B-1167
September 1976

Damage Assessment and Control of Wireworms in Grain Sorghum

George L. Teetes*

Summary

Populations of the true wireworm, *Aeolus mellillus* (Say), were determined with baited traps of sorghum seed. Trap catches were highest 1 or 2 weeks after trap establishment. The number of wireworms found in traps was twice the number present in one linear row foot. A population level of one wireworm per linear foot of row usually damaged approximately 10 percent of the planted seed, which caused a reduction in plant stand but not in grain yield.

Several insecticide seed treatments reduced wireworm numbers and damaged seed, and some resulted in increased plant stands but not yields. Lindane appeared to affect seed germination. Carbofuran and Dasanit® (0, 0-diethyl O-P-(methylsulfinyl-phenyl) phosphorothioate] appear to hold promise as replacement seed treatments for the standard chlorinated hydrocarbon insecticides.

Introduction

The economic importance of false wireworms (Tenebrionidae) and true wireworms (Elateridae) as pests of sorghum planting seed is not well known. The seriousness of these seed pests has been masked because of the extreme effectiveness of certain chlorinated hydrocarbon insecticides, such as dieldrin, which have been routinely applied to seed before planting usually by commercial seed companies. Daniels (1955, 1957, 1961, 1966, and 1971) reported that wireworms were sporadic pests of sorghum in the Texas High Plains. He also concluded that control was possible using several organochlorine insecticides applied as seed or soil treatments or by rotation.

Daniels and Chedester (1975) reported that soil treatments of thiofanox, Dasanit®, and carbofuran were more effective in controlling wireworms in grain sorghum than disulfoton, aldicarb, phorate, or a one-to-one combination of disulfoton-Dasanit®.

The current trend toward banning certain chlorinated hydrocarbon insecticides for use in soil pest control has created the need to find replacement insecticides in the phosphate or carbamate groups. Seed treatments versus in-furrow or band applications would reduce the amount of toxicant and would not require extra farming operations. There is also a need for a method of assessing the severity of wireworms in the absence of treated seed and a monitoring tool for determining the need for the implicaion of control measures. Therefore, the research reported here was conducted.

Methods and Materials

Baited traps

A modification of a baiting system used in the corn belt to monitor soil pests of corn was used to determine wireworm populations in soil to be planted to grain sorghum. The traps consisted of holes that were approximately 5 inches in diameter and 8 inches deep. Three ounces of untreated sorghum seed were placed in each trap and covered with moist soil. Wire mounted flags were used to mark trap locations in the field.

Traps were positioned in the center of 100-foot long plots, four rows wide and were arranged in a

Associate Professor, The Texas Agricultural Experiment Station (Department of Entomology).

randomized complete block design with four replications. The test was conducted in a 1-acre field at the Texas Agricultural Experiment Station at Lubbock. The field had been planted to grain sorghum for the preceding 3 years.

Twenty-four traps were established March 11, 1975. At weekly intervals for 3 weeks, eight (2/rep) of the traps were inspected and wireworms counted.

On May 9, 1975, the field was planted to a commercial hetero-yellow endosperm hybrid. To assess the level of damage to seed and the subsequent effect on stand of untreated seed, 50 feet of each 100-foot plot was planted to dieldrin treated sorghum seed. In addition, the number of wireworms per linear row foot in the seed drill was determined in the area planted to untreated seed for subsequent comparison with the number of wireworms caught in baited traps.

Insecticide Seed Treatments

Several insecticides representing the three major insecticide classes were applied to sorghum planting seed to determine both their efficacy in controlling wireworms and their effect on germination.

Insecticides, formulation, and rate per 100 pounds of seed are shown in Table 3. Equivalent amounts of technical ingredient insecticide were applied to 2-pound lots of sorghum seed. Seeds were treated March 24, 1975 in a small tumble-turn slurry machine. Water and Captan® fungicide were mixed with each insecticide formulation before application to seed. After treatment, seeds were stored in paper bags and allowed to dry.

