./acre	1028	665	654
Dieldrin 2 lbs./acre w.p.	1206	701	686
Check	1496	689	633

These data show there are fewer beets in the rows treated with insecticides than in the check, so it is possible that these insecticides are phytotoxic or in some way affect germination, emergence, or survival. It can also be noted that stand counts are higher in the heptachlor plots than in the aldrin and dieldrin plots. Dieldrin as a wettable powder resulted in a higher stand count than the granular form. Even though there was a reduction in initial stand counts, the beet stand was still satisfactory provided the beets were properly thinned.

After the beets were thinned, the total number of beets was counted in three 95-foot rows. At weekly intervals the fields were checked and all dead and dying beets were removed. Beets remaining on August 1 were counted. Since little or no damage is done by the maggots after late July, these data indicate sugar beets were protected from root maggots in rows where insecticides were mixed with fertilizer.

Further evidence is provided by harvest data. Beets from two adjacent 50-foot rows in each treatment were collected and weighed. Three plots were harvested with mechanical beet harvesters. This method of harvesting is not too accurate when harvesting small

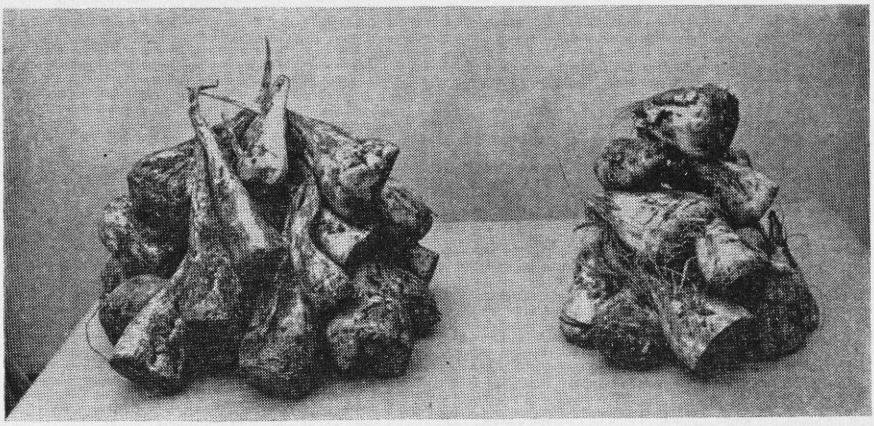

FIGURE 2.—*Beets on left were grown in rows where an insecticide was mixed with fertilizer; beets on right were grown in rows not treated with insecticide. Both groups were taken from a comparable length of row. Note the increase in number of beets and the long roots.*

plots as occasionally a beet or two is lost due to breakage of the beet or failure of the machine to pick up all beets. For this reason one plot was harvested by hand. The tops were removed from the beets by the same individual to insure greater accuracy in yield data. The data from this plot are summarized below in Table III. It can be noted that the increase in yield was nearly 100 per cent in some replicates.

TABLE III.—**Weight of beets obtained from two 50-foot rows harvested by hand (Johnson farm).**

Treatment	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Total
Aldrin 1 lb./acre	86	88.5	97	84.5	356
Aldrin 2 lbs./acre	96	100	95.5	83	374.5
Heptachlor 1 lb./acre	113	100	88.5	92.5	394
Heptachlor 2 lbs./acre	101	103	93.5	89	386.5
Dieldrin 1 lb./acre	73	56.5	97.5	74.5	301.5
Dieldrin 2 lbs./acre	89.5	89.5	93	91	363
Dieldrin 2 lbs./acre w.p	115	101.5	84.5	83	384
Check	62	58.5	60	58	238.5

The differences in yield obtained from the various treatments are not great. Apparently all insecticides in this test killed maggots. When yields from all farms are totaled (Table IV) there seems to be a greater increase in yield in the plots treated with heptachlor, and dieldrin as a wettable powder appears to produce a higher yield than does the granular formulation.

Beets from the plots were selected for residue analysis. Results showed no insecticide was recovered from the roots or foliage at harvest time. Sugar analysis performed by American Crystal Sugar Company laboratories indicated no significant change in sugar content.

TABLE IV.—**Total weights from all replicates.**

Treatment	Ebert	O. Haug	L. Haug	Johnson	Total	Tons/Acre
Aldrin 1 lb./acre	425	417.5	410.5	356	1609	13
Aldrin 2 lbs./acre	499	433	353	374.5	1659.5	13.1
Heptachlor 1 lb./acre	546	403	519	394	1862	15
Heptachlor 2 lbs./acre	564	392	442	386.5	1784.5	14.5
Dieldrin 1 lb./acre	467.5	452	403	301.5	1624	13.1
Dieldrin 2 lbs./acre	460	417	419.5	363	1659.5	13.1
Dieldrin 2 lbs./acre w.p.	486	488.5	416.5	384	1775	14.5
Check	391.5	407.5	405	238.5	1442.5	11.8

Insecticides mixed with fertilizer would seem to provide an economical means of insect control since no additional equipment or labor is required. The estimated cost of insecticide is approximately $2.00 to $2.50 per acre. These data have shown that a two to four tons per acre increase in yield can be obtained by using insecticides mixed with fertilizer in areas where damage is relatively severe. If beets brought $12.75 per ton, $25.50 to $51.00 additional income might be realized at an expenditure of $2.00 to $2.50 **per acre** by the sugar beet grower.

Summary and Conclusions

It must be emphasized that results reported here are based upon one year's work. Future studies must verify these data before valid conclusions can be drawn. However, a few tentative conclusions can be suggested:

1. Serious damage from the sugar beet root maggot occurs. Stand reductions and yield losses of two to four tons per acre were recorded.

2. Aldrin, dieldrin, and heptachlor mixed with fertilizer and applied at the rates of one and two pounds per acre gave marked increases in yield. Greatest increases were obtained with heptachlor in the first year's trials. Tentatively, all three materials at one pound per acre are recommended.

3. Aldrin, dieldrin, and heptachlor mixed with fertilizer caused some reduction in initial stands. However, when beets were properly thinned, near normal stands resulted.

4. Sugar content did not seem to be seriously affected by the application of insecticides.

5. No residues of aldrin or dieldrin were recovered from beet foliage or roots. Tests at other stations have revealed the same for heptachlor.

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