Control of Some Tobacco Pests

Circular 191

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THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN

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CONTROL OF SOME TOBACCO PESTS

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The introduction of potent new insecticides ten years ago provided excellent control of many insects on tobacco. It led to effective control of such perennial pests as wireworms, and offered promise of still more effective remedies. However, the use of these insecticides caused new problems of injury to plants and possible effects on the flavor of the crop.

The investigation of these new materials has continued, and this report supplements the information printed in Circular 179 (Turner, 1949) entitled "Control of Tobacco Insects". It covers tests and observations made during the period 1951-1954.

TOXICITY OF INSECTICIDES TO PLANTS

Tobacco is especially sensitive to some chemicals. Petroleum oil, for instance injures tobacco much more severely than it damages other plants. This sensitivity makes proper selection of pest control materials particularly important.

The usual precautions for avoiding injury to plants have been of some value. It is important that the amount applied be no larger than necessary to control the pests, and that the applications be made as uniformly as possible. Wilted plants seem to be more susceptible to injury than turgid plants, but some materials cause injury when drops of water are present on leaves. The following information has been obtained as a result of tests for toxicity to plants, or incidental to experiments to control insects.

Chlordane has been suggested for control of ants and cutworms in plant beds. When mixed with ferbam, Chlordane wettable powder was reported to injure plants Chlordane wettable powder (50%) and chlordane emulsion (48%) alone, ferbam alone, and a combination of the chlordane formulations with ferbam were tested on young plants in the plant bed. The highest dosage of chlordane wettable powder (48 pounds of actual chlordane per acre) caused slight injury from which the plants recovered. When the chlordane wettable powder was combined with ferbam, the plants were killed or injured beyond use. There was no visible injury to these plants by the chlordane emulsion (46, 92, and 184 pounds of actual chlordane per acre), either alone or combined with ferbam. It is obvious that the combination of chlordane wettable powder with ferbam increased the injury from the chlordane wettable powder (Figure 1).

Chlordane dust (10%) was applied in this plant bed to replicated plots at the rate of 1/8, 1/4, and 1/2 pounds per 100 square feet. There was no evidence of injury to the plants by this application.

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1 The assistance of A. DeCaprio, Carl Swanson, and Mrs. Nancy W. Wheeler is acknowledged with thanks. The photographs were made by B. W. McFarland.

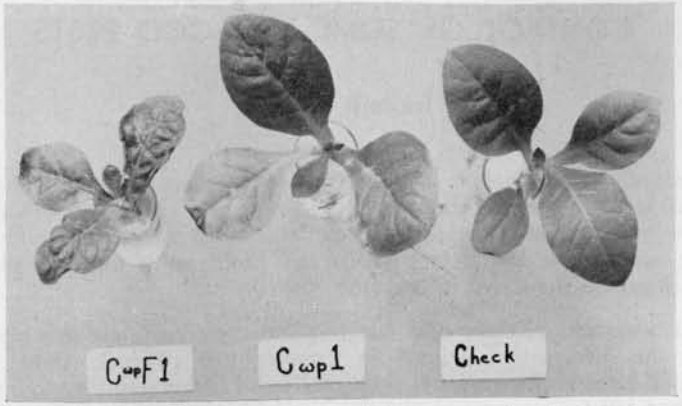

Figure 1. Phytotoxic effects on young tobacco plants of chlordane wettable powder when combined with fermate (Cwp F 1) and when used alone (Cwp 1).

In 1954, 10% chlordane dust was applied at the rate of ½, 1, and 2 pounds per 100 square feet to very young plants (two to four-leaf stage). All applications reduced the stand and retarded growth of surviving plants. In another test ¼ and ½ pounds per 100 square feet were applied in plant beds. Both dosages affected the plants. The average size of the plants 27 days after treatment is shown in Figure 2. Toxaphene dust (10%) applied at the same rates caused no injury.

