STUDIES ON CORN EARWORM CONTROL IN THE EVERGLADES [1]

EMMETT D. HARRIS, JR.
Everglades Experiment Station, Belle Glade, Florida

The corn earworm, *Heliothis zea* (Boddie), is the most damaging insect that attacks sweet corn in Florida. This is especially true as most of the corn is sold as fresh corn under the grade of U. S. Fancy. Among other requirements, a U. S. Fancy ear must show no evidence whatever of corn earworm attack to the ear itself or even within the silk channel. No vegetable pest requires a more intensive spray program than that necessary to control this pest. Everglades growers spray or dust at least every other day from the time the first silks appear within a planting, until all the silks are dry. Where large acreages of corn are involved, the same sprayer or duster may be operated 24 hours a day. The author's primary objective in corn earworm control studies on sweet corn is to find ways to reduce the number of necessary insecticide applications, and, at the same time, maintain a high degree of corn earworm control. To date the fulfillment of this objective has not been accomplished.

Spray applications were made with a high-clearance, self-propelled sprayer built at the Everglades Experiment Station [2]. A Myers jumbo nozzle fitted with a No. 3 disc was used on each side of the sweet corn row. The nozzles were at approximately the same height as the silks, and at a right angle to the stalks. The spraying pressure was 200 pounds per square inch. For all trials, Golden Security variety of sweet corn was planted in rows that were three feet apart and thinned to give a 12-inch spacing within the row. Budworm and disease control was accomplished with DDT-parzate sprays until the time of silking. Experimental insecticide applications were begun the day after the first silks appeared and continued until all silks were dry. In each experiment a randomized complete block design employing four replications was used. A 100-ear sample was examined in each plot to determine the percentage of ears that were free of earworm injury. Before analysis of variance was conducted, these percentages were transformed to angles (arc sin $\sqrt{\%}$).

Comparison of control programs that either are recommended or are in common use in the Everglades: This test is probably the first in which all of the corn earworm control programs in common use in the Everglades have been compared in one experiment. With the exception of the DDT wettable powder spray each of the programs in the trial are recommended in Everglades Experiment Station Mimeo 55-11 [3]. According to station recommendations the DDT-mineral oil emulsion should contain 2.5 gallons of a white mineral oil to each 50 gallons of spray but due to error the mineral oil was used at the rate of 1.25 gallon to each 50 gallons of emulsion. Dusts were applied with Niagara Cyclo Junior hand dusters at approximately 30 pounds per acre.

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[1] Florida Agricultural Experiment Stations, Journal Series No. 639.

[2] Harrison, D. S., and C. S. Yager. 1957. A hi lo all-purpose sprayer. Agricultural Engineering (In Press).

[3] Hayslip, Norman C., and W. H. Thames, Jr. 1955. Protecting the ears of sweet corn from insect damage in the Everglades area. Everglades Station Mimeo Report 55-11.

TABLE 1. COMPARISON OF CORN EARWORM CONTROL PROGRAMS IN COMMON USE IN THE EVERGLADES.

Treatments	Intervals Between Applications (Hours)	Pounds of Active Ingredient per Acre	Worm-free Ears	
			Angle* **	Percent
5% DDT + 1% Parathion dust	48	1.5 + 0.3	70.51	89
2% parathion dust	48	0.6	72.54	91
10% DDT dust	48	3.0	73.97	92
DDT EC (2 lbs./gal.)	48	2.0	76.64	95
5% DDT + 1% parathion dust	24	1.5 + 0.3	78.36	96
DDT EC + mineral oil	48	2.0 + 1.5 gal.	78.48	96
DDT 50% WP	48	2.0	80.81	98
DDT 50% WP	24	2.0	83.02	99
10% DDT dust	24	3.0	84.04	99
2% parathion dust	24	0.6	84.73	99
Untreated check †	—	—	——	49

* Percentages were transformed to angles (angle = arc sin $\sqrt{\%}$) before conducting analysis of variance.

** Means joined by the same line are not significantly different; Means not joined by the same line are significantly different.

† Untreated check plots were not included in the analysis.

