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Chemical Control Of Corn Earworm In Large Plantings Of Sweet Corn

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
HENRY LEVECK, Director
STATE COLLEGE MISSISSIPPI

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Chemical Control of Corn Earworm in Large Plantings of Sweet Corn, State College, Mississippi

BY W. A. DOUGLAS AND E. L. MOORE[1]

During and immediately after World War II, sweet corn was produced in the Hattiesburg, Greenville, and Batesville, Mississippi areas. The sweet corn from these areas was marketed on a "clip corn" basis and sold primarily to Army camps during the war. After the war, cooperatives were formed and the sweet corn was sold locally as well as at distant markets. The acreage planted to sweet corn on individual farms was small, seldom over 5 acres.

By 1951, all distant and most local markets demanded nonclipped corn, but farmers were not producing worm-free corn and thus could not sell their product. By 1955, Mississippi producers were virtually out of the sweet corn business. At that time the Agricultural Economics and Horticultural departments of Mississippi State University began their investigation of the number of growers who followed the cultural and chemical control practices recommended by the Mississippi Agricultural Experiment Station. Their investigations revealed that damage by the corn earworm [**Heliothis zea** Boddie] was a primary reason for the rejection of Mississippi grown sweet corn. None of the acreage in the study had received the recommended insecticide program. Only 4 percent of the acreage had received the minimal spray program with 60 percent receiving only three applications of an insecticide.

In small plots at State College, Mississippi, and Tifton, Georgia, many new chemicals, applied with hand sprayers, have been tested for earworm control. In order to evaluate the more superior chemicals on a semicommercial basis and to demonstrate their effectiveness when properly applied, large-scale experiments were established at State College. In this program were tested only those chemicals that had provided the most effective earworm control in small plots at Tifton or State College. Results of the large-scale tests are recorded here.

Materials and Methods

The 1960 tests involved two sweet corn hybrids—Seneca Chief and Golden Security In 1961 the tests included a third hybrid—Royal Gold. These hybrids were selected mainly because of their differences in foliage density.

Seneca Chief represents a type with dense foliage and many flag leaves. Thus satisfactory spray coverage of this variety is difficult. On the other hand, Golden Security represents a type with moderate foliage and few flag leaves. It is therefore easy to obtain coverage of this hybrid. Royal Gold, similar in many respects to Golden Security, has large ears and almost no flag leaves; so for it, too, coverage is easy.

In addition these hybrids were selected because they possess one or more desirable horticultural characteristics. Seneca Chief gives fairly high yield, produces high quality corn, and in this area retains top quality at maturity over a period of 4 to 5 days. Golden Security is prolific. Few other hybrids approach its yield in number of ears per acre. The ears are well shaped, of moderate quality, and very short. Of its total weight an ear of Golden Security yields about 32 percent in cut corn. It loses top quality in about 30 hours. Royal Gold produces very well. The ears are large, long, well-shaped, and well-suited to the Mississip-

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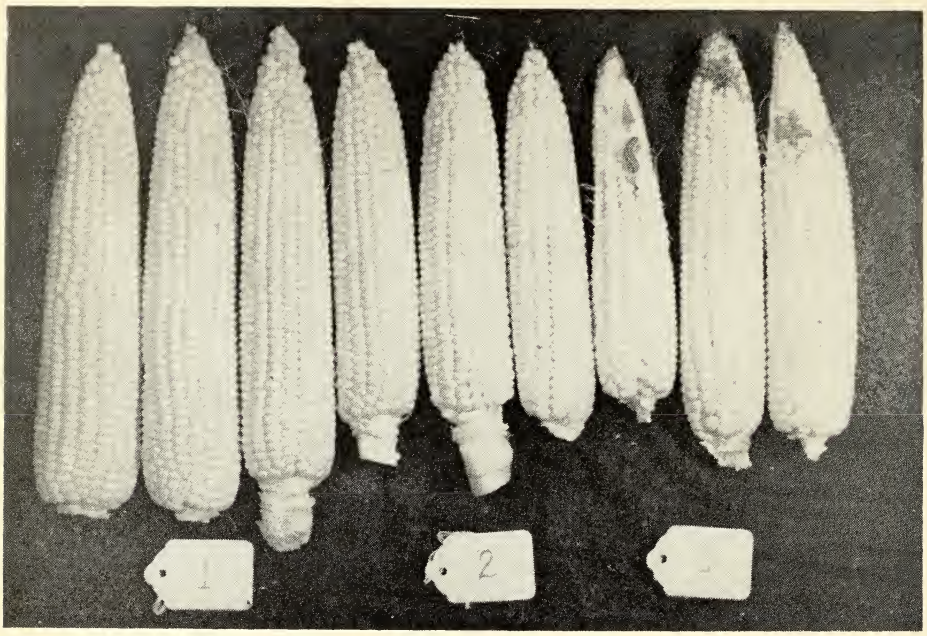