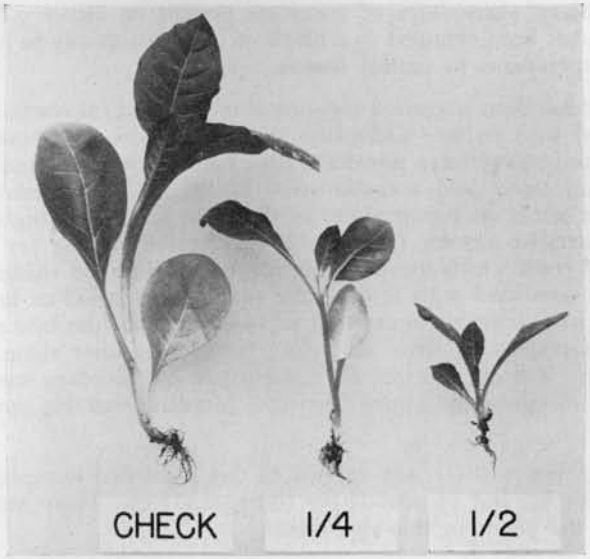

Figure 2. Average sized tobacco plants from plots dusted with chlordane 10% dust at ½ and ¼ pound per 100 square feet. Plants were treated in the 4-leaf stage.

In some circumstances growers require treatment for wireworms to be applied when the plants are set. For this purpose, 4 ounces of chlordane wettable powder has been used in 50 gallons of setter water. Growers have been interested in emulsions because they stay in suspension better than wettable powders. Some chlordane emulsions have been used successfully for this purpose.

In 1952, several emulsions were added to setter water for control of maggots. The maggot infestation did not develop, but in this test dieldrin emulsion (4, 8, and 16 ounces per 50 gallons of setter water) severely damaged the plants. It was necessary to reset all rows treated with this formulation. The dieldrin emulsion used contained a solvent which was responsible for this injury.

Dieldrin wettable powders have been used in other states in tobacco setter water without apparent injury (Allen *et al.*, 1954). Chlordane, aldrin, and lindane emulsions were used in this test without any indication of injury.

Lindane wettable powder (25%) used at the rate of 1¼ ounces in 50 gallons of setter water injured the roots of tobacco severely (Figure 3). This rate was 1½ times as high as the test with lindane emulsion mentioned in the preceding paragraph. Increase in the amount of lindane wettable powder beyond this amount increased the damage to the tobacco plant.

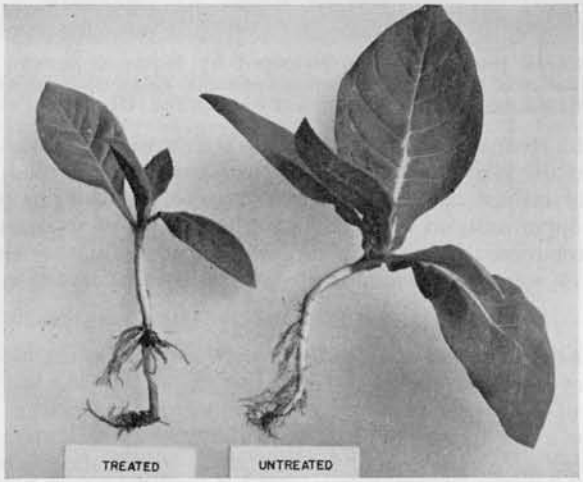

Figure 3. Effect on root development of lindane 25% wettable powder applied in the setter water as compared to plant set with untreated water.

CUTWORMS

Most species of cutworms do their damage in the spring by cutting off newly-set plants. The caterpillars either overwinter in the soil or develop from eggs laid very early in the season. In recent years, species which develop somewhat later, and cause damage by feeding on the leaves, have been troublesome (Figure 4). Another species, the black cutworm, has been very abundant and destructive on land covered by flood-water early in the spring. The moth of the black cutworm lays its eggs as the flood waters recede.

