# WIREWORM CONTROL ON SWEET CORN IN ORGANIC SOILS [1]

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The southern potato wireworm, *Conoderus falli* Lane, and the corn wireworm, *Melanotus communis* (Gyllenhal), are important vegetable crop pests in organic soils of the Everglades. Sweet corn is one of the crops most susceptible to damage by either of these wireworms. The southern potato wireworm has developed resistance to chlorinated hydrocarbon insecticides in Florida (Workman 1963) and in South Carolina (Reid and Cuthbert 1956). However, it is usually adequately controlled by any one of several phosphatic insecticides. The corn wireworm has been the more difficult species to control in the organic soils of the Everglades. Soil insect control is usually more difficult in organic soils than in mineral soils.

Wireworm control research in the Everglades was intensified in 1961 after many growers reported inadequate control with recommended practices. Several insecticides were compared. Insecticide baits were evaluated in applications made before planting sweet corn and in applications made after corn plants had emerged from the soil.

## EXPERIMENTAL PROCEDURE

All insecticide materials were broadcast on the soil surface. Those applied before planting were disked-in to a depth of about 6 inches immediately after application. Materials applied after seeding emergence were immediately scratched-in to a depth of 2 or 3 inches.

Treatments were evaluated for effect on wireworm populations by taking 2.75 inch diameter soil cores to a depth of 4 to 6 inches. Each core was taken so as to contain the crown of a single corn plant. In Test 1, wireworms were separated from the soil cores with Berlese funnels. It was later found that wireworms could be detected more effectively by spreading the soil sample thinly on a flat surface. Treatments were also evaluated by counts of stand and dead or wilted plants.

## PRE-PLANTING BROADCAST APPLICATIONS

TEST 1: Aldrin 25% granules and 5% Kepone (decachlorooctahydro-1, 3,4-metheno-2H-cyclobuta (cd) pentalene-2-one) cornmeal bait were applied at 5 pounds of actual toxicant per acre. Aldrin at 4 pounds and chlordane at 6.5 pounds were applied in 80 gallons of emulsion per acre. All insecticides were broadcast on 25 October 1961 to 50 by 15 foot plots. On 8 November 1961, each plot was planted to four 40-foot rows of Florigold sweet corn leaving a five-foot buffer at the ends and a three-foot buffer at the sides of the plots. There were six randomized complete blocks.

On 14 and 24 November, 5, 12, 18, and 29 December 1961, and 11, 19, and 26 January 1962, two soil cores were taken from each of the two middle rows of each plot. The number of southern potato wireworms per 100 plants and the average stand for each treatment on 5 December

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1961, are shown in Table 1. Corn wireworms were too scarce to make comparisons.

TABLE 1.—EFFECTS OF PRE-PLANTING BROADCAST INSECTICIDE SOIL TREATMENTS ON WIREWORM POPULATIONS AND CORN STANDS.

| | | Wireworms per 100 plants | | | | |
|---|---|---|---|---|---|---|
| | | Southern potato wireworms | | Corn wire-worms | Stand (thousands of plants per acre) | |
| Insecticide Treatment | Lb. actual toxicant per acre | Test 1 | Test 2 | Test 2 | Test 1 | Test 2 |
| Diazinon Bait | 5 | — | 0.8 | 4.2 | — | 28.0 |
| Kepone Bait | 5 | 1.4 | 0 | 7.5 | 31.0 | 28.2 |
| Diazinon Spray | 4 | — | 0 | 10.0 | — | 28.1 |
| Kepone Spray | 4 | — | 0 | 16.7 | — | 27.9 |
| Diazinon Granules | 5 | — | 0 | 8.3 | — | 27.6 |
| Aldrin Spray | 4 | 4.2 | 5.0 | 10.0 | 27.4 | 27.6 |
| Aldrin Granules | 5 | 4.2 | — | — | 25.5 | — |
| Diazinon-Aldrin Spray | 2 * | — | 0 | 14.2 | — | 26.4 |
| Chlordane Spray | 6.5 | 15.1 | — | — | 25.2 | — |
| Untreated | | 8.3 | 1.7 | 20.0 | 24.6 | 27.0 |

* Each.