Figure 1. Chemical sprays effectively controlled corn earworms in two sweet corn hybrids. No. 1—Royal Gold (three ears on the left) and No. 2—Golden Security (three center ears), were sprayed daily to within four days of harvest. No. 3—the nonsprayed Golden Security check.

pi market. The yield of cut corn is about 28 percent, but because of the large ear size, the amount of cut corn per acre of Royal Gold approximates that of Golden Security. The ability of Royal Gold to retain top quality at harvest is poor.

In general the block size of the test plantings was 16 rows wide and 300 feet long for each hybrid tested. The 16 rows were divided into 4 four-row plots, the minimum plot size for a chemical treatment. Alleys were provided at the end of the plots for turning the equipment. Treatment plots were randomized and replicated 4 times. Samplings for analysis of data were taken at random from the two center rows of a plot. The data reported represent the average of four replicates.

The first planting in 1960 was made on April 15, the second on May 15, and the third on July 9. The different planting dates were used to capitalize on the variation in the corn earworm infestation as the season progressed. Usually the heaviest infestations occur in the early and late plantings. Infestations in midseason plantings are usually moderate.

The chemicals were applied with a 4-row high clearance sprayer at a pressure of at least 100 p.s.i. The nozzles were arranged so that each one directed a spray stream toward the silks. Four 65° and 80° fan-type nozzles were employed per row and set to thoroughly cover a 30-inch band. The 30-inch band was necessary to compensate for the variation in ear height on various stalks. Number 65001 or 8001 Tee Jet nozzles were used with a pressure of 100 to 120 p.s.i. and the spray rig, traveling at a speed of 3 miles per hour, delivered 25 gallons of spray per acre. The timing and number of applications were varied among the treatments as listed in the tables.

Table 1. Results of tests to control the corn earworm on two varieties of sweet corn treated with DDT mechanically sprayed at different times beginning 5 days after first silk emergence. Corn planted April 15, 1960.

Hybrid	Time of application	No. of applications	Percent worm free	Percent* control
Seneca Chief	Daily	11	70	70
	Every other day	6	63	63
	Every 3rd day	4	26	26
	Check plot	None	0	0
Golden Security	Daily	11	78	78
	Every other day	6	65	65
	Every 3rd day	4	47	47
	Check plot	None	0	0

*Percent control calculated by Abbott's formula: [Modified by members of Maryland Agr. Expt. Sta. See J. of Wash. Aad. Sci. 55, 1-5 (1965)].

$\frac{x-y}{x} \times 100 =$ percent control, where

x = percent living in check. y = percent living in treated plot.

Table 2. Results of tests to control the corn earworm on two varieties of sweet corn treated with two different insecticides mechanically sprayed several times, beginning on the day or 1 day before silk emerged. Corn planted on May 15, 1960.

Hybrid	Material	Number of applications	Time of application	Type of nozzle	Percent worm free	Percent control*
Seneca Chief	DDT	11	Daily	Cone	96	90
		11	"	Fan	100	100
		6	Every other day	Cone	100	100
		6	"	Fan	95	88
		4	Every 3rd day	Cone	100	100
		4	"	Fan	98	95
	Carbaryl	6	Every other day	Cone	98	95
		6	"	Fan	100	100
	Check	None	----------	-----	58	-----
Golden Security	DDT	11	Daily	Cone	100	100
		11	"	Fan	100	100
		6	Every other day	Cone	98	95
		6	"	Fan	97	92
		4	Every 3rd day	Cone	97	92
		4	"	Fan	90	73
	Carbaryl	6	Every other day	Cone	97	92
		6	"	Fan	100	100
	Check	---	----------		37	----

*Percent control calculated by modified version of Abbott's formula.