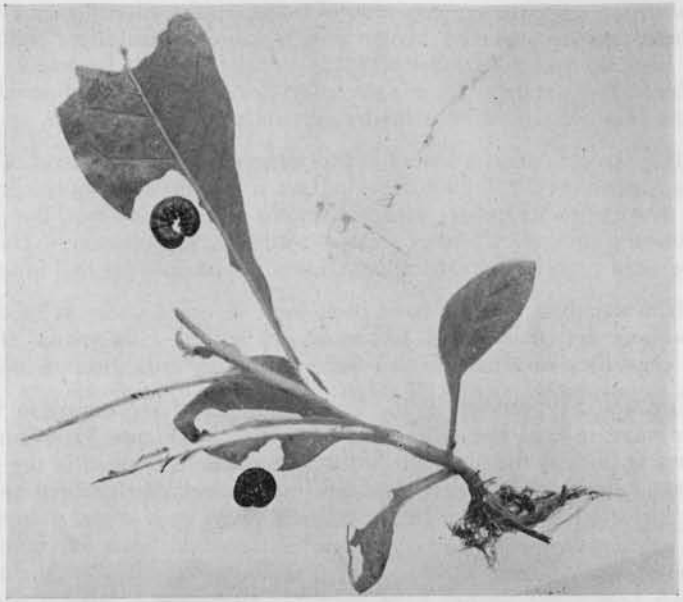

Figure 4. Tobacco plant severely damaged by cutworm larvae.. The coiled cutworms in the photo were removed from the soil at the base of this plant.

The classical control for cutworms was a bran mash bait which was applied by hand when the plants were set. This bait was mixed as used and required a great deal of manual labor. The development of the chlorinated insecticides provided an opportunity to replace this method by direct treatment of the soil or by use of commercially prepared bait. Results of preliminary tests, published in Circular 179, were encouraging enough to justify a continuation of the work.

MEASURING RESULTS OF TREATMENT

Three ways of measuring the results of cutworm treatments have been used: (1) a count of plants severed, (2) a count of plants showing leaf feeding, and (3) a count of cutworms recovered from the soil around plants. The data in Table 1 show a good correlation between the number of cutworms recovered and the number of plants severed in four plots. Correlation between number of cutworms and plants severed plus plants damaged by leaf feeding was also good. However, correlation between leaf feeding and number of cutworms was not good.

A count of total number of plants damaged seems to be reliable and has been used to measure results of treatment in most cases.

TABLE 1. COMPARISON OF PLANT DAMAGE AND NUMBERS OF CUTWORMS PRESENT IN NEWLY SET TOBACCO FIELDS

Plot number	Cutworms recovered	Plants severed	Leaf feeding	Plants damaged
1	8	9	2	11
2	14	11	10	21
3	73	85	19	104
4	50	57	23	80

TYPE OF TREATMENT

The preliminary report in Circular 179 indicated that treatment of the surface of the soil using 3 pounds of toxaphene or chlordane per acre controlled a light infestation of cutworms. The dust or spray was left undisturbed for a week, and heavy rainfall did not destroy the value of the materials. This sort of treatment poisoned the surface of the soil over which the cutworms traveled in search of food. Treatment was made a week before setting to allow time to kill the cutworms.

Tobacco growers had some difficulty in using this method. It was not always possible to make applications a week in advance, and it was sometimes necessary to re-harrow the field for planting. Some growers were concerned about loss of insecticide from the surface of the soil, and requested information on the effectiveness of treatment harrowed in immediately. The results of a dosage test with toxaphene and chlordane are given in Table 2. The insecticides were applied May 25, harrowed immediately, and the plants were set May 31. Toxaphene dust gave poor control, even when 6 pounds per acre, or twice the usual dosage, was applied. Control with chlordane was somewhat more effective.

In another test 3 pounds of toxaphene per acre was applied May 21, harrowed in immediately, and the field set May 28. Cutworm damage was severe and reduction in injury was only 13 per cent. The field was harrowed and a portion treated with toxaphene which was left undisturbed. Control was 75 per cent. Obviously toxaphene was much more effective when left on the surface.

TABLE 2. CUTWORM CONTROL BY BROADCAST APPLICATIONS HARROWED IN IMMEDIATELY AFTER TREATMENT

Formulation	Lbs. toxicant per acre	Plants damaged		Total damage	Per cent reduction in damage
		June 4 [1]	June 11		
Toxaphene 10% dust	1.5	52 [2]	26	78	46.2
	3	48	21	69	52.4
	6	47	19	66	54.4
Chlordane 10% dust	1.5	53	16	69	52.4
	3	28	9	37	74.4
	6	16	6	32	77.9
Checks		102	43	145	

1 Restocked June 5 — cutworms allowed to remain in the soil.
2 Counts of June 4 and June 11 — a total of two replicates.

INSECTICIDE-FERTILIZER MIXTURES

The possibility of adding insecticides to fertilizers was considered. This would eliminate the necessity of a special application of insecticide for cutworm

TABLE 3. INSECTICIDE-FERTILIZER MIXTURES FOR THE CONTROL OF CUTWORMS — 1951

Insecticide	Lbs. toxicant per acre	Plants damaged		Total damage	Per cent reduction in damage
		June 6 [1]	June 18		
Toxaphene	1.5	8	7	15	63.4
	3	7	7	14	65.8
	6	5	6	11	73.1
Chlordane	1.5	6	2	8	80.5
	3	5	1	6	85.3
	6	2	5	7	82.9
Checks		21	20	41	.....

