BULLETIN 326
MARCH 1960

CORN EARWORM CONTROL

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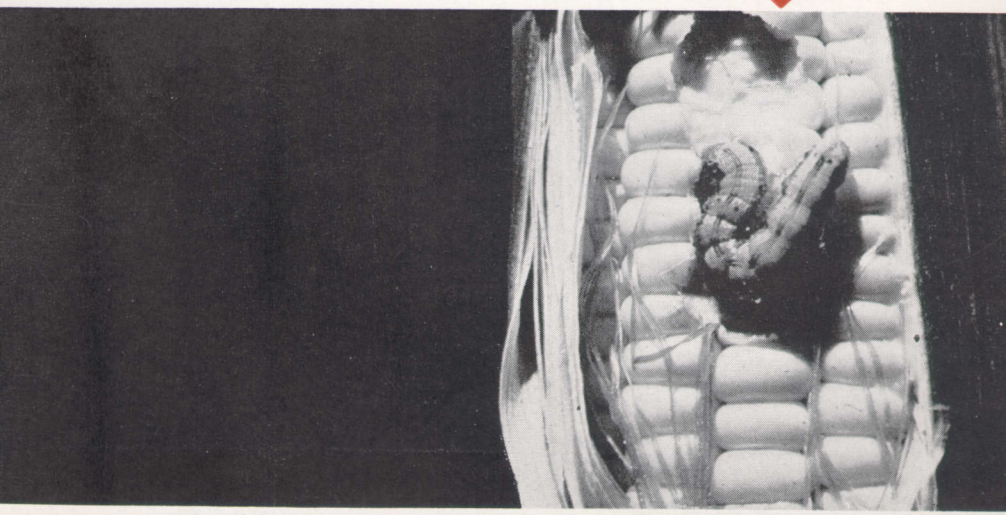

First Printing 5M, March 1960

HOW to CONTROL CORN EARWORM

Alabama sweet corn growers are faced with the task of controlling the corn earworm every year. Unless this pest is kept under control, almost all ears of sweet corn are badly damaged. Good control is possible, but it requires timely and thorough insecticide applications.

What to Use. DDT emulsion sprays give best results. Two pounds of DDT (1 gallon of 25 per cent emulsifiable concentrate) in 20 to 25 gallons of water should be used per acre for each application.

How to Apply. Spray application is recommended. It should be put on with ground equipment. The sprayer should be equipped with four flat fan nozzles per row, two on each side. The two nozzles on each side of the row should be at least 12 inches apart (vertically) and cover at least 24 inches of the plant in the ear region. Spray should be applied at 150 to 200 pounds pressure, with the highest pressure for heavy growth of corn.

When to Spray. Spraying should be begun in time to make two applications (2 days apart) before first silks appear. Then spraying should be done every other day until silks are brown. Daily spraying during silking gives better worm control and is good insurance against delays in subsequent application caused by heavy rains or machinery breakdowns.

Caution. Do not feed DDT-treated foliage to lactating dairy animals or to meat animals within 60 days of slaughter.

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Corn Earworm Control on Sweet Corn in Alabama

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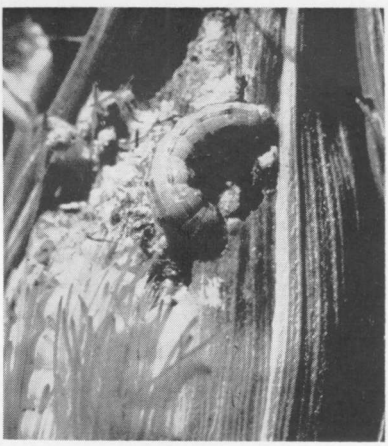
THE CORN earworm[1] is the most important insect pest of sweet corn in Alabama. Unless control measures are used each year, almost every ear is damaged and the sweet corn grower suffers heavy losses.

Until a few years ago, sweet corn growers made no effort to control the earworm in corn. Essentially every ear of corn was infested, so the packer and shipper clipped the tip ends from roasting ears to remove the earworm larvae and their damage. "Clipped end" roasting ears were a common sight in grocery stores throughout the country.



Shown here is typical damage to ears of sweet corn when the corn earworm is not controlled in Alabama.

Effective methods for controlling the corn earworm in sweet corn with insecticides have been developed in the past 20 years. The oil injection method *(2)* reported in 1938 renewed interest in the problem. In 1945 it was found that DDT was an effective insecticide against the earworm in sweet corn *(3)*. Subsequent work *(1, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19)* with DDT resulted in practical measures for worm control in fresh market corn.

[1] *Heliothis zea* (Boddie), Order Lepidoptera, Family Phalaenidae.

When practical worm-control measures became a reality, consumers no longer accepted "clipped end" corn. The practice of clipping tips has been completely abandoned. The grower must strive through insect control measures to deliver worm-free corn to the packing shed.

Research on earworm control in sweet corn was begun at the Gulf Coast Substation, Fairhope, in 1941 and continued through 1959. Life history studies were made at Auburn in 1948 *(14)*.

The early work on control involved application of insecticides to individual ears with a hand applicator. Dichloroethyl ether, oil, and pyrethrum extracts, as well as arsenate of lead, were included in these early experiments. Some earworm control was obtained with these materials, but no practical control measures resulted. Subsequent research *(7, 8, 9, 10, 11, 12)* conducted primarily at the Gulf Coast Substation resulted in practical and effective control measures. Results of this research and recommendations based on it are given in this publication.

