Chemical Control of Wireworms

By
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Can effective and economical control of wireworms be had by chemical means? Initial progress in this direction has been made by the development of soil fumigation, but its high cost seriously limited its use. Soil fumigation, while effective in destroying the worms, represented a cost of $20.00 or more per acre for materials alone, depending on the type of fumigant used. Such fumigation is considered too costly for general use.

Following the announcement in 1947 by Greenwood of the Connecticut Station and Pepper and others of the New Jersey Station of the possibilities of benzene hexachloride as a means of controlling wireworms, it was decided to include this chemical in tests being conducted by the North Dakota Agricultural Experiment Station.

Two wireworm infested fields of wheat were selected for the tests. One, a 66 acre field of wheat, 40 acres of which were destroyed outright by wireworms, owned by Wm. H. Campbell and located about 15 miles southwest of Minot. The other was a 10 acre field of wheat belonging to Robert Burt at Southam. Here the damage was restricted to the higher elevations in the field, while in the Campbell field the injury was fairly general. In both fields the wireworms were small, most of them about ¼ inch in length. They had eaten into the germinating wheat to such an extent that the crop was very thin or entirely destroyed in the areas of infestation. Specimens collected and sent to M. C. Lane were determined as the prairie Grain Wireworm, *Ludius destructor* Brown. (Figure 1)

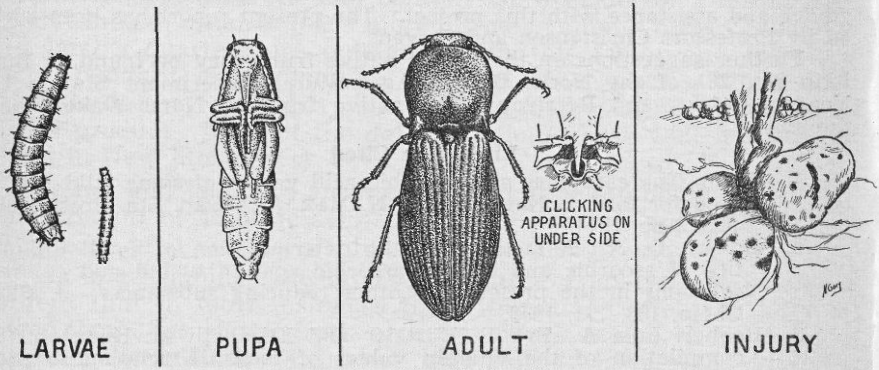

Figure 1.—Life History of Prairie Grain Wireworm *Ludius destructor* Brown.
(Courtesy N. D. State Seed Department)

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While other species of wireworms occur in North Dakota, the prairie grain wireworm is the most prevalent. The following account deals primarily with this species, although the general life history of other species is similar except the larval existence is generally shorter.

The adult, commonly known as a "click beetle" is black and about ½ inch in length. It is called a click beetle because when placed on its back, it has the ability to spring into the air with a clicking sound, and to repeat the procedure until it alights on its feet. The larva is slender, yellowish to amber in color, wire-like in appearance and may attain a length of about one inch at maturity. Damage to crops is caused entirely by the larvae. They are particularly destructive to small grains, corn and potatoes.

During spring the larvae feed on the germinating seeds which results in bare patches or thinning of the stands. They also feed on potato seed pieces which often accounts for the failure of the plants to develop. Later in the season the worms bore into the developing tubers. Some years they have damaged upwards of 15 per cent of the potato crop of North Dakota. Worm damaged tubers are reduced in market value.

The female click beetle deposits her eggs in the soil during spring. Within three weeks the eggs hatch into tiny larvae which begin feeding. These larvae develop slowly and very little feeding injury is noticeable until the second year. The larvae feed below the soil surface from three to eleven years with the majority reaching maturity in 4-5 years. During August of their last year in the larval stage, they change to a pupa or resting stage, still buried in the soil. In about three weeks they change to adults. They remain in the soil until the following spring when they emerge, mate and return to the soil to lay their eggs.

Chemicals Tested

At both the Minot and Southam locations three materials were applied:-(1) 5 per cent DDT furnished by Agricultural Supply Company, Grand Forks, North Dakota; (2) 5 per cent Chlordane (Velsicol or 1068) from Velsicol Corporation, Chicago, Illinois, furnished through the courtesy of Riverdale Chemical Company, Harvey, Illinois; (3) 10 per cent benzene hexachloride containing approximately 1 per cent gamma isomer from the J. T. Baker Chemical Company, Phillipsburg, New Jersey.