1 Field restocked after first count. No effort made to destroy cutworms uncovered at time of restocking.

control. Results of a replicated test in which the insecticide was applied in the fertilizer are given in Table 3. Control was reasonably good, but the amount of restocking (240 plants per acre) was still rather high.

Tests of the possible residual effect of insecticides either harrowed in, or applied with fertilizer, showed that neither toxaphene nor chlordane persisted sufficiently to be of value.

SPRAY TREATMENTS OF PLANTS

Many growers prefer to set plants and then attempt to control cutworms. One possibility is the use of row-crop sprayers for the purpose. Tests of endrin and heptachlor, materials known to be effective against cutworms, were made in 1954. Sprays were applied at the rate of 100 gallons per acre on newly-set plants. The results (Table 4) show some control, but were far from satisfactory.

TABLE 4. SPRAY APPLICATION ON NEWLY SET TOBACCO PLANTS FOR THE CONTROL OF CUTWORMS

Insecticide	Lbs. toxicant per acre	Plants damaged			Per cent reduction in damage	
		June 17	June 22	July 8	June 22	July 8
Endrin 18.5% emulsion	.5	6	6	13	73.9	51.9
Heptachlor 25 % wettable powder	1	6	9	13	60.8	51.9
Check	..	8	23	27	.....	.....

BAITS

A 5 per cent toxaphene bait ready for use was introduced in 1951, and the first test showed excellent results. Treatment made May 31, the day the plants were set, was still providing excellent protection from leaf feeding three weeks later. Only three plants were cut on the treated plots, and 38 plants on the untreated plots. Reduction in total damage was 85 per cent. The bait was more easily spread than poisoned bran mash and it did not injure the plants.

In 1952 a test was made of toxaphene dust and toxaphene bait. The treatments were so applied that the amount used per acre could be measured. The results are given in Table 5. The bait appears to be about twice as effective in terms of amount used as the dust.

TABLE 5. CONTROL OF CUTWORMS BY TOXAPHENE DUST AND BAIT

Lbs. toxicant per acre	Per cent reduction in damage	
	Dust	Bait
.75	.....	61.9
1.5	80.9	71.4
3.0	71.4	90.5
6.0	76.2	.....

A further test compared time of treatment with control using dust and bait. The results are given in Table 6, and show that the dust was most effective when applied a week before setting. The bait was most effective when applied after setting. The best control with the bait was 95 per cent, and the best with dust 86 per cent.

TABLE 6. TIMING OF DUST AND BAIT

Material	Per cent reduction in damage (days before setting)		
	7	3	0
Toxaphene 10% dust	86	62	81
Toxaphene 5% bait	67	62	95

Baits were also compared with sprays of endrin applied to infested plants. The immediate result of spraying with ½ pound endrin per acre was as good as from application of 1½ pounds toxaphene in bait. However, the bait continued to protect the plants, and at the end of 10 days was providing much better control than the spray.

SETTER WATER APPLICATIONS

Applications of insecticides in setter water provided good control of wireworms. However, use of chlordane at the same rate (4 ounces of 48% emulsion in 50 gallons of water) failed to control cutworms. The treated plots had only 16 per cent reduction in damage.

Further tests were made in 1952, using four materials (Table 7). None of the materials provided adequate control of cutworms.

TABLE 7. CUTWORM CONTROL BY INSECTICIDES IN SETTER WATER

Formulation	Oz. Formulation 50 gal. water	Plants Damaged [1]		Total damage	Per cent reduction in damage
		Severed	Leaf feeding		
Aldrin 2% emulsion	4	24	4	28	22
	8	24	3	27	25
	16	15	5	20	44
Dieldrin 15% emulsion	4	27	1	28	22
	8	15	0	15	58
	16 [2]	....	..	....	....
Chlordane 48% emulsion	2	19	9	28	22
	4	18	4	22	39
	8	18	6	24	33
Lindane 5% emulsion	1	14	3	17	53
	2	43	5	48	0
	4	31	13	44	0
Check	..	167	49	216 [3]	....
Average of 2 checks				36	

1 Totals of two replicates. Count made on June 13.
2 The phytotoxic effect of Dieldrin emulsion at this level was so severe it was impossible to read damage.
3 Total 12 checks.