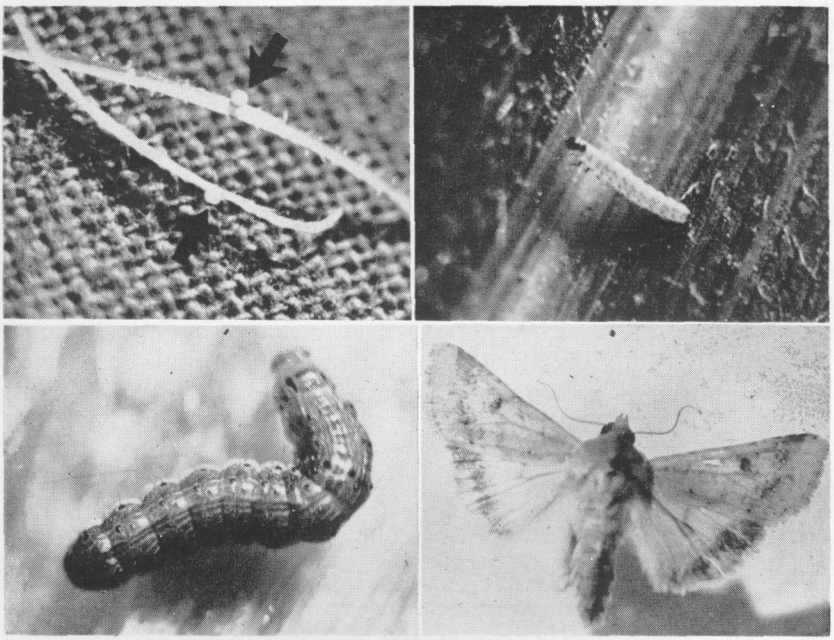
DESCRIPTION, LIFE HISTORY, and HABITS

The corn earworm has been studied by many researchers, and reports on its description, life history, and habits have been published *(7, 14, 15)*.

The four stages in the life cycle of the corn earworm are the egg, larva (worm), pupa, and adult (moth).

The eggs, which are deposited singly, are white and shiny at first but darken before hatching. They are somewhat smaller than a pin head but are visible to the naked eye. The eggs are hemispherical and are ridged along the sides. The moth prefers to deposit eggs on the corn silk; however, before silks appear the eggs are laid on leaves and stalks of young plants. One moth lays from 500 to more than 1,000 eggs. The eggs hatch in 2 to 3 days.

The larvae are very small (1.5 mm.) when they emerge from the egg. The head and legs of newly-hatched larvae are shiny black and the body is pale and transparent. After some feeding, which begins soon after hatching, the body becomes opaque and creamy yellow. The larvae grow rapidly for about 3 weeks and reach a length of almost 2 inches. The older larvae vary in color from light green to brown or nearly black. Alternating light and dark stripes run lengthwise of the body. There is usually a double



Stages in the life cycle of the corn earworm are shown above. At top left are eggs (arrows) on corn silks; small larva is shown at top right. An older larva is at bottom left and the adult (moth) is shown at bottom right.

dark line the length of the body along the center of the back. The head is yellow and the legs are nearly black.

Larvae from eggs deposited on leaves and stalks migrate to the whorl where they feed and often cause damage. When tassels emerge from the whorls, the larvae migrate down the stalks to the ears. Most severe damage caused by the earworm is to ears, and most of this damage is done by larvae that hatched from eggs deposited on the silks. Larvae from eggs laid on silks start feeding on the tender silks and migrate down the silk channel to the tip of the ear where they feed on the developing kernels, badly damaging the ear tip. In severe cases the entire ear may be destroyed. Although several larvae may hatch on one silk mass, more than one mature larva is seldom found in an ear since earworm larvae are cannibalistic. The mature larvae cut holes in the shucks, drop to the ground, and burrow into the soil to pupate.

The pupa is dark brown and about ¾ inch in length. It is formed in an earthen cell 2 to 6 inches below the soil surface.

Pupation requires 8 to 9 days during the summer months. The corn earworm passes the winter in the pupal stage.

Corn earworm adults (moths) emerge from the pupae and make their way to the surface of the soil. The moths, which have a wing expanse of about 1½ inches, vary in color from light brown to gray. The front wings are usually grayish brown marked with dark irregular lines and have dark areas near the tips. The hind wings are white with irregular dark spots.

The first moths emerge from overwintering pupae at Fairhope in early April and at Auburn they appear about the middle of May. Moths feed on the nectar of flowers. Mating occurs soon after emergence and egg laying begins. The moths move about on warm, cloudy days but primarily in late afternoon and early evening.

Total time from egg to adult is about 30 days during the summer. Several generations occur each year.

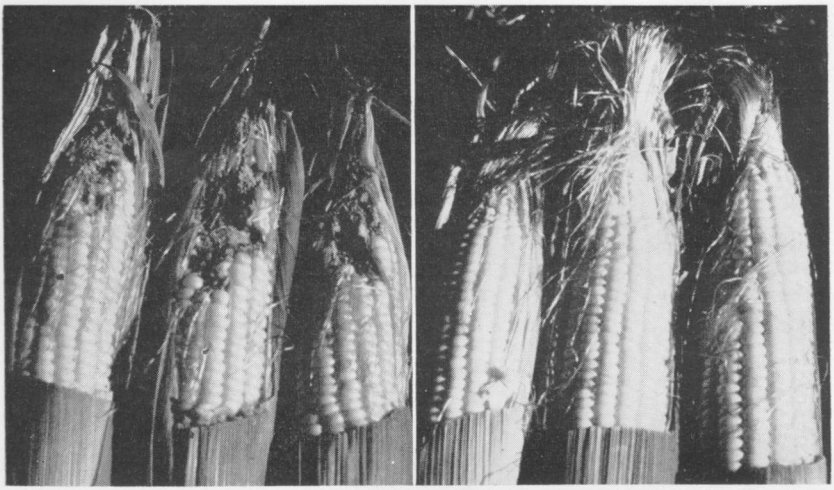
CONTROL of the EARWORM

Insecticides

The following insecticides were used in experiments on earworm control in sweet corn since 1950: mineral oil, toxaphene, parathion, aldrin, dieldrin, TDE, Dilan, endrin, heptachlor, methoxychlor, CPR (a combination of piperonyl cyclonene, pyrethrins, and rotenone), DDT, Phosdrin, Thiodan, Chlorthion, Delnav, Sevin, and malathion. Various combinations of these insecticides, with and without mineral oil, were evaluated, Tables 1-6.