The plants were silking during the latter half of April and examinations for earworm injury were made on May 2. Dusts containing 10 percent DDT or two percent parathion gave a significantly higher percentage of worm-free ears when applied at 24-hour intervals than when applied at 48-hour intervals (Table 1). The difference between the 24 and 48-hour intervals was not significant for a dust containing five percent DDT plus one percent parathion. No significant differences occurred among the percentages of worm-free ears given by DDT wettable powder sprays at 24 and 48-hour intervals. A DDT wettable powder spray applied at 24-hour intervals gave a significantly higher percentage of worm-free ears than any 48-hour interval dust application. Otherwise there were no significant differences between dusts and sprays as to degree of earworm control obtained. There were no significant differences among the results given by the different DDT sprays.

Toxaphene-DDT and toxaphene-parathion mixtures: Table 2 shows the results of a comparison of parathion, toxaphene, DDT, a toxaphene-DDT mixture, and a toxaphene-parathion mixture for earworm control on corn that was in silk during late April and was harvested on May 2. When used at the same rate per acre as an emulsion, toxaphene was inferior to DDT for earworm control. The addition of 0.5 pound of DDT to two pounds of toxaphene per acre did not increase control. The addition of two pounds of toxaphene to 0.25 pound of parathion per acre did not increase the effectiveness of parathion. DDT and parathion were about equally effective.

TABLE 2. CORN EARWORM CONTROL WITH EMULSIONS OF TOXAPHENE, PARATHION, DDT, AND TOXAPHENE COMBINATIONS.

Insecticide and pounds of active ingredient per acre	Worm-free Ears	
	Angle* **	Percent
Toxaphene (2.0) + DDT (0.5)	61.82	78
Toxaphene (2.0)	62.03	78
Parathion (0.25)	72.57	91
Toxaphene (2.0) + Parathion (0.25)	73.68	92
DDT (2.0)	76.64	95
Untreated check †	——	49

* Percentages were transformed to angles (angle = arc sin $\sqrt{\%}$) before conducting analysis of variance.

** Means joined by the same line are not significantly different; Means not joined by the same line are significantly different.

† Untreated check plots were not included in the analysis.

DDT, toxaphene, and DDT-toxaphene emulsions were applied at 4-day intervals to silking sweet corn during late May and early June for earworm control. At one or two pounds per acre, toxaphene failed to increase the effectiveness of DDT (Table 3). Two pounds of DDT without toxaphene gave significantly better control than one pound of DDT plus toxaphene. Two pounds of DDT plus toxaphene was not significantly better than one pound of DDT plus toxaphene. Alone at two pounds per acre, toxaphene gave significantly less earworm control than any DDT or DDT-toxaphene treatment.

TABLE 3. TOXAPHENE, DDT, AND TOXAPHENE-DDT EMULSIONS FOR CORN EARWORM CONTROL.

Insecticide	Pounds of Active Ingredient per Acre	Worm-free Ears	
		Angle * **	Percent
Toxaphene	2	37.66	37
Toxaphene + DDT	2 - 1	49.30	57
Toxaphene + DDT	1 - 1	50.18	59
Toxaphene + DDT	1 - 2	50.62	60
Toxaphene + DDT	2 - 2	53.57	65
DDT	2	57.69	71
Untreated check †	——	——	6

* Percentages were transformed to angles (angle = arc sin $\sqrt{\%}$) before conducting analysis of variance.

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† Untreated check plots were neither randomized within this experiment nor included in the analysis. Value taken from check plots in an adjacent experiment.

DDT, DDT-oil, endrin, sevin, thiodan, and guthion emulsions: Emulsions were applied at 4-day intervals during May to compare three dosages of endrin, sevin, thiodan, and guthion with DDT (2 pounds), and DDT-oil (2 pounds + 2.5 gallons) emulsions. All emulsions were applied at the rate of 50 gallons per acre.

Endrin at 1.6 pounds per acre gave a degree of control that was not significantly different from that given by either DDT or DDT-oil. Endrin at 0.8 pound per acre gave a percentage of worm-free ears that was significantly less than that obtained with DDT-oil but not DDT. The 1.6 pound dosage of endrin was significantly more effective than the 0.8 and 0.4 pound levels. The 0.8 and 0.4 pound dosages were not significantly different (Table 4).

TABLE 4. COMPARISON OF ENDRIN DOSAGES, DDT, AND DDT-OIL FOR CORN EARWORM CONTROL.

