The Sugar Beet Root Maggot in North Dakota[1]

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The sugar beet root maggot, *Tetanops myopaeformis* (von Roder), has become a pest of beets in the Red River Valley of North Dakota. It is known to be present from the Canadian border south to Hillsboro in Traill County. However, economic damage appears to be limited to the lighter soil areas with the more severely damaged fields in southern Pembina and northern Walsh Counties.

Biology

Jones, et al. (1)[3] summarized the known history of the insect up to 1952, described the damage, and gave the essential features of its life history as it occurs in southern Idaho.

In the Red River Valley of North Dakota adult flies emerge in June and lay their eggs in the soil around the small beet plants. Maggots attack the roots of the beets and cause the most severe damage during July. Feeding appears to be completed in early August and the maggots move away from the beets. They gradually move downward in the soil and are found at depths of 6 to 12 inches at the end of the season. Hibernation occurs in the larval stage; pupation occurs in the spring.

Many details of the biology and ecology of the insect are as yet unavailable; for example, adult emergence is subject to considerable fluctuation. In 1954 the peak of adult activity was about June 28, in 1955 about June 14. In 1955 egg laying was at its maximum when most growers were conducting thinning operations. Little is known of the effects of these cultural measures on egg-laying behavior, egg hatch, and larval survival. It seems probable that variations in these practices may have significant effects on root-maggot populations.

It appears that the insect has a compulsory diapause. All efforts to obtain pupation and emergence of adults without subjecting the larvae to cold temperatures were unsuccessful. How much cold and how long the exposure must be is unknown. Preliminary tests indicate considerable tolerance of sub-freezing temperatures. Absolute minimums or length of exposure to various sub-freezing temperatures are again unknown.

Pigweed (*Amaranthus retroflexus*) and lambsquarters (*Chenopodium album*), both common weeds, were reported as hosts by Hawley (2). Infested pigweed plants were found in North Dakota in 1955. Possibly other related plants are also acceptable hosts.

The adult fly is sometimes extremely active and difficult to catch. At other times it may reverse this behavior and almost resemble a sweat bee; at such times it will not fly unless prodded and can often be caught with the hands. The latter behavior seems associated with egg-laying activities, the former is probably associated with migration to host-plant areas. How

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[1] Published with the approval of the Director of the North Dakota Agricultural Experiment Station as a contribution from Station Project BJ-5,44.

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[3] Numbers in parentheses refer to literature cited.

far and the direction in which flight occurs has not been determined. General observations indicate the flight is random since large populations have been observed in grain and potato fields as well as sugar beet fields. Furthermore, flight may continue for distances of at least one-half mile; evidence of extremely heavy movements of one-fouth mile has been recorded.

Control

Control recommendations in western beet growing areas include regulation of soil moisture by irrigation, seed treatment, and fertilizer-insecticide mixtures applied as broadcast treatments. Since no irrigation is available, this measure is not applicable to beet culture in the Red River Valley. Seed treatment with lindane is used for wireworm culture but few data on its effectiveness for root-maggot control are available. Broadcast applications of fertilizer are not the usual procedure; instead, the fertilizer (only phosphate is used) is drilled directly into the row with the seed.

Hawley (2) reported that the fly has a pre-oviposition period of about ten days. It is theoretically possible then, to control the pest by killing the adults before egg laying begins. In 1954 preliminary experiments in North Dakota gave some evidence of reduced damage where sprays were applied to control the adults.

Upon the basis of this rather fragmentary information, the 1955 experimental control plots were developed. Control was attempted by means of seed treatments, insecticide-fertilizer mixtures applied with the seed, and by spraying to kill the adult flies.

Am 3N seed from the same seed lot was used in all seed treatment and fertilizer-insecticide mixture plots. Commercial fields were utilized for adult control plots; consequently, the seed source varied.

Seed Treatments

If successful, seed treatment would be a simple and inexpensive method of control. Seed could be treated prior to delivery insuring complete participation of growers making the cost very low.