Significantly fewer southern potato wireworms were present in treated than in untreated plots. Chlordane plots contained more southern potato wireworms than the untreated plots and highly significantly more than plots treated with other insecticides. There were significantly fewer southern potato wireworms in 5% Kepone cornmeal bait plots than in plots treated with aldrin. Although Kepone bait plots contained considerably more plants than the other plots, treatments did not differ significantly in respect to stand. During most of the season the plants in Kepone bait plots were taller and more uniform in size than those in plots treated otherwise.

TEST 2: Kepone 4% cornmeal bait, 5% diazinon corn grits bait, and 5% diazinon walnut shell granules were broadcast at 5 pounds of actual toxicant per acre. Applications of 80 gallons per acre were made of emulsions of Kepone, diazinon, and aldrin at 4 pounds of actual toxicant per acre and a mixture of 2 pounds each of aldrin and diazinon per acre. Insecticides were applied broadcast and disked-in on 4 October 1963, one week before planting. The field was then rolled.

Treatments and the untreated check were replicated four times in a Randomized Complete Block design. Each 12 by 30 foot plot was planted to four 20-foot rows of Florigold 107 sweet corn 11 October 1963.

Ten soil cores from each plot were examined for wireworms on 23 October 1963; 20 soil cores per plot were examined 20 November 1963. The numbers of wireworms per 100 plants for each treatment are shown in Table 1. Although only a very few southern potato wireworms were collected, it could be seen that aldrin was ineffective against this species. There were significantly fewer corn wireworms in treated plots than in untreated plots. The solid formulations resulted in significantly fewer corn wireworms than the emulsions. The two baits seemed to be more effective than the other treatments.

On 11 October 1963, stand counts showed no significant differences among treatments (Table 1). U. S. Fancy sweet corn yields did not differ significantly among the treatments on 13 January 1964.

### PRE-PLANTING AND POST--MERGENCE BROADCAST APPLICATIONS

Diazinon 5% corn grits bait, 4% Kepone cornmeal bait, 5% diazinon walnut shell granules, and 10% parathion clay granules were compared. Pre-planting, post-emergence, and pre-planting plus post-emergence applications were compared for the two baits. Granules were applied only before planting. At each application 5 pounds of actual toxicant per acre were applied. Thus, plots that received both pre-planting and post-emergence applications were treated with a total of 10 pounds of actual toxicant per acre.

Pre-planting applications were made on 16 January 1964, to plots that were 30 feet long and 12 feet wide. Each plot was planted to four 20-foot rows of Florigold 107 sweet corn 30 January 1964. Post-emergence applications were made 19 February 1964. Dead and wilted plants indicated that wireworms were active at this time.

Plots were sampled for wireworms by taking 10 soil cores per plot on each observation date. Observations before the post-emergence applications were made 10, 13, and 17 February. Those taken after post-emergence applications were on 20 and 25 February, 6 March, and 3 April. As very few southern potato wireworms were taken, only corn wireworms per 100 plants are shown in Table 2. Stand counts were made 12 February and 20 March and are shown in Table 2. Stands on 12 February were adjusted for the number of plants removed for wireworm counts from 13 February through 12 March.

Before post-emergence applications no significant differences among insecticide treatments resulted from wireworm counts; treated plots contained significantly fewer wireworms than untreated plots. Observations made after post-emergence applications indicated that the baits were significantly more effective than the granules in reducing corn wireworm populations. An analysis covering wireworm counts made both before and after post-emergence applications indicated that there were significantly fewer corn wireworms in treated plots than in untreated ones, highly significantly fewer wireworms in baited plots than in granule-treated plots, and significantly fewer corn wireworms in plots than had been baited before planting than in those plots that were baited only after seeding emergence. Wireworm counts indicated no advantage in following a pre-planting bait application with a post-emergence application. In the period following their application, post-emergence baits resulted in significantly fewer corn wireworms than the untreated check.