Table 3. Results of tests to control the corn earworm on two different varieties of sweet corn treated with two different insecticides mechanically sprayed several times beginning on the day first silks emerged. Corn planted on July 9, 1960.

Hybrid	Material	Number of applications	Time of application	Percent worm free	Percent control*
Seneca Chief	DDT	8	Daily	54—	54
		5	Every other day	14	14
		4	Every 3rd day	17	17
	Carbaryl	8	Daily	62	62
	Check	None	-------	0	0
Golden Security	DDT	8	Daily	77	77
		5	Every other day	47	47
		4	Every 3rd day	25	25
	Check	None		0	0

*Percent control calculated by modified version of Abbott's formula.

Twenty-five ears in each replicate were examined as soon as they reached the early dough stage. The ears were husked and the amount of feeding on each infested ear was measured. Data in the "percent worm free" column was calculated from these records.

1960 Tests

Two hybrids and two chemicals were tested. Golden Security and Seneca Chief were planted on April 15, May 15 and July 9. The chemicals applied were DDT, 25% emulsifiable concentrate at 2 pounds per acre per application in all three plantings and Carbaryl, 85% sprayable at 1 ¼ pounds per acre per application in the May 15 and July 9 plantings In the May 15 planting cone and fan-type nozzles were compared. The frequency and number of applications of each insecticide and the results are shown in Tables 1, 2, and 3.

The first daily spray application was delayed until 5 days after first silk emergence in the April 15 planting because of mechanical trouble with the spray equipment. This delay allowed the earworm moth to oviposit for 5 days on untreated silks and probably accounted for the poor control obtained from all treatments. as shown in Table 1. The infestation was 100% in both hybrids. Results from these tests emphasized that with high moth populations present, satisfactory control is not obtained when the spray schedule is initiated after the silks emerge from the ears. Applying DDT on every third day was of little value since it gave only 26 percent control in Seneca Chief and 47 percent in Golden Security The most satisfactory degree of control was obtained from 11 daily applications of DDT which gave 70 percent control in Seneca Chief and 78 percent in Golden Security.

In the May 15 planting the first sprays were applied on the day or day before the silks emerged. The planting came into silk at a time when moth population was moderately light and the resulting infestation was only 42 percent in Seneca Chief and 63 percent in Golden Security Table 2 shows that under these conditions both insecticides gave a high percentage of worm free ears and no differences in efficiency were observed between flat fan and cone shaped nozzles Slight husk and leaf damage was noted in corn sprayed daily with DDT, but no damage was observed on corn sprayed daily with Carbaryl.

In the July 9 planting spray treatments were started on the day the first silks appeared August 26 and continued through September 3. The results are shown in Table 3. The check plots in this test were 100% infested and almost completely devoured by corn earworms which provided a very severe test of the insecticides. Infestation was so severe in the tassels, stalks and ears that poor pollination occurred and none of the ears were marketable.

Under these conditions of heavy infestation, daily applications of DDT gave only 54 percent control in Seneca Chief and 77 percent in Golden Security while daily applications of Carbaryl gave 62 percent control in Seneca Chief.

1961 Tests

All three hybrids were planted April 17, May 18, and June 27. Carbaryl (80% sprayable), 1 ¼ pounds per acre per application, and DDT (25% emulsifiable concentrate), 2 pounds per acre per application, were applied in the tests. The materials, number and time of applications, percentage of worm-free ears and percentage of control for the three plantings are presented in Table 4. The results in Table 4 show conclusively that insecticides must be applied throughout the silking period for satisfactory earworm control. Daily applications of DDT beginning with first silk appearance and continuing up to 4 days before harvest gave 92% control in each variety. Applying Carbaryl daily, every other

Table 4. Results of tests to control the corn earworm in three varieties of sweet corn treated with two different insecticides mechanically sprayed several times beginning at different silking stages, 1961.