Insecticide	Pounds of Active Ingredient per Acre	Worm-free Ears	
		Angle * **	Percent
Endrin EC (1.6 lbs./gal.)	0.4	57.89	72
Endrin EC	0.8	62.30	78
DDT EC (2 lbs./gal.)	2.0	67.16	85
Endrin EC	1.6	69.00	87
DDT EC + mineral oil	2.0 + 2.5 gals.	74.36	93
Untreated check †	—	——	40

* Percentages were transformed to angles (angle = arc sin $\sqrt{\%}$) before conducting analysis of variance.

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† Untreated check plots were not included in the analysis.

TABLE 5. COMPARISON OF SEVIN DOSAGES, DDT, AND DDT-OIL FOR CORN EARWORM CONTROL.

Insecticide	Pounds of Active Ingredient per Acre	Worm-free Ears	
		Angle * **	Percent
Sevin EC (1 lb./gal.)	0.5	57.93	72
Sevin EC	1.0	63.30	80
Sevin EC	2.0	66.94	85
DDT EC (2 lbs./gal.)	2.0	67.30	85
DDT EC + mineral oil	2.0	75.63	94

* Percentages were transformed to angles (angle = arc sin $\sqrt{\%}$) before conducting analysis of variance.

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Sevin at one and two pounds per acre, and DDT, were not significantly different in corn earworm control (Table 5). The DDT-oil emulsion gave significantly better control than the other treatments. Both DDT and the two pound dosage of sevin were significantly better than the 0.5 pound dosage of sevin.

TABLE 6. COMPARISON OF THIODAN DOSAGES, DDT, AND DDT-OIL FOR CORN EARWORM CONTROL.

Insecticide	Pounds of Active Ingredient per Acre	Worm-free Ears	
		Angle * **	Percent
Thiodan EC (2 lbs./gal.)	0.5	51.24	61
Thiodan EC	2.0	64.88	82
Thiodan EC	1.0	64.94	82
DDT EC (2 lbs./gal.)	2.0	66.72	84
DDT EC + mineral oil	2.0 + 2.5 gals.	73.56	92

* Percentages were transformed to angles (angle = arc sin $\sqrt{\%}$) before conducting analysis of variance.

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The percentages of worm-free ears given by thiodan at one and two pounds per acre and DDT were not significantly different, but were significantly higher than that for thiodan at 0.5 pound (Table 6). DDT-oil emulsion was significantly the most effective treatment.

The DDT-oil emulsion was significantly better than guthion at 0.75 or 0.38 pound per acre (Table 7). DDT was significantly better than guthion at the 0.38 pound level. The 1.5 pound dosage of guthion was significantly better than the 0.38 pound dosage.

TABLE 7. COMPARISON OF GUTHION DOSAGES, DDT, AND DDT-OIL FOR CORN EARWORM CONTROL.

Insecticide	Pounds of Active Ingredient per Acre	Worm-free Ears	
		Angle * **	Percent
Guthion EC (1.5 lbs./gal.)	0.375	60.41	76
Guthion EC	0.75	68.14	86
Guthion EC	1.5	70.97	89
DDT EC (2 lbs./gal.)	2.0	72.77	91
DDT EC + mineral oil	2.0	77.42	95
Untreated check †	——	——	49

* Percentages were transformed to angles (angle = arc sin $\sqrt{\%}$) before conducting analysis of variance.

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† Untreated check plots were not included in the analysis.

Discussion

Although experiments reported in this paper have not indicated a better corn earworm control program, they have shown some interesting side lights. When care was taken to apply as many gallons of wettable powder spray as DDT emulsion, the wettable powder spray gave a degree of control about equal to that given by the emulsion. DDT wettable powder sprays have never been recommended for corn earworm control in Florida, but most of the sweet corn growers in the Everglades who spray are using wettable powders in preference to DDT emulsifiable concentrates. This is apparently because emulsifiable concentrates are more expensive, and also because some growers have experienced spray burn with emulsions. The author observed spray injury to sweet corn ears from DDT-oil emulsions but not from DDT emulsion when used alone.

The addition of toxaphene to parathion or DDT emulsions did not increase corn earworm control. In fact, it appeared that admixture with toxaphene slightly decreased the degree of control given by DDT in emulsions.

Considering both the degree of control obtained and the cost of the insecticides, neither endrin, sevin, thiodan, nor guthion show promise for corn earworm control. At the higher dosages each gave a degree of control comparable to that given by DDT but as these are comparatively new insecticides, the cost per pound of actual toxicant will probably be much greater than that for DDT.