The applications were made during the period June 12-14. Each treatment was replicated three times at each place. The plots varied in size from 32x136 feet at the Minot location to 48x272 feet at Southam. Check plots of similar size separated the treated plots on the Minot field, but were not provided for on the Southam field.

The dusts were applied at the rate of 20 pounds per acre with a wheelbarrow type of duster having four discharge outlets and

powered by a Briggs-Stratton engine. On the same day the dusts were applied, the farmers cooperated by disking or harrowing the plots to a depth of about 5 inches.

Determining Wireworm Abundance

A soil auger and sifter (Figure 2) were used for taking soil samples in order to test the results of the treatments. Following the recommendation of Lane (1947) a 6-inch diameter post-hole digger was selected, because a hole one foot deep nearly fills a 10-quart pail and represents approximately ¼ cubic foot. Twenty soil samples were taken at random over each plot in order to obtain a more accurate count than is possible with fewer samples and larger volumes of soil. The soil was first sifted over an 8-mesh screen and the smaller larvae up to ½ inch were collected as they fell into a pan below. The full grown larvae did not always pass through this screen and the residual soil was placed in a hopper with 4-mesh (¼ inch) screen which readily passed the full grown wireworms. The sifting apparatus made from hollow pipes was

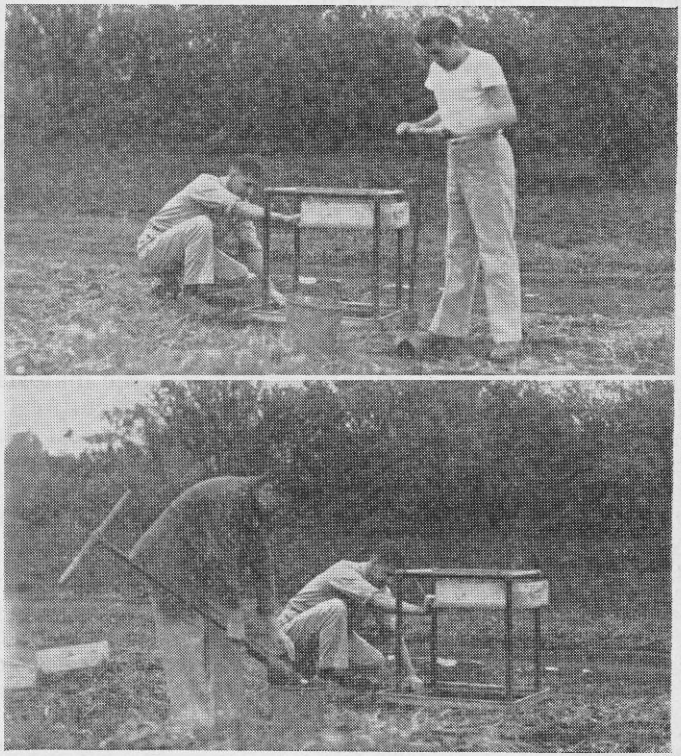

Figure 2.—Method of Soil Sampling to Determine Abundance of Wireworms.

light and easily carried to the various plots. While a field assistant brought samples of soil, another worker sifted , collected, and tabulated the wireworms.

It is easy for the farmer to learn if wireworms are present in a field and whether they are numerous enough to damage his crops. Simple homemade soil sampling equipment may be constructed for determining populations. Two frames can be made and the screen meshes held in place by pieces of lath nailed to the bottom. Instead of the sifting apparatus pictured, the soil can be sifted over a piece of canvas. After sifting through the 12-mesh screen, the residue can be dumped into the frame with the ¼ inch mesh screen.

Results of Soil Treatments

The plots were examined in early September following application of the treatments. The examination consisted of sifting 20 soil samples each ¼ cubic foot, taken with an auger, and counting all wireworms collected. The samples were collected at well distributed points from each plot and the results recorded in Table 1.

Table 1. Numbers of Wireworms from twenty ¼ cubic foot samples for each replicate.