Hybrid	Material	Number of applications	Time of application	Percent worm-free	Percent control*
Planted April 17, 1961					
Seneca Chief	DDT	15	Daily beginning with first silks	92	92
	Carbaryl		Daily first 7 days after silking	6	6
		3	Every other day after silks emerged	10	10
		3	Every 3rd day after silks emerged	4	4
	Check	None		0	—
Royal Gold	DDT	11	Daily	92	92
	Carbaryl	4	Daily first 4 days after silking	4	2
		3	Every other day	0	0
		2	Every 3rd day	10	1
	Check	None		2	—
Golden Security	DDT	10	Daily	92	92
	Carbaryl	1	First day after silking	2	2
	Check	None		0	—
Planted May 18, 1961					
Seneca Chief	Carbaryl	13	Daily beginning with first silks	94	92
		5	Every third day after first silks	76	69
	DDT	5	Every third day after first silks	76	69
	Check	None		22	—
Royal Gold	Carbaryl	11	Daily beginning with first silks	98	97
		4	Every third day	94	92
	DDT	4	Every third day	92	89
	Check	None		28	—
Golden Security	Carbaryl	11	Daily beginning with first silks	9	93
		4	Every third day	96	94
	DDT	4	Every third day	98	97
	Check	None		38	—
Planted June 27, 1961					
Seneca Chief	Carbaryl	14	Daily beginning with first silks	98	98
		5	Every third day	78	78
	DDT	5	Every third day	20	20
	Check	None		0	—
Royal Gold	Carbaryl	14	Daily beginning with first silks	98	98
		5	Every third day	78	78
	DDT	5	Every third day	74	74
	Check	None		0	—
Golden Security	Carbaryl	14	Daily beginning with first silks	100	100
		5	Every third day	96	96
	DDT	5	Every third day	78	78
	Check	None		0	

*Percent control calculated by modified version of Abbott's formula.

day, or every third day during the first half of the silking period gave 10 percent or less control. Spraying plants during the first 7 days of the silking period apparently left later silk growth free of insecticides and thus attractive for moth oviposition. At the time damage was recorded, the larvae had developed on the unsprayed portion of the silks in a normal manner.

The corn earworm infestation was light in the May 18 planting. The percentage of worm-free ears in the check treatments was 22 in Seneca Chief, 28 in Royal Gold, and 38 in Golden Security (Table 4). Daily applications of Carbaryl throughout the silking period gave 92 percent control in Seneca Chief, 100 in Royal Gold, and 97 in Golden Security. Applying Carbaryl every third day gave 82 per-

cent earworm control in Seneca Chief, and 92 percent in Royal Gold and Golden Security. DDT applied every third day gave 69 percent control in Seneca Chief, 89 in Royal Gold, and 97 in Golden Security.

The corn earworm infestation was very heavy in the June 27 planting with all three hybrids having a 100% infestation. Carbaryl applied daily throughout the silking period gave 98 percent control in Seneca Chief and Royal Gold and 100 percent in Golden Security. When applied every third day, this material gave 78 percent control in Seneca Chief and Royal Gold and 96 percent in Golden Security. The degree of control from DDT applied every third day was 20 percent in Seneca Chief, 74 in Royal Gold, and 78 in Golden Security.

Summary and Conclusions

Results of all tests indicate that spray applications must be made from the appearance of the first silk up to four days of harvest to obtain effective earworm control.

Carbaryl is recommended for earworm control on sweet corn because it gave equally satisfactory control and does not present the residue hazard of DDT.

The degree of control depends on the level of infestation and number of spray applications. Under conditions of light infestations (40-60%) the application should be made every third day. When the infestations are moderate (60-80%) the application should be made every other day. Heavy infestations (80-100%) require daily applications.

The spray may be applied with either a cone or fan type nozzle. The nozzle size should be determined by the formulation of the material, pressure and tractor speed. Four nozzles should deliver the chemical at 1 ¼ pounds actual per acre per application.

Earworm control was more easily accomplished in Golden Security and Royal Gold than in Seneca Chief. Dense foliage in Seneca Chief made spray coverage of the silks difficult.