Germination tests were initiated April 12, 1975 using the standard cotton seed germination technique. One hundred seeds of each treatment were placed on wetted paper towels and held at 68° F (16 hours) and 86° F (8 hours) during each 24-hour cycle. There were six replications for each seed treatment. Percent seed germination was recorded at 7 and 10 days after placement in the incubation chamber.

Equal amounts of seed treated with each insecticide were planted in two separate tests to determine effectiveness for wireworm control. Treatments were arranged in a randomized complete block design with three replications. Plots were four rows, 50 feet long.

Five days following planting on May 9, 1975, wireworm damaged seed and wireworm numbers were determined in one linear row foot in each plot. After plant emergence, plant stand counts were made at weekly intervals for 4 weeks.

At harvest, seed yields were obtained from heads cut from 13.1 row feet of each plot. The heads were threshed and the seeds cleaned and weighed, and yields (lb/acre) were calculated.

Results and Discussion

Baited Traps

Comparison of the number of true wireworm, *Aeolus mellillus* (Say), caught in baited traps and wireworms per linear row foot and subsequent plant populations and yield are shown in Table 1. The number of wireworms found in baited traps 1 or 2 weeks after establishment was about equal (2.1 and 2.3, respectively). However, wireworm numbers in baited traps after 3 weeks were less than one-half the number caught 1 or 2 weeks previously. The decrease in number of wireworms in traps after 3 weeks may have been because of the extensive rotting and moulding of sprouted and unsprouted seed.

In several of the baited traps some seeds were in dry soil, and germination did not take place. Few wireworms were found in these areas. Most wireworms were found in areas of the traps where germination had begun or in the moist soil adjacent to the seeds. Based on these data, it would appear that baited traps should be inspected during the first 2 weeks after establishment.

A comparison of wireworm numbers caught in baited traps with the population of wireworms per linear row foot showed that the baited traps caught about twice the number of wireworms as were present in one linear foot of row, and that this population level was capable of destroying about 10 percent of the seed present. This 10 percent damaged seed was less than the 17 percent reduction in plant population resulting from planting untreated seed. Plant stand counts (mean of four samplings) revealed a per acre population of 47,103 for the

TABLE 1. COMPARISON OF NUMBERS OF WIREWORMS CAUGHT IN BAITED TRAPS AND WIREWORMS PER LINEAR ROW FT. AND SUBSEQUENT PLANT POPULATIONS AND YIELD, LUBBOCK, 1975

TREATMENT	WIREWORMS/BAITED TRAP AFTER INDICATED WEEK 1	2	3	WIREWORMS/LINEAR FT	PERCENT DAMAGED SEED	PLANT POP. /ACRE AND (%) DECREASE[1]	YIELD IN LBS/ACRE AND (%) DECREASE[1]
Dieldrin						47,103 a	3666 a
Untreated	2.1	2.3	1.0	1.0	10	39,087 (17) b	3266 (11) a

[1]Means followed by the same letter are not significantly different at the 5% level (Duncan's multiple range test).

plots planted to dieldrin treated seed and 39,087 for the check. However, the 17 percent reduction in stand resulted in only an 11 percent reduction in yield and did not constitute a significant difference. The percent reduction in yield compares closely with the percent damaged seed.

The data are not sufficient to establish a distinct correlation between wireworm infestation levels and stand or yield reductions of sorghum. The baited traps, however, provide a means of determining pest populations before planting.

Insecticide Seed Treatments

The effect on germination of various insecticide seed treatments is shown in Table 2. Percent germination of sorghum planting seed following treatment with heptachlor, chlordane (8#EC), carbofuran (2 oz AI/100 lbs seed), diazion, or dieldrin was as high or higher than the percent germination of the untreated seed (90.0 and 92.5 percent at 7 and 10 days, respectively). Chlordane, carbofuran (4.0 oz AI/100 lbs seed), and Dasanit® only slightly reduced seed germination. The greatest reduction in seed germination resulted from the application of diazinon-lindane (83.7 and 84.3 precent at 7 and 10 days, respectively). The effect of germination was apparently a result of the lindane because diazinon did not affect germination when used alone.