Throughout the various experiments, the most consistent control was obtained with DDT. Thiodan and Sevin, two relatively new insecticidal compounds, compared favorably with DDT when used at the same rates as DDT.

Mineral oil-DDT combinations for earworm control were thoroughly investigated. Various oils were tested, Table 6, as well as several proprietary formulations containing DDT and mineral oil. In these studies, Tables 2, 5, 6, 7, 8, 9, 13, as well as in nationally coordinated research *(12)*, use of mineral oil resulted in increased earworm control over that obtained with DDT alone. However, mineral oil frequently caused foliage injury to corn and undesirable spots on shucks and flag leaves



Effect of a good earworm control program is shown by these ears of sweet corn. Untreated corn, left, is badly damaged, but treated ears, right, are worm-free.

of roasting ears. The burn was severe during hot, dry weather. For this reason, mineral oil is not generally used in Alabama.

Rates of DDT

Several experiments were conducted to determine the amount of DDT to use in sprays for most effective earworm control. Some of the trials included comparisons with and without mineral oil. Rates from 0.5 to 4.0 pounds of DDT per acre per application were used, Tables 3, 7, 8, 19, 20.

In these experiments at least 2 pounds of DDT (1 gallon of 25 per cent emulsifiable concentrate) was needed per acre per application for good earworm control.

Sprays and Dusts

An experiment was conducted in 1952 to determine the relative efficiency of DDT dusts and sprays, Table 9. Four pounds of DDT as spray and dust was applied per acre per application by airplane. Five applications were made at 3-day intervals beginning when 10 per cent of stalks were in silk. The sprays resulted in about 30 per cent worm-free ears and the dusts in about 15 per cent. Thus, sprays were superior to dusts for worm control.

Dusts are washed off by rains to a greater degree than are spray residues. In fact, it is generally believed by entomologists that rain may actually increase effectiveness of emulsion sprays by carrying the insecticide into the silk channels of ears.

Application of Insecticides

Airplane application of insecticides for earworm control in sweet corn would be desirable if good results could be obtained. It would be particularly desirable when the ground is muddy or when corn stalks have been blown and twisted by wind. Results of an experiment in which airplane and ground equipment were compared are given in Table 9.

Although 4 pounds of DDT per acre was applied by airplane and only 2 pounds by ground equipment, sprays applied by ground equipment resulted in significantly more worm-free ears. The sprays were applied at 3-day intervals in this experiment. Reduced intervals between applications may have resulted in less difference between the two methods of application. Airplane application, of course, does not concentrate the insecticide in the ear region.

Two types of ground equipment for spraying sweet corn have been used successfully. One is a high-clearance self-propelled

High-clearance sprayers like the one shown above have been used successfully for applying insecticide to sweet corn for controlling the corn earworm.

A low-clearance power sprayer drawn by a regular farm tractor can be used successfully for spraying sweet corn, but an alley for the tractor must be left unplanted for every eight rows. Nozzle arrangement is shown in the inset.

spray machine that will move over the corn without breaking the stalks. Several such machines are currently on the market and others have been fabricated in machine shops. For small acreages, a mule-drawn, high-clearance sprayer may be used. For best results, high-clearance equipment should have at least 6 feet clearance from the ground. The second type of spray equipment is a low-clearance power sprayer drawn by a regular farm tractor. To use this sprayer in corn, an area the width of two rows is left unplanted after each eight rows. The sprayer is equipped with a horizontal boom mounted high enough to clear the corn stalks.

Corn sprayers should be equipped with horizontal booms that can be raised or lowered with a minimum of labor. The boom should be long enough to cover at least eight rows. Booms with flexible joints are preferred for ease of turning near fences or other obstacles or in moving along public roads.

Considerable research was done on nozzle types, pressure, gallonage per acre, and other factors in earworm control.

Pressure. Pressure of the spray is an important consideration in worm control. The pressure must be high enough to atomize the spray and to penetrate the foliage and silk mass. However, when nozzles with small orifices are used, pressure can be too

high for maximum effect. If the spray is divided into a very fine mist, it drifts or blows away and does not stick when it strikes the corn plant.

Corn with heavy growth requires greater pressure than that with less growth. Amount of growth varies with variety, soil type, and moisture. An example of the result of using insufficient pressure when there was a heavy infestation of earworm in the whorls before tasselling is shown in Table 19. None of the spray treatments given in Table 19 resulted in satisfactory worm control, even though the rate of DDT and spray intervals were optimum in some of the treatments.

Results of experiments in which pressure was a variable are shown in Tables 10 and 20. In Table 10, where vegetative growth was medium to light, 120 pounds of pressure was most effective of the three pressures tried. Where growth was heavy, 200 pounds pressure was much more effective than 100, Table 20. With nozzles that deliver 20 to 30 gallons of spray per acre, such as four No. 65067 per row, 200 pounds of pressure was considered an effective operating pressure.

Gallonage. Investigations were made on varying the gallons per acre from 6 to 50. Results of two such studies are presented in Tables 11 and 12. There was no difference between treatments because of different gallonages of spray. Gallonages of less than 20 per acre require nozzles with very fine orifices. The fine orifices are difficult to keep from clogging. Thus, 20 to 25 gallons of spray per acre is about the minimum for efficient sprayer operation. The gallonage, of course, must contain the correct amount of insecticide. The same amount of DDT, 2 pounds per acre, should be used regardless of total gallons of spray per acre.