Plots were placed on four farms in the area around Auburn, North Dakota. Randomized single-row 100-foot plots were replicated four times on each farm. The rows were marked with a standard-type beet drill and 0-46-0 fertilizer was applied at the rate of 100 pounds per acre in the rows at time of marking. The treated seed was then planted with Planet Junior hand seeders at the rate of 5 pounds per acre. The following materials were used: 75 percent aldrin, 75 percent dieldrin, 75 percent heptachlor, 75 percent lindane, 50 percent American Cyanamid 12008, 50 percent American Cyanamid 3911, and 25 percent Hercules AC 528. All materials were wettable powders and were applied at rates of .5 pound and .75 pound actual insecticide per 100 pounds of seed. DDT 50 percent wettable powder was applied at rates of .5 pound and 1 pound actual per 100 pounds of seed. Insecticides were applied to seed previously treated with Phygon and to untreated seed. Checks with Phygon treatment and no treatment were included in the tests.

Emergence of beets was recorded by counting three 100-inch portions of each row. Any phytotoxic effects of treatments would be evident from these counts. After thinning, the beets remaining in each 100-foot row were

counted. On August 1, all rows were again counted to determine the reduction in stand resulting from maggot attacks. At harvest, yields were taken from a 50-foot portion of each row.

No significant differences in original stand or in after-thinning stand were recorded. Likewise, yield data showed no increase of treated over untreated rows.

Adult Fly Control

Randomized plots 275 feet long and 204 feet wide (117 rows with 20-inch spacings) replicated two times on each of three farms in the Auburn area were sprayed at about the peak of fly activity. Sprays were applied at the rate of 15 gallons per acre using 400 pounds pressure. Nozzles were located approximately over the rows but the boom was adjusted so the entire surface area of the plots was covered with spray.

Aldrin, dieldrin, heptachlor, and Hercules AC 528 at .5 pound per acre, and endrin at .4 pound per acre were the insecticides used. Checks were left in all plot areas. In addition to the above, one-half gallon of beet molasses added as an attractant to aldrin and endrin sprays was applied to plots on two farms and one plot was sprayed with American Cyanamid 3911 at .5 pound per acre.

Effectiveness of the spray treatments was evaluated by counting the number of beets remaining in representative portions of the row after maggot damage was completed. For this purpose five sample areas near the center of each plot were selected. Each sample area was four rows wide and 50 feet long; thus counts were made from 1000 feet of row in each plot. While many dead flies were seen on the ground following spray applications, the stand counts showed no increase in sprayed over unsprayed plots; likewise, there was no decrease in the percent of stunted plants in the treated plots. Stunted plants are those which have recovered after maggot attack. No yield data were taken.

Insecticide-Fertilizer Mixtures

Conforming with the standard practice of fertilizer application in the area, an 0-46-0 fertilizer was used with applications calibrated at approximately 100 pounds per acre. Except for the dieldrin wettable powder, insecticides were obtained as 30-60 mesh granular formulations. Aldrin and heptachlor were 25 percent materials and dieldrin was a 10 percent formulation. In the plots where dieldrin was used in wettable powder form, a 50 percent wettable powder was used. Fertilizer and insecticide were mixed together in a cement mixer. Some differences in bulk resulted from the use of different percentage formulations and different types of materials, but the variations are not believed to be significant.

Randomized plots six rows wide and 100 feet long, replicated four times, were planted on four farms. Phygon-treated seed was used in all plots. Table 1 gives the materials used and rates of application. Stand counts were recorded by making three 100-inch counts per plot. After thinning, counts were made in three 95-foot rows in each plot and on August 1, the same rows were recounted. Yields were taken from two 50-foot portions of row in each plot. On three farms the plots were mechanically harvested and on the fourth farm they were harvested by hand.

Table 1.—Fertilizer - Insecticide Mixtures for Control of Sugar Beet Root Maggot. Summary of Data From Four Farms, Auburn, North Dakota, 1955.