TABLE 2. EFFECT OF INSECTICIDE SEED TREATMENT ON GERMINATION OF SORGHUM PLANTING SEED

TREATMENT	FORMULATION	OZ. AI RATE/100# SEEDS	PERCENT GERMINATION AT INDICATED DAY AFTER TREATMENT 7	10
Heptachlor	3#EC	1.5	92.5	93.7
Chlordane	40% WP	1.5	88.5	90.0
Chlordane	8#EC	1.5	92.0	92.6
Carbofuran	75% WP	2.0	90.2	90.5
Carbofuran	75% WP	4.0	87.0	90.3
Dasanit	6#EC	2.0	86.0	88.3
Diazinon-Lindane	11+16.6% WP	1.5 + 2.3	83.7	84.3
Diazinon	4#EC	2.0	91.7	92.2
Dieldrin	50% WP	1.0	91.3	93.0
Check			90.0	92.5

Most insecticides applied to the seed before planting resulted in a reduction in wireworm numbers (Table 3). However, the effect of the wireworms was not reflected in damaged seed since few damaged seed were found. The small percentage of damaged seed, except in the check, may have been a direct result of the reduction in wireworm numbers, sampling, or as Daniels (1961) concluded that the insecticides demonstrated repellant action.

Plant stand counts among treatments did not differ greatly and were significantly reduced only in plots planted to diazinon-lindane treated or untreated seed. The stand reduction in the check was apparently because of the wireworm damage; whereas, stand reduction in the diazinon-lindane plots was apparently because of reduction in germination (Table 2). Yields did not differ significantly among treatments.

In an identically arranged test in another field, results similar to those described above were obtained (Table 4). Both wireworm numbers per linear foot and percent damaged seed were less in plots planted to insecticide treated seed than in plots of untreated seed. Plant populations in plots planted to heptachlor and carbofuran treated seed were higher than those planted to untreated seed. Yields from treated plots were not significantly higher than the untreated plots, and only the chlordane (40 percent D) treatment resulted in lower yield.

Based on these preliminary efficacy data, it would appear that some phosphate or carbamate

TABLE 3. EFFECT OF INSECTICIDE SEED TREATMENTS APPLIED FOR CONTROL OF WIREWORMS IN GRAIN SORGHUM, LUBBOCK, 1975, TEST 1

INSECTICIDE	FORMULATION	OZ. AI RATE/100 LBS SEED	WIREWORMS/ LINEAR FT[1]	PERCENT DAMAGED SEED	PLANT POP. /ACRE AND (%) INCREASE[2]	YIELD/ACRE AND (%) INCREASE[2]
Heptachlor	3#EC	1.5	0.5	0	48533 (21) bc	3700 (14) a
Chlordane	40% D	1.5	0.3	3	44633 (15) cd	3333 (4) a
Chlordane	8#EC	1.5	0.9	7	44200 (14) c	3600 (11) a
Carbofuran	75% WP	2.0	0.5	0	50267 (24) b	3633 (12) a
Carbofuran	75% WP	4.0	1.0	0	48967 (22) bc	4366 (27) a
Dasanit	6#EC	2.0	0.3	0	51133 (25) ab	3300 (5) a
Diazinon+Lindane	11 + 16.6% WP	1.5 + 2.3	1.3	0	37267 (0) e	3200 (0) a
Diazinon	4#EC	2.0	0.4	0	47233 (19) bcd	2800 (0) a
Dieldrin	50% WP	1.0	1.0	0	55033 (31) a	3900 (18) a
Check			1.4	16	38133 (–) e	3200 (–) a

[1]Wireworms/baited trap 2.1.