In order to know the correct proportions of DDT concentrate to mix with water, it is essential to know the amount of spray (gallonage) delivered per acre. An excellent description of how to calibrate a sprayer is given in Auburn University Agricultural Experiment Station Circular 126.

Nozzles. Studies were conducted on type and number of nozzles per row for the most effective spray for control of earworm. Comparisons were made of flat fan and hollow cone nozzles and of two and four nozzles per row.

Results of these experiments are given in Tables 12 and 13. In 1951 excellent control was obtained with all nozzle arrange-

ments and there was no significant difference between results with flat fan or hollow cone nozzles nor with two or four flat fan nozzles per row, Table 12. In 1955, flat fan nozzles gave better results than the hollow cone type, Table 13. It is noted that two high-gallonage agricultural nozzles (such as used for spraying fungicides on potatoes) gave essentially the same control as did four flat fan nozzles. The current recommendation is four flat fan nozzles per row. The nozzle most commonly used is No. 65067.

Coverage of ear region of the stalk is essential in earworm spraying. Good coverage is more important than nozzle type, although type and number of nozzles influence the extent of coverage obtained. Regardless of type or number of nozzles, a vertical coverage of at least 24 inches in the ear region of the stalk is necessary. Position of ears on corn stalks varies somewhat and every ear must be covered with each application for maximum results.

To obtain desired coverage, nozzles are placed on drops from

A nozzle arrangement like the one shown here gives good ear-region coverage.

a horizontal boom that passes over the top of the corn. Two nozzles are arranged on each side of each row so that the spray is directed into the ear region. The two nozzles on each side should be at least 12 inches apart vertically. The lower nozzle works satisfactorily by directing the spray directly toward the row. Center of the spray pattern from the lower nozzle should be as near the middle of the ears as can be determined. The upper nozzle should direct the spray slightly downward and forward (or backward) onto the silks. This arrangement gives an overlapping of the spray patterns from the two nozzles near the ear tips, and it provides at least 2 feet of vertical coverage.

Speed. As indicated in Table 12, there was no difference in control between ground speeds of 4 or 8 miles per hour of the spraying machinery provided the sprayer was calibrated at the speed used. Speed of the machine affects the volume of spray inversely. The faster a machine moves over the ground, the less gallonage per acre it delivers at a constant pressure. A satisfactory operating speed, dependent on the machine and terrain, should be determined and the machine calibrated for that speed.

It has been suggested that reversing the direction of the spray machinery with alternate applications would increase effectiveness of earworm control. However, in an experiment in 1956 where sufficient pressure was used, reversing direction of the sprayer with alternate applications had no effect on earworm control, Table 3.

Timing of Sprays

Considerable research in the past few years was devoted to determining when to begin spraying, how often to spray, and when to stop.

The silk is the most desirable place for the earworm moth to lay eggs. Thus, protection of the silk is the most important consideration in earworm control. The longer the silking period, the longer the spray program must continue.

Studies have been made on the time and rate that sweet corn produces silks. The rate of silking depends on moisture conditions, and within a specific field, on the homogenity of the soil. In 1955, Table 14, 1 week was required for a field of sweet corn on the Gulf Coast Substation to develop full silk (every stalk

showing silk, not all silks full grown) after the first silks appeared. Soil moisture was low and the soil varied from one side of the field to the other. In 1958, Table 15, the corn was in full silk the fourth day after appearance of the first silks. In this field the first silks appeared about 2 weeks after the first ear shoots began to show on stalks. Tassels appeared about 1 day after ear shoots.

When to Begin. When earworm infestations were light to medium and there were no earworms in the whorls of sweet corn, there was no advantage in beginning the spray program before silks appeared, Tables 4 and 17. However, when earworm infestations were heavy and worms were present in the whorls, presilk sprays were advantageous, Table 3. A delay of 1 day in beginning the spray program may result in less control, Table 18. It is difficult to determine in advance how severe worm infestation will be in the ears, even though no whorl injury may be evident. Therefore, the grower should attempt to apply at least two sprays before the first silks appear.

Interval Between Sprays. Much of the early work was done with 3-day intervals between sprays, since it takes about 3 days for earworm eggs to hatch. Because the favorite part of the plant for egg laying is the green silk, it would appear that application of DDT to corn silks at 3-day intervals would give excellent control.

Early recommendations for earworm control stated that spraying should begin when 10 per cent of stalks were in silk and continue at 3-day intervals until silks were brown *(4)*. This program normally required four or five applications. When earworm infestations were not severe (10 to 20 per cent worm-free ears in unsprayed corn), this program usually resulted in over 90 per cent worm-free ears, Tables 16 and 17. However, in 1954 when infestation was heavy (no worm-free ears in unsprayed corn), seven sprays applied at 3-day intervals beginning before the first silks appeared resulted in only 80 to 85 per cent worm-free ears, Table 8. This experiment vividly illustrated that when earworm infestation was severe, a spray program with 3-day intervals between sprays gave only fair earworm control, even though it began before silks appeared.

In 1955, a year of reasonably light earworm infestation (11 per cent worm-free ears in unsprayed corn), five or six sprays

applied at 2-day intervals during the silking period resulted in over 90 per cent worm-free ears, Table 18. Three-day interval spray programs in the same experiment gave poorer worm control. A delay of one day in beginning the spray program in this experiment caused a drop in control. In another experiment in the same field, 16 daily applications resulted in 93.5 per cent worm-free ears, Table 13.

Experiments conducted in 1956 and 1957 (years of high and medium infestations, respectively) with 1- or 2-day intervals between sprays during the silking period resulted in good earworm control, Tables 3 and 4. In 1959, under conditions of severe earworm infestations, a 3-1-3 program (3-day interval until silking began; 1-day interval until full silk; and 3-day interval until silks were brown) was superior to a continuous 2-day interval program.