APHIDS

The green peach aphid (*Myzus persicae* Sulzer) has become a major pest of tobacco. The potato aphid (*Macrosiphum solanifolii* Ashm.) and the bean root aphid (*Trifidaphis phaseoli* Pass.) also occur on tobacco but have caused no serious damage.

The green peach aphid normally overwinters in this area as an egg on peaches, wild cherry, and other related trees. These eggs usually hatch in April. On these hosts the insect is easy to detect in the spring because of the marked curling of infested foliage. In May winged aphids fly from peaches and cherries to summer host plants. If tobacco beds are open during this flight, an early infestation will start in the beds.

The green peach aphid may overwinter in the greenhouse also. Under favorable environmental conditions this aphid can be found in the field on plants that remain green throughout the winter. Colonies of aphids under these conditions increase as the temperatures rise and days lengthen. Winged aphids are produced and these infest other summer host plants in April, May, and June. Sprouting potato cull piles have been observed to support large colonies of this aphid early in the season. From these plants, the infestation of tobacco in the bed and field is an ever-present possibility. The tobacco seed bed and the shade tent furnish a very favorable enviroment for development of aphids, and afford protection from insect enemies. If the aphid is present in those situations, it can be expected to reproduce in numbers sufficient to cause serious damage.

Control of this insect depends on detecting it early in the season (Figure 5), and avoiding as much as possible infestation of bed or field. Infestation may result from carrying aphid-infested plants from the greenhouse to the plant bed or from the plant bed to the field.

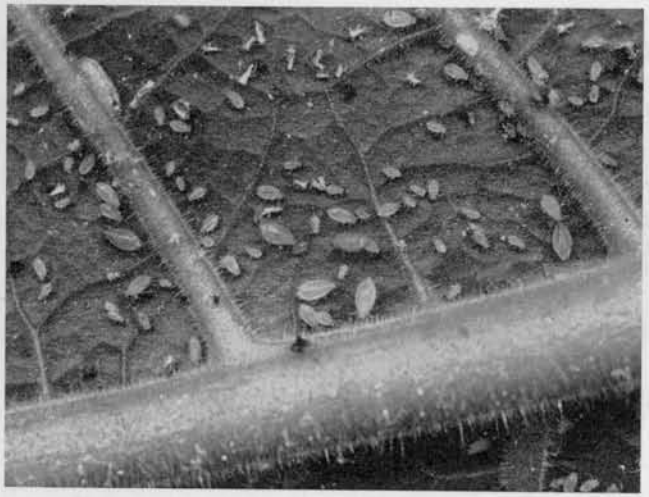

Figure 5. Green peach aphids (*Myzus persicae* (Sulzer)) on the underside of a leaf from a young tobacco plant. Photograph courtesy of W. M. Kulash, Dept. of Zoology and Entomology, North Carolina State College of Agriculture, Raleigh, N. C.

Recognition of aphid infestation when it is in its early stages is difficult but most important. The glandular hairs of the tobacco plant trap a large number of assorted small insects. The green peach aphid is, however, the only aphid known to produce colonies on the leaves. Presence of the wingless form of these small greenish insects on the underside of tobacco leaves or on the new leaves or suckers forewarns of a possible infestation.

CONTROL OF APHIDS

Turner (1950) pointed out that treatments applied to prevent aphids on tobacco result in less damage than treatments made after heavy infestations develop. DDT dust applied either before tobacco was infested or against a light infestation was effective in preventing damage by this insect. In this case it was believed that DDT acted as a repellent.

On the basis of biological information, and results of the DDT tests, a system of control of aphids on tobacco has been developed. The principal emphasis is on treatment of plants in the beds at least a week before setting, using parathion spray or dust. This is followed by field dusting with DDT (diluted in sterilized tobacco dust) to control flea beetles and prevent aphid infestation If, by chance, aphids became troublesome later in the season, parathion sprays applied by mist blower or aircraft have controlled the pest. Visible residue is kept at a minimum by use of small amounts of parathion wettable powder.