[2]Means followed by the same letter are not significantly different at the 5% level (Duncan's multiple range test).

TABLE 4. EFFECT OF INSECTICIDE SEED TREATMENTS APPLIED FOR CONTROL OF WIREWORMS IN GRAIN SORGHUM, LUBBOCK, 1975, TEST 2

INSECTICIDE	FORMULATION	OZ. AI RATE/100 LBS SEED	WIREWORMS/ LINEAR FT[1]	PERCENT DAMAGED SEED	PLANT POP. /ACRE AND (%) INCREASE[2]	YIELD/ACRE AND (%) INCREASE[2]
Heptachlor	3#EC	1.5	0.5	0	54600 (24) ab	4666 (11) a
Chlordane	40% D	1.5	0.3	0	45500 (9) bc	3566 (0) b
Chlordane	8#EC	1.5	0.0	0	52433 (21) abc	4066 (0) ab
Carbofuran	75% WP	2.0	0.3	3	55467 (25) ab	4400 (6) a
Carbofuran	75% WP	4.0	0.0	0	61100 (32) a	5100 (19) a
Dasanit	6#EC	2.0	0.3	0	49833 (17) bc	4533 (9) a
Diazinon+Lindane	11 + 16.6 WP	1.5 + 2.3	0.3	0	45067 (8) bc	4466 (7) a
Diazinon	4#EC	2.0	0.3	3	50267 (17) bc	4100 (0) a
Dieldrin	50% WP	1.0	0.3	2	48100 (14) bc	4663 (11) a
Check			0.7	7	41600 (–) c	4133 (–) a

[1]Wireworms/baited trap 1.3.

[2]Means followed by the same letter are not significantly different at the 5% level (Duncan's multiple range test).

insecticides applied as seed treatments may provide effective replacements for the standard chlorinated hydrocarbon insecticides previously used as seed protectants against wireworms. Presently, diazinon and diazinon + lindane are registered for use on sorghum planting seed as a planter-box treatment. Carbofuran or Dasanit® are not registered as a sorghum seed protectant against wireworms.

In addition, there is some concern about the phytotoxic effects of carbofuran and Dasanit® applied directly to seed, even though no effect on germination was shown in the tests reported here. The phytotoxic effects may appear if the seed must be stored for a considerable length of time after treatment and before planting.

In past years dieldrin has performed effectively as a seed protectant both for soil pests and for stored grain pests. This quality or dual role may be lost with the use of phosphorate and carbamate insecticide seed treatments.

Acknowledgments

The author appreciates the financial support of the Texas Grain Sorghum Producers Board and the assistance of Mr. Curtis Schaefer, Alvin Wade, and Brad Pate. The cooperation and assistance of Dr. Earl Minton are also gratefully acknowledged.

KEYWORDS: grain sorghum seed / wireworm, *Aeolus mellillus* (Say) / insecticides / Texas.

Literature Cited

Daniels, Norris E. 1955. False wireworm control in sorghum. Tex. Agr. Exp. Stn. PR-1793. p.2.

Daniels, Norris E. 1957. False wireworm control in wheat. Tex. Agr. Exp. Stn. PR-1978. p.2.

Daniels, Norris E. 1961. Protecting young grain sorghum from soil insects. Tex. Agr. Exp. Stn. PR-2172. p.3.

Daniels, Norris E. 1966. Soil insect control and insecticidal residue detection. J. Econ. Entomol. 59:410-413.

Daniels, Norris E. 1971. Detection of insecticidal residue and control of soil insects. J. Econ. Entomol. 64:175-177.

Daniels, Norris E. and Louis D. Chedester. 1975. Wireworm control in grain sorghum. Tex. Agr. Exp. Stn. PR-3306. p.4.

The Texas Agricultural Experiment Station, J. E. Miller, Director, College Station, Texas
2M — 9-76