When to Stop. The current recommendation is to continue spraying until silks turn brown. This recommendation is based on the premise that eggs may be laid on the corn silks as long as the silks are living. Normally such a spray program is discontinued about a week before harvest. There are some indications that sprays applied after the silks stop growing may be unnecessary, Tables 19 and 20. However, further research is needed to definitely establish this fact.

Control of Earworms in the Whorl

Corn earworms frequently damage corn by feeding in the whorls before the stalks tassel, especially in late plantings. Severe injury in the whorl will reduce yield. When tassels emerge, the larvae migrate down the stalk, attack the developing ear, and cause severe damage to green market sweet corn.

Earworms in the whorl can be controlled with DDT sprays or granules. Treatment should be applied as soon as leaf-feeding injury becomes prevalent. Two pounds of technical DDT (1 gallon of 25 per cent emulsifiable concentrate or 40 pounds of 5 per cent granules) should be applied per acre to corn knee-high or larger. The spray or granules should be applied directly into the whorls.

DDT sprays applied in the ear region will not successfully control earworm larvae that move down the stalks from tassel to ear. These worms are usually half-grown or larger and are

difficult to kill. They usually reach the ear before they get enough DDT to kill them.

SUMMARY and CONCLUSIONS

The corn earworm attacks sweet corn in Alabama every year. Control measures must be applied every year to produce worm-free market sweet corn.

DDT at 2 pounds per acre per application has consistently given the best earworm control of any insecticide tested.

Use of mineral oil with DDT gave an increase in earworm control, but its use may cause foliage and ear injury during hot, dry weather.

Emulsion sprays have resulted in better worm control than dusts.

Applications of DDT sprays by airplane at 3-day intervals were not as effective as by ground equipment.

Sprays must be applied at pressures sufficient to penetrate the foliage and silk mass. In corn with heavy foliage, spray should be applied at 200 pounds pressure.

Effective earworm control was obtained with spray volumes of 6 to 50 gallons per acre. Twenty to 25 gallons per acre was most practical.

Flat fan nozzles were slightly superior to hollow cone nozzles.

The sprayer should be equipped with four flat fan nozzles per row, two on each side of the row that direct the spray into the ear region of the stalk.

Reversing direction of the spray machinery with alternate applications failed to increase earworm control.

For best earworm control, spraying should be started in time to make two applications before the first silks appear. At this time, about one-half of the stalks will be in tassel.

Sprays should be applied at 2-day intervals. Daily applications during the silking period assure even more effective worm control.

Continuing to spray until silks turn brown has given good earworm control. Indications are that spraying may be stopped sooner; however, further research is needed to establish this fact.

Earworms in the whorls of untasselled corn may reduce yield, and they move down the stalks to the ears when tassels emerge and do further damage. DDT granules or sprays should be applied when earworm injury appears in untasselled corn.

TABLE 1. WORM-FREE EARS IN SWEET CORN FOLLOWING INSECTICIDAL EMULSION SPRAYS, TALLASSEE, 1951

Treatment[1]	Worm-free ears	
	Per cent	Angle
Untreated check	*0*	*0*
No insecticide, 10 lb. mineral oil	3	6.8
Insecticide mixed with 10 lb. mineral oil		
4 lb. toxaphene, 1 lb. parathion	82	65.4
1 lb. aldrin	41	39.4
1 lb. dieldrin	60	51.0
2 lb. TDE	70	57.0
2 lb. toxaphene	70	57.0
1 lb. Dilan	46	42.0
0.5 lb. endrin	64	53.1
1 lb. heptachlor	34	35.4
2 lb. methoxychlor	7	12.8
LSD, .05		12.8

[1] Four sprays were applied at 3-day intervals beginning when 50 per cent of stalks were showing silk. Indicated rates are per acre per application.

TABLE 2. WORM-FREE EARS IN SWEET CORN FOLLOWING VARIOUS INSECTICIDAL TREATMENTS, CLANTON, 1952

Treatment[1]	Worm-free ears	
	Per cent	Angle
Untreated check	*22*	*27.7*
2 lb. toxaphene, 1 lb. DDT	45	42.2
CPR, 1 qt.[2]	26	30.3
2 lb. DDT	56	48.2
2 lb. DDT, 2.8 gal. mineral oil	53	46.5
LSD, .05		8.14

[1] Four sprays were applied at 3-day intervals beginning when 34 per cent of stalks were showing silk. Indicated rates are per acre per application.

[2] CPR was a commercial formulation containing 2 gm. piperonyl cyclonene, 0.2 gm. pyrethrins, and 1.0 gm. rotenone per 100 ml.

TABLE 3. WORM-FREE EARS IN SWEET CORN FOLLOWING VARIOUS INSECTICIDAL TREATMENTS, FAIRHOPE, 1956

Treatment[1]	No. of applications	Worm-free ears	
		Per cent	Angle
Untreated check	*0*	*1.0*	*4.90*
2.5 lb. DDT, began spraying 1 day after first silks appeared, intervals as indicated			
1-day	15	96.5	81.69
2-day	8	84.5	67.28
3-day	5	65.5	54.07
1-day for 7 applications, 2-day thereafter	11	95.5	78.37
2-day for 4 applications, 1-day thereafter	11	81.8	65.05
3-day for 3 applications 1-day thereafter	9	52.5	46.44
1-day for 7 applications, 3-day thereafter	9	91.8	74.07
2.5 lb. DDT applied at 2-day intervals until 1 spray was applied to full silk, 3-day intervals thereafter, spray schedules started as indicated			
3 days before silking began	9	89.8	71.73
1 day before silking began	8	84.0	67.00
1 day after silking began	7	81.0	64.43
1 day after silking began, reversed directions of machinery with alternate applications	7	80.0	63.61
1.5 lb. DDT and 1.75 gal. mineral oil, began spraying 1 day after first silks appeared, 2-day intervals throughout	8	91.0	74.20
Began spraying 1 day after first silks appeared, 2-day intervals until 1 spray was applied to full silk, 3-day intervals thereafter			
0.25 lb. Phosdrin	7	8.8	16.63
2.0 lb. Thiodan	7	81.3	64.75
1.0 lb. Chlorthion	7	12.3	20.34
LSD, .05	----	----	8.54
.01	----	----	11.41

[1] Spraying was continued on all plots until silks turned brown. Indicated rates are per acre per application.