The effectiveness of parathion has been established by numerous tests. It has the disadvantage of being highly toxic to humans, and spray operators must use suitable precautions to avoid difficulty. Numerous other materials have been tested from time to time as possible replacements for parathion.

In 1951, DDT wettable powder was compared with *Metacide* emulsion. *Metacide* is an analog of parathion, and was reported to be less toxic to humans than parathion. The tests were made on randomized plots suitably replicated and sprayed on July 18. Heavy rains fell on July 19 and 22, and the field was irrigated on July 27. Counts of aphids on five leaves from each of the three plots have been summarized in Table 8.

TABLE 8. CONTROL OF APHIDS ON TOBACCO BY SPRAY APPLIED JULY 19

Material	Ounces per acre	July 23 Aphids	July 23 Per cent reduction	July 27 Aphids	July 27 Per cent reduction	July 30 Aphids	July 30 Per cent reduction
DDT 50%	32	164	50.1	308	35.7	239	52.0
wettable	16	249	24.3	376	21.5	330	33.7
powder	8	284	13.7	253	47.2	290	41.8
Metacide	6	44	87	32	93.3	91	81.7
33.4%	3	63	81	61	87.2	143	71.3
emulsion	1.5	65	80	128	73.3	154	69.1
Check		329		479		498	

In this test DDT performed as expected, reducing the population by about half. *Metacide* gave good initial control and good protection for about ten days after application.

In 1953 three organic phosphate insecticides and DDT were compared as to effectiveness in controlling the green peach aphid on fiield tobacco. The field used was heavily damaged by hail during this test and the crop was a complete loss. However, it was possible to complete the experiment as far as control of aphids was concerned. The results are given in Table 9.

TABLE 9. CONTROL OF APHIDS ON TOBACCO BY SPRAYS JULY 23, AND ON JULY 23, AUGUST 6 AND 20. COUNTS ON AUGUST 27.

Material	Amount toxicant per acre	Single application		Three applications	
		Total no. of aphids	Per cent reduction	Total no. of aphids	Per cent reduction
Parathion	1 lb.	3	96	11	86
15%	.5	30	61	39	49
wettable powder	.25	20	74	18	77
Metacide	4 oz.	18	77	4	95
50% emulsion	2	13	83	12	84
	1	38	51	44	43
Malathion	16 oz.	15	81	14	82
57% emulsion	8	15	81	11	86
	4	50	35	23	70
DDT	2 lb.	14	82	42	46
50%	1	20	74	6	92
wettable powder	5	31	60	24	69
Checks (average)		77.2			

The highest concentration of parathion, *Metacide,* and malathion gave good control of aphids. The somewhat variable results were probably caused by the relatively low population of aphids.

A test was made in the greenhouse to determine the length of time malathion would be effective. When heavily infested plants were dipped in a suspension of malathion wettable powder, the plants were relatively free of aphids for about two weeks (Table 10.). During the next two weeks the aphids reinfested the plants. It was obvious that malathion killed chiefly by contact, and that there was no persistent residue to prevent reinfestation.

TABLE 10. RESIDUAL EFFECTIVENESS OF MALATHION 25% WETTABLE POWDER AGAINST THE GREEN PEACH APHID ON TOBACCO. GREENHOUSE TEST — 1953

Formulation	Concentration	Total aphids on three plants					
		Before treatment	Days after treatment				
			1	5	8	12	28
Malathion [1]	1-1600	932	0	1	16	2	1486
25% wettable powder	1-800	898	0	2	11	1	940
	1-25	974	14	0	0	2	780
Check (treated with water)		538	526	466	610	625	1284

1 Applied as a dip.

WIREWORMS

The use of chlordane has provided an effective control for wireworms (Figure 6) in tobacco soils (Greenwood (1947, 1948)). From 4 to 6 pounds of chlordane per acre, applied to the surface of the soil and harrowed in immediately, has killed the wireworms, and the soil has been free from wireworms for at least three years. If the chlordane is left on the surface for extended periods, enough may evaporate to reduce the effectiveness seriously. The chlordane can be applied with a row crop sprayer, with the nozzles directed down, at the rate of 8 to 12 pounds of 50 per cent wettable powder or emulsion per acre. Chlordane dust (10%) can be used at the rate of 40 to 60 pounds per acre, mixed with dry sand and applied with a fertilizer spreader.