Treatment	Total Initial Stand	Total Stand After Thinning	Total Stand August 1	Yield Per Acre (tons)
Aldrin 1 lb./A	1002	673	665	13.08
Aldrin 2 lbs./A	1043	659	653	13.53
Heptachlor 1 lb./A	1229	676	669	15.29
Heptachlor 2 lbs./A	1123	648	642	14.62
Dieldrin 1 lb./A	1094	677	671	13.21
Dieldrin 2 lbs./A	1028	665	654	14.93
Dieldrin w.p. 2 lbs./A	1206	701	686	14.53
Check	1496	689	633	11.83

Table 1 records initial stand, stand after thinning, stand on August 1, and yield in tons per acre for all treatments on all farms.

It should be noted that the initial stand in all treatments was less than the check. This was true for all treatments on all farms and indicates a phytotoxic effect from the treatments. By careful thinning these differences were to a great extent eliminated.

Data show increased yields from the use of all fertilizer-insecticide mixtures. Since they represent one year's data only, and because some error was observed in the mechanically harvested plots, the increases and differences between treatments may not be significant.

Figure 1 shows typical examples of untreated plots and plots treated with insecticide-fertilizer mixtures.

Figure 1.—Effects of fertilizer-insecticide treatments. Beets in left hand picture treated with fertilizer-insecticide mixtures. Beets in right hand picture untreated. Pictures taken in same field on same day.

Figure 2 shows differences in yield recorded from a 50-foot row sample of a treated plot as compared to a check plot.

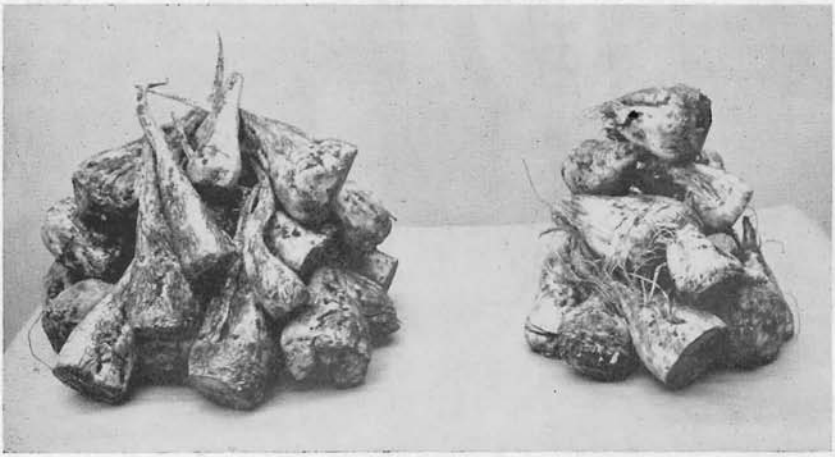

Figure 2.—Beet samples from rows treated with insecticide-fertilizer mixture, and fertilizer only. Treated row on left, check on right.

Note not only the difference in the number of beets, but their size and conformation. Beets from the treated plot have long tap roots; beets in the check are short and stubby, the tap roots having been severed by the maggots. Larger size of beets in the check is due to thinning of the stand by the maggot. Short, stubby beets are poorly anchored in the soil and may be pulled out when the beets are topped. This was observed to cause some loss due to failure of the digger to recover these displaced beets.

Sugar content of beets from treated and untreated plots was not significantly different although a slightly higher content was found in beets from treated plots.

Summary

The sugar beet root maggot is a major problem in sugar beet production on the lighter soils of the Red River Valley of North Dakota.

While the general pattern of the seasonal history of the maggot is known, many details of its biology and ecology are as yet unavailable.

Extensive control experiments demonstrated that seed treatments and control of adult flies were ineffective, but fertilizer-insecticide mixtures gave encouraging results. Since the data are from one year's investigations only, definite conclusions cannot be drawn. However, heptachlor, aldrin, and dieldrin at 1 pound per acre mixed with 0-46-0 fertilizer and drilled into the rows with the seed appear to offer promise.

References

(1) JONES, E. W., DOUGLASS, J. R., PARRISH, C. P. and JENSEN, VERNAL. 1952. Experiments on control of the sugar beet root maggot. Proc. Amer. Soc. Sugar Beet Tech. pp. 490-496.

(2) HAWLEY, I. M. 1922. The sugar-beet root maggot (*Tetanops aldrichi* Hendel), a new pest of sugar beets. Jour. Econ. Ent. 15 (6) :388-391.