TABLE 4. WORM-FREE EARS IN SWEET CORN FOLLOWING VARIOUS INSECTICIDAL SPRAYS, FAIRHOPE, 1957

Treatment[1]	No. of applications	Worm-free ears	
		Per cent	Angle
Untreated check	*0*	*6.8*	*14.88*
2.0 lb. DDT, began spraying when stalks were shooting freely, intervals as indicated			
1-day	21	99.5	87.13
2-day	11	96.3	80.34
3-day	8	86.3	68.26
3-day until silking began, 1-day until full silk, 3-day thereafter	12	98.3	83.65
Same as above less first spray	11	99.3	86.53
Same as above less first and second sprays	10	98.5	84.04
2.0 lb. DDT, began spraying day first silks appeared, 1-day intervals until 1 spray was applied to full silk, 3-day intervals thereafter	10	98.6	79.24
Began spraying when stalks shooting freely, 3-day intervals until silking began, 1-day intervals until 1 spray was applied to full silk, 3-day intervals thereafter, insecticide rate as indicated			
1.0 lb. DDT	12	95.5	78.62
2.0 lb. toxaphene	12	32.5	34.74
0.25 lb. endrin	12	74.5	59.79
0.5 lb. Delnav	12	55.0	47.88
2.0 lb. Sevin	12	96.5	79.51
0.5 lb. heptachlor	12	60.0	50.94
0.5 lb. malathion	12	51.0	45.53
0.25 lb. parathion	12	58.0	49.64
LSD, .05	----	----	6.06
.01	----	----	8.10

[1] Spraying was continued on all plots until silks turned brown. Indicated rates are per acre per application.

TABLE 5. WORM-FREE EARS IN SWEET CORN FOLLOWING APPLICATION OF THREE MINERAL OIL EMULSION SPRAYS, FAIRHOPE, 1951

Treatment[1]	Percentage worm-free ears
Untreated check	2
2 lb. DDT	47
2 lb. TDE	23
4 lb. toxaphene	28
LSD, .05	12

[1] Each spray contained 10 pounds of mineral oil per acre. Three applications were made at 3-day intervals beginning when 90 per cent of the stalks were showing silk. Indicated rates are per acre per application.

TABLE 6. WORM-FREE EARS IN SWEET CORN FOLLOWING USE OF SEVERAL MINERAL OILS WITH DDT, FAIRHOPE, 1952

Treatment[1]	Worm-free ears	
	Per cent	Angle
Untreated check	2	5.7
1.5 lb. DDT plus 1.75 gallons of oil		
Sovaspray No. 1	70	57.1
Superla White No. 13	73	59.1
Premier White	76	60.6
Mineral Seal	59	50.1
Carnation	75	59.8
Shell No. 7	65	53.8
1.5 lb. DDT, no oil	52	46.2
WE-5[2]	65	53.7
LSD, .05	----	7.06

[1] Four sprays were applied at 3-day intervals beginning when 42 per cent of stalks were showing silk. Indicated rates are per acre per application.

[2] WE-5 is a proprietary product containing 0.8 lb. DDT and 4.32 lb. mineral oil per gallon. It was used at the rate of 2 gallons per acre.

TABLE 7. WORM-FREE EARS OF SWEET CORN FOLLOWING SPRAYS WITH VARYING RATES OF DDT IN DDT-MINERAL OIL EMULSIONS, CORTE FARM, 1951

Treatment[1]	Worm-free ears	
	Per cent	Angle
Untreated check	*19.0*	*25.1*
No DDT, 10 lb. mineral oil	32.5	34.5
Mixed with 10 lb. mineral oil		
0.5 lb. DDT	53.5	47.0
1.0 lb. DDT	77.5	61.7
2.0 lb. DDT	89.0	70.7
LSD, .05	----	8.0

[1] Indicated rates are per acre per application for 4 applications at 3-day intervals beginning when 10 per cent of stalks were showing silk.

TABLE 8. WORM-FREE EARS IN SWEET CORN FOLLOWING DDT SPRAYS WITH AND WITHOUT MINERAL OIL, FAIRHOPE, 1953-54

Treatment[1]	Worm-free ears			
	1953[2]		1954[3]	
	Per cent	Angle	Per cent	Angle
Untreated check	*13.5*	*21.3*	*0*	*0*
1.0 lb. DDT with mineral oil	82.0	65.3	58.8	50.1
1.0 lb. DDT, no oil	51.8	46.0	17.5	24.5
1.5 lb. DDT with mineral oil	90.0	72.6	74.5	60.0
1.5 lb. DDT, no oil	73.7	59.4	42.8	40.7
2.0 lb. DDT with mineral oil	88.0	70.0	81.0	64.3
2.0 lb. DDT, no oil	80.3	63.7	53.3	46.9
2.5 lb. DDT with mineral oil	----	----	86.8	68.9
2.5 lb. DDT, no oil	85.3	67.7	64.5	53.5
3.0 lb. DDT, no oil	----	----	54.0	47.3
4.0 lb. DDT, no oil	----	----	67.5	55.3
LSD, .05	----	9.5	----	6.0

[1] Indicated amounts are per acre per application. Mineral oil was used at rate of 1.75 gallons.