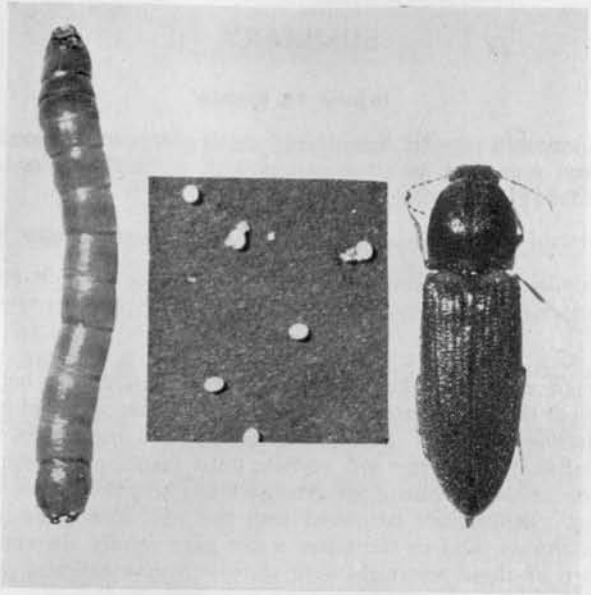

FIGURE 6. Eggs, larvae, and adult insect of the eastern field wireworm (*Limonius agonus* (Say)). The larvae is the destructive stage of this pest; the adult insect does little or no damage.

If the broadcast treatment cannot be used, chlordane in the setter water has provided reasonably effective control of wireworms. The rate usually used is 4 ounces of 50 per cent wettable powder in 50 gallons of water.

Both aldrin and heptachlor have been effective in controlling wireworms in other states (Rawlings and Davis (1950) and Kulash and Monroe (1954)). The rate suggested is 2 to 3 pounds of the toxicant per acre, or about half as much as in the case of chlordane.

SUMMARY

Injury To Plants

Chlordane wettable powder has injured small plants in the seedbed, and the injury has been increased by combination with ferbam. Chlordane dust has injured very small plants in the seedbed.

Lindane wettable powder has injured roots when used in setter water.

Dieldrin emulsion has severely injured plants when used in setter water.

Cutworms

Toxaphene or chlordane dusts, broadcast at least five days before planting on the surface of the soil at rates equivalent to 3 pounds of actual insecticide per acre, gave effective control of cutworms only when the insecticides were allowed to remain undisturbed on the soil surface until planting. Toxaphene bait at 1½ pounds of actual toxaphene per acre gave effective protection when applied after planting. Insecticides harrowed into the soil, insecticide-fertilizer mixtures, and emulsions used in the setter water gave results not considered satisfactory. None of these materials were shown to give residual protection one year after application.

Endrin and heptachlor sprays applied after plants were set in the field have shown some promise for the control of cutworms. Toxaphene dust at rates equivalent to 3 pounds of actual insecticide per acre applied to plants set in the field gave protection that was considered satisfactory. Late season cutworm damage has been controlled by growers making applications to the plant and the soil of DDT dusts at rates equivalent to 1 to 2 pounds of actual DDT per acre.

Aphids

Aphids were effectively controlled by single applications of several organic phosphate insecticides. *Metacide* and parathion provided effective control at rates recommended by the manufacturer. Both of these materials are *extremely toxic* and should only be used when all safety precautions are taken. Malathion, another organic phosphate insecticide, is also effective in controlling aphids. It is not as effective as either *Metacide* or parathion unless it is applied to give complete coverage. Since the residual protection is somewhat lower than either *Metacide* or parathion, more than one application may be necessary. The toxicity of malathion to human beings is much lower than that of either *Metacide* or parathion. The same safety precautions are not required in the use of this material. Malathion can be used safely in the plant bed when applied seven days before pulling to prevent infestation by aphids.

Wireworms

Broadcast treatment with chlordane harrowed in immediately has controlled wireworms. Aldrin and heptachlor have been used successfully in the same way in other states. Wettable powders of each have been used in setter water with no evidence of injury to plants.

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