On both 12 February and 20 March, treated plots contained significantly more plants than untreated plots. However, any conclusion is dampened by the observation that post-emergence bait plots, as yet untreated on

TABLE 2.—EFFECTS OF PRE-PLANTING AND POST-EMERGENCE BROADCAST SOIL INSECTICIDE APPLICATIONS.

| Insecticide formulation* | Time of Application | Corn wireworms per 100 plants relative to time of post-emergence applics. | | | Stand (Thousands of plants per acre) | | Percent dead or wilted plants |
|---|---|---|---|---|---|---|---|
| | | Before | After | Average | 12 Feb. | 20 Mar. | |
| Diazinon Bait | Pre-Planting | 3.3 | 0.8 | 1.9 | 21.3 | 20.3 | 0 |
| Diazinon Bait | Post-Emergence | 7.8 | 3.3 | 5.2 | 23.2 | 21.7 | 1.7 |
| Diazinon Bait | Both | 0 | 1.7 | 1.0 | 20.1 | 19.6 | 0.6 |
| Kepone Bait | Pre-Planting | 1.1 | 1.7 | 1.4 | 26.5 | 25.5 | 0.5 |
| Kepone Bait | Post-Emergence | 6.7 | 5.8 | 6.2 | 21.2 | 17.5 | 3.4 |
| Kepone Bait | Both | 3.3 | 1.7 | 2.4 | 23.1 | 21.3 | 0.6 |
| Parathion Granules | Pre-Planting | 3.3 | 9.2 | 6.7 | 22.6 | 21.2 | 1.7 |
| Diazinon Granules | Pre-Planting | 6.7 | 9.2 | 8.1 | 24.1 | 20.9 | 5.7 |
| Untreated | —— | 8.9 | 7.5 | 8.1 | 16.5 | 13.9 | 13.9 |

* Each material applied at 5 lbs. actual toxicant per acre on each application date.

12 February, were more nearly equal to previously treated plots than to the plots that remained untreated during the experiment. A much better test was a Chi-Square analysis for percent stand loss between 12 February and 20 March. The percent loss was highly significantly less in treated than in untreated plots, in plots baited before planting than in plots baited only after seedling emergence, and in diazinon-baited plots than in Kepone-baited plots. Parathion granules resulted in significantly less stand reduction than diazinon granules.

## Discussion and Conclusions

Insecticide baits are promising for wireworm control. Inadequate chemical control of soil insects is possibly often caused by the insect's failing to contact the insecticide at the full applied dosage. With well distributed broadcast applications the soil insects may remain below the treated strata of soil until the insecticide has partially or completely lost its effectiveness. Insects are even more likely to escape insecticides that are applied in the seed furrow or unevenly distributed in broadcast applications. The proper bait should actually lure the insect to the treated area to be destroyed upon contact or by ingesting the insecticide.

Post-emergence bait applications were of some value in controlling wireworms although they were not as effective as pre-planting bait applications. However, a post-emergence bait may help if a grower has failed to get adequate control with another control measure or has not used one. Also, the results with post-emergence bait strongly suggest that soil insects may be controlled on perennial crops with baits after the residual effects of a pre-planting application have deteriorated.

Additional research is needed. More attractive baits must be sought. Insecticides must be evaluated for suitability for use in baits. It must be determined if baits are more effective in broadcast or in band applications. The insecticide bait should be a valuable tool in soil insect control, but we must learn how best to use this tool.

## Literature Cited

*Reid, W. J., Jr.*, and *F. P. Cuthbert, Jr.* 1956. Resistance of the southern potato wireworm to insecticides. J. Econ. Ent. 49: 879-880.

*Workman, R. B.* 1963. Insecticide resistance tests for the southern potato wireworms. J. Econ. Ent. 56: 419.