[2] Five sprays were applied at 3-day intervals beginning when 5 per cent of stalks were in silk.

[3] Seven sprays were applied at 3-day intervals beginning when corn was shooting and tasseling.

TABLE 9. WORM-FREE EARS IN SWEET CORN FOLLOWING VARYING METHODS OF APPLYING DDT, BON SECOUR, 1952

Treatment[1]	Worm-free ears	
	Per cent	Angle
Untreated check	*5.5*	*13.3*
Applied by airplane		
4 lb. DDT spray, 300 microns	30.3	33.0
4 lb. DDT spray, 50 microns	27.3	31.2
4 lb. DDT dust	14.8	22.5
Applied by ground equipment		
2 lb. DDT spray	73.3	58.9
2 lb. DDT-mineral oil spray	73.8	59.3
LSD, .05	----	6.8

[1] Five applications were made at 3-day intervals beginning when 10 per cent of stalks were showing silk. Indicated amounts are per acre per application.

TABLE 10. WORM-FREE EARS IN SWEET CORN FOLLOWING APPLICATION OF DDT-MINERAL OIL SPRAYS AT DIFFERENT PRESSURES, FAIRHOPE, 1951

Spray pressure[1]	Per cent worm-free ears	
	First harvest, June 12	Second harvest, June 19
p.s.i.		
80	15	48
120	35	62
240	25	55
LSD, .05	no difference	7.0

[1] Two nozzles per row were used in this experiment. Three sprays were applied at 3-day intervals when 90 per cent of stalks were showing silk.

TABLE 11. WORM-FREE EARS IN SWEET CORN FOLLOWING APPLICATION OF DDT-MINERAL OIL SPRAYS IN DIFFERENT GALLONAGES PER ACRE, FAIRHOPE, 1951

Gallons of spray per acre[1]	Per cent worm-free ears	
	First harvest, June 12	Second harvest, June 19
6	16	44
9	23	43
12.5	13	44
LSD, .05	no difference	no difference

[1] Three gallons per acre per application of a proprietary DDT-mineral oil concentrate was applied in each case. Three sprays were applied at 3-day intervals beginning when 90 per cent of stalks were in silk.

TABLE 12. WORM-FREE EARS IN SWEET CORN FOLLOWING APPLICATION OF DDT-MINERAL OIL SPRAYS BY VARIOUS METHODS, CORTE FARM, 1951

Treatment[1]	Worm-free ears	
	Per cent	Angle
Untreated check	37	37.3
4 fan-type nozzles used per row		
12.5 gal., low speed	95	77.6
25 gal., low speed	98	82.2
50 gal., low speed	99	83.9
25 gal., high speed	98	84.4
4 cone-type nozzles used per row		
25 gal., low speed	98	83.0
2 fan-type nozzles used per row		
25 gal., low speed	98	83.6
LSD, .05	----	8.2

[1] Four sprays were applied at 3-day intervals beginning when 10 per cent of stalks were in silk. All plots received the same amount of DDT-mineral oil concentrate per acre per application. Indicated amounts are for volume of spray per acre. Low speed was approximately 4 m.p.h. and high speed 8 m.p.h.

TABLE 13. WORM-FREE EARS IN SWEET CORN FOLLOWING USE OF VARIOUS NOZZLE ARRANGEMENTS, SPRAY INTERVALS, AND RATES OF DDT, FAIRHOPE, 1955

Treatment[1]	Total no. of sprays	Worm-free ears	
		Per cent	Angle
Untreated check	*0*	*8.5*	*14.7*
Four flat fan nozzles per row			
1-day interval, 2 lb. DDT	16	93.5	77.7
2-day interval, 2 lb. DDT	8	75.5	60.8
3-day interval, 2 lb. DDT	6	67.3	55.2
3-day interval, 2.5 lb. DDT	6	72.8	58.8
3-day interval, 3 lb. DDT	6	73.3	58.9
3-day interval, 2 lb. DDT with 1 gal. mineral oil in alternate applications[2]	6	51.8	46.0
Four hollow cone nozzles per row			
2-day interval, 2 lb. DDT	8	63.8	53.0
3-day interval, 2 lb. DDT	6	41.3	39.9
Two hollow cone high-gallonage agricultural nozzles per row			
3-day interval, 2 lb. DDT	6	61.3	51.5
LSD, .05		----	9.6

[1] Spray program started on May 23 and continued until June 8; delayed 1 day because heavy rain on May 29. Indicated rates are per acre per application.
[2] Received oil on May 23 and 30 and June 6.

TABLE 14. SILKING RATE OF GOLDEN CROSS BANTAM EVERGREEN SWEET CORN, FAIRHOPE, 1955

Date and time	Per cent of stalks showing silk
May 23, 4:00 p.m.	2.5
May 24, 9:00 a.m.	9.8
May 24, 5:00 p.m.	17.7
May 25, 8:00 a.m.	31.7
May 26, 10:00 a.m.	57.0
May 30, 8:00 a.m.	95.0

TABLE 15. DEVELOPMENT OF EAR SHOOTS, TASSELS, AND SILKS IN GOLDEN SECURITY SWEET CORN, FAIRHOPE, 1958

Date and time	Per cent of stalks showing		
	Ear shoots	Tassels	Silks
May 14, 2:00 p.m.	19	----	----
May 19, 2:00 p.m.	30	15	----
May 20, 7:00 a.m.	55	24	----
May 20, 4:00 p.m.	60	26	----
May 21, 7:00 a.m.	71	33	----
May 21, 4:00 p.m.	75	46	----
May 22, 7:00 a.m.	81	49	----
May 27, 7:00 a.m.	----	----	5
May 28, 7:00 a.m.	----	----	26
May 29, 7:00 a.m.	----	----	57
May 30, 7:00 a.m.	----	----	82