Insecticide	Replicate 1	Replicate 2	Replicate 3	Total Number
Minot Plots:				
1. DDT 5%	18	15	28	61
2. Chlordane 5%	14	15	16	45
3. Benzene hexachloride 10% (1% gamma)	5	1	3	9
Check—no treatment	20	22	20	62
Southam Plots:				
1. DDT 5%	21	24	34	79
2. Chlordane 5%	4	22	36	62
3. Benzene hexachloride 10% (1% gamma)	0	0	2	2

A review of Table 1 shows effective control obtained only from the application of benzene hexachloride. Chlordane gave a poor degree of control and DDT was practically ineffective against the worms.

The approximate retail cost for 20 pounds of benzene hexachloride to treat one acre is $3.00 The cost of application will be additional unless a special attachment, such as used for distributing commercial fertilizer, is employed to distribute the insecticide along with routine tillage operations.

Probably the only serious question raised against the use of benzene hexachloride on land where potatoes are to be grown is, will its use harm the flavor of the tubers? This question has

arisen because of the unpleasant and persistent odor of this insecticide. Pepper and his associates (1947) report that some of the men who helped harvest their plots took samples home and reported that the flavor of the potatoes was poor. They had samples cooked under laboratory conditions and sampled by 23 persons. Five of the tasters had no preference; however, more than 50% rated one or more of the treated samples as tasting better than the checks. The cooking tests indicated that many people could not detect any change in flavor due to the treatment.

Greenwood (1947) remarks that tubers grown on Connecticut Agricultural Experiment Station plots have not taken up the odor of benzene hexachloride at concentration of 2.5 pounds of crude (0.25 pounds gamma) per acre. This amount is .5 pounds in excess of the rate per acre found effective in the North Dakota experiments.

When Control Measures Are Necessary

If no wireworms are found in 20 holes, it is safe to plant any crop. Fields showing more than one wireworm per three square feet of well spaced soil surface should not be planted to potatoes without applying soil treatment. Shirck and Lane (1946) have found that 0 to 4 wireworms per twenty holes is safe to plant late potatoes; 5 to 8 wireworms, sugar beets; 9 to 15 wireworms, beans, peas or small grains. With 20 or more wireworms in 20 test holes, severe damage may occur to any annual crop, and land should be seeded to alfalfa or be treated with soil insecticide.

Control Recommendations

Damage to annual crops of potato and wheat in wireworm infested fields may be prevented by treatment with 10% benzene hexachloride. This insecticide may be applied by mechanical dusters such as used for dusting potatoes and other crops. The dusts should be worked into the soil with a disk or harrow within twenty-four hours after the application is made. The treatment should be applied at least one month in advance of seeding or planting a susceptible crop to give the insecticide time to destroy the worms. At this cost per acre it is practical to treat small grain fields which would give adequate control of wireworms in both the current cereal crop and the following potato crop in the normal rotation.

Munro and Telford (1942) have shown that *clean* shallow summer fallow from about the middle of June until the middle of August materially reduced wireworm populations. Where potatoes were grown one or more times during a 4-year period, subsequent tuber injury was substantially *increased.* The highest wireworm populations occurred in fields planted to potatoes year after year or to potatoes alternated with small grains and sweet clover. Where summer fallow had been employed one or more times during the previous 4-year period, the subsequent wireworm injury was *reduced.*

Shirck, Lane, et al (1946) state that under Idaho conditions, red clover is one of the crops most commonly associated with the build-up of wireworm populations. Small grains, particularly barley and wheat are favorable host plants and therefore produce rapid growth of wireworms. Extreme dryness of soil is harmful to wireworms and alfalfa serves well as a soil-drying crop. Wireworms in the pupal stage are soft and easily crushed and unable to enter the soil if thrown on top. Many of them can thus be destroyed by plowing the ground in early August.

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A Method of Submitting Blood Samples for Serological Tests

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Every fall poultrymen, hunters and others interested in diseases of birds submit blood samples to laboratories for tests for the diagnosis of such diseases as pullorum disease, paratyphoid infections, and Newcastle disease. Many times these samples arrive at the laboratory in such a decomposed state that they are unfit for serological tests. The following directions are given for those desiring to submit samples for testing.

First, the person submitting samples should prepare a report giving dates, location of outbreak of disease and symptoms. Any other information that would add to the history should be