TABLE 16. EFFECT OF NUMBER OF APPLICATIONS OF DDT-MINERAL OIL EMULSION SPRAYS ON CONTROL OF CORN EARWORM IN SWEET CORN, CORTE FARM, 1951

Treatment[1]	Worm-free ears	
	Per cent	Angle
Untreated check	*19*	*25.2*
3 applications	77	61.6
4 applications	95	76.7
5 applications	97	81.0
6 applications	96	80.5
LSD, .05	----	7.2

[1] All sprayed plots received 1.5 pounds of DDT and 16 pounds of mineral oil per acre per application. All sprays were applied at 3-day intervals beginning when 10 per cent of stalks were in silk except the plots receiving 6 applications; in that case, the first spray was applied when 1 per cent of stalks were in silk.

TABLE 17. WORM-FREE EARS IN SWEET CORN FOLLOWING DIFFERENT TREATMENTS WITH DDT-MINERAL OIL SPRAYS, CORTE FARM, 1952

Treatment[1]	Worm-free ears	
	Per cent	Angle
Untreated check	*22.0*	*27.9*
4 applications beginning presilk	93.0	74.7
5 applications beginning presilk	92.8	74.7
4 applications beginning 10% silk	91.5	73.3
5 applications beginning 10% silk	90.0	71.9
LSD, .05	----	4.4

[1] Sprays were applied at 3-day intervals.

TABLE 18. RESULTS OF VARIOUS DDT-MINERAL OIL SPRAY TREATMENTS ON CONTROL OF THE CORN EARWORM IN SWEET CORN, FAIRHOPE, 1955

Treatment	Worm-free ears	
	Per cent	Angle
Untreated check	*11.0*	*19.1*
Began spraying first day after first silk		
6 applications at 2-day intervals	90.5	72.4
5 applications at 3-day intervals	81.0	64.3
5 applications at 2-day intervals	91.8	73.4
4 applications at 3-day intervals	77.8	62.0
Began spraying second day after first silk		
6 applications at 2-day intervals	76.8	61.4
4 applications at 3-day intervals	74.5	59.7
LSD, .05	----	5.4

TABLE 19. WORM-FREE EARS IN SWEET CORN FOLLOWING VARIOUS DDT EMULSION SPRAY TREATMENTS[1], FAIRHOPE, 1958

Treatment				Worm-free ears	
DDT, lb./a.	Began spraying	Stopped spraying	Interval between sprays (days)	Per cent	Angle
Untreated check				*0.0*	*0.0*
2.0	25% ear shoots	silks brown	2	41.8	40.2
2.0	50% tassel	silks brown	2	44.3	41.7
2.0	50% tassel	silks brown	3 to silking; 1 to full silk; 3 thereafter	38.5	38.5
2.0	50% tassel	silks brown	3 to silking; 2 to full silk; 3 thereafter	28.5	32.3
1.5	50% tassel	silks brown	2	29.5	32.8
1.0	50% tassel	silks brown	2	18.0	25.1
0.5	50% tassel	silks brown	2	2.5	8.9
1.5	50% tassel	silks brown	3 to silking; 1 to full silk; 3 thereafter	25.8	30.1
1.0	50% tassel	silks brown	3 to silking; 1 to full silk; 3 thereafter	13.8	21.6
0.5	50% tassel	silks brown	3 to silking; 1 to full silk; 3 thereafter	1.3	4.5
2.0	50% tassel	silks grown	2	41.3	40.0
2.0	50% tassel	silks grown + 1 appln.	2	41.8	40.2
2.0	50% tassel	silks grown + 2 applns.	2	42.8	40.8
2.0	50% tassel	silks grown	3 to silking; 1 to full silk; 3 thereafter	33.5	35.3
2.0	50% tassel	silks grown + 1 appln.	3 to silking; 1 to full silk; 3 thereafter	42.0	40.3
LSD, .05				----	9.9

[1] The poor worm control shown in this table resulted from a combination of insufficient pressure for the heavy vegetative growth and a heavy infestation of earworm in the whorls before tasselling.

TABLE 20. WORM-FREE EARS IN SWEET CORN FOLLOWING VARIOUS DDT EMULSION SPRAY TREATMENTS, GULF COAST SUBSTATION, 1959

Treatment[1]	Worm-free ears	
	Per cent	Angle
Untreated check	*0.0*	*0.00*
2 lb. DDT		
2-day interval until silks are brown	65.3	53.99
3-day interval to silking; 1-day to full silk; 3-day until silks are brown	77.8	61.94
Same as above except 3-2-3 intervals	51.8	46.05
2-day interval until silks are brown		
1.5 lb. DDT	60.3	50.96
1.0 lb. DDT	40.3	39.07
0.5 lb. DDT	12.3	20.11
3-1-3 intervals until silks are brown		
1.5 lb. DDT	72.8	58.67
1.0 lb. DDT	45.5	42.41
0.5 lb. DDT	16.3	23.48
2 lb. DDT, 2-day interval until silks are grown	64.8	53.69
Same as above plus 1 application at 2-day interval	62.5	52.37
Same as above plus 2 applications at 2-day interval	61.0	51.36
Same as above plus 3 applications at 2-day interval	66.5	54.80
1 lb. DDT, 2-day interval until silks are brown, plus sticker	35.0	36.76
2 lb. DDT, 2-day interval until silks are brown, 100 p.s.i.	36.0	36.66
LSD, .05	...	2.36

[1] All sprays were applied at 200 p.s.i. pressure unless otherwise indicated. Spraying began when corn was in full tassel but before silks began to show. Indicated amounts are per acre per application.

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