# INEFFECTIVENESS OF THE OVERHEAD-IRRIGATION METHOD FOR THE APPLICATION OF INSECTICIDES TO CONTROL THE SUGARCANE MOTH STALK-BORER, *DIATRAEA SACCHARALIS* (FABRICIUS)[1]

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## INTRODUCTION

The uneven topography of Hacienda Santi or Juana Díaz, near central Cortada, Santa Isabel, P.R., makes the distribution of irrigation water to fields of sugarcane very difficult by ordinary gravity methods. The light and porous soils of the area also offer an irrigation problem, since much water is lost by seepage and is never used by the cane. To solve this problem, a system of overhead irrigation was installed using a central pumping station to distribute the water through a series of subterranean pipes, 6 inches in diameter, terminating in 31 vertical risers or towers, hereafter referred to as towers, through each of which the water could be applied from a greater height than that of fully grown cane in adjoining or slightly overlapping circular areas of 2½ acres.

The distribution of the water was quite even within the area, as was proved by collections in a series of pails spaced at 10-foot intervals from the base of the towers to the outside of the irrigated area. Each revolution of the nozzle at the top of the tower had a duration of about 10 minutes, and 6 revolutions were required to apply 0.994 inch of water per acre to each area. The towers were operated one by one; while one was in operation the others were closed, and as soon as a tower was about to be closed the next one following in schedule was opened immediately. In this manner there was always a tower in operation during the irrigation periods.

To render the irrigation most effective the operations were conducted at night when the wind velocity was much lower than during the day. In the southcoast of Puerto Rico, as elsewhere in the Island, the velocity of the wind drops considerably after 6:00 p.m. and becomes almost zero during the night, when only a zephyr blows. At this time the overhead irrigation worked best.

[1] The writers are grateful for the full cooperation that was given to them in this investigation by: Maybin S. Baker, Head, Research Department; T. B. Fraser, General Field Manager, Cortada Division, both from Luce & Co., S. en C.; George N. Wolcott, Head, Department of Entomology and Juan L. Moreno, Research Assistant in Entomology, both from the Agricultural Experiment Station, Río Piedras, P. R.

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[3] Agronomist, Research Department, Luce & Co., S. en C., Aguirre, P. R.

TABLE 1.—*Water received by each crop of sugarcane grown at the Colonia Juana Díaz, Santa Isabel, 1948–52*

| Crop year[1] | Rainfall[2] | Overhead irrigation | Total quantity of water[3] |
|---|---|---|---|
| | *Inches* | *Inches* | *Inches* |
| 1948–49 | 41.45 | 48.00 | 89.45 |
| 1949–50 | 35.93 | 41.00 | 76.93 |
| 1950–51 | 39.02 | 36.70 | 75.72 |
| 1951–52 | 31.19 | 37.30 | 68.49 |

[1] Means the period from July to the next June, or from one harvest to the next.

[2] Natural rainfall, as obtained by the Saurí pluviometer at Colonia Juana Díaz. All records courtesy of M. S. Baker, Luce & Co., Aguirre.

[3] Includes the natural rainfall plus the water received by the sugarcane when using the artificial method of the overhead irrigation.

### Rainfall and Overhead Irrigation Water

Table 1 summarizes the quantity of water received by each crop of sugarcane grown at Hacienda Juana Díaz from the summer of 1948 through all seasons, up to the summer of 1952, a period during which four different crops were harvested. Both the water received via overhead irrigation and that as natural rainfall are included.

## MATERIALS AND METHODS

### Overhead Irrigation for Spraying

The use of overhead irrigation makes possible the application of fertilizers dissolved in water, and of insecticides for the control of white grubs and other soil-insect pests of sugarcane.

When the purchase of an airplane for the application of insecticides to control the sugarcane moth stalk-borer was being considered, it seemed desirable to determine whether any of these insecticides would be effective during the Puerto Rican long-crop season, if applied by means of overhead irrigation. In the late winter of 1950, G. N. Wolcott[4] was requested to prepare a scheme of procedure to include all the new insecticides which might be of possible value, but by the time they had been purchased, the crop season was so far advanced as to make their application inadvisable at that time. By postponing the initiation of the tests until September 1950, it was possible to use cane which had just begun to form stalks and had a maximum development of leaf surface to receive the insecticides.

By starting the sprayings in September or October, the results of the effectiveness of the insecticides could be determined at the time of harvesting by examining the base of the stalks which developed and were

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subject to borer infestation when the insecticides were applied. It was not anticipated that the upper portions of the stalks developing from mid-November to the end of the crop season, would be affected by the insecticides, although it might be possible for the lag in subsequent infestation to take some time.

During 1950 the sprayings were scheduled as follows: The first, September 26–27; the second, October 13–14; the third, October 30–31; and the fourth and last, November 14–15.

During 1951, when the experiment was repeated, the sprayings were scheduled as follows: The first, October 16–17; the second, October 30–31; the third, November 13; and the fourth and last, November 27–28.

The applications of the insecticides took more time than was anticipated. Theoretically, if one revolution of the nozzle of the towers required only 10 minutes, the application of 10 insecticides at 2 strengths should not take all night. Actually, the delay involved in opening and closing the valves and changing the nozzles, and in applying an equal quantity of water to the checks, extended the time for making the tests from shortly after sunset until after sunrise of the next day. Frequently the full moon brilliantly illuminated the scene during the spraying operations; at other times the night was dark as a cave. During dark nights one could observe the intermittent flashes from the lighthouse on the offshore Island of Caja de Muertos. Those present during the spraying operations, besides the writers, were G. N. Wolcott, Mario Pérez[5], field assistants Juan Zambrana and Wilfredo Cruz, and laborers in charge of operating the towers.

## Insecticides Used

The original plan called for tests with 12 insecticides, but DDT and Dilan, made by the Commercial Solvents Corp., were not available when the tests began. Those actually used in the 1950 experiment were Aldrin, Chlordane, Dieldrin, Ryania, Gy-phene, CPR Emulsion Concentrate, Marlate (methoxychlor), Rhothane, benzene hexachloride, and Kryocide. In the 1951 experiment the same insecticides were used with the exception of Dilan, Heptachlor 2E Emulsion, and Dr. Wolf's Insecticide which were substituted for Dieldrin and CPR Emulsion Concentrate (see table 2).

The concentration of insecticides or rate used per acre, as well as number of towers on which they were applied are presented in table 2.

The insecticides used during these tests may be described as follows: Hyman 118 or Aldrin, a product of Julius Hyman & Co., of Denver, Colo., known as Octalene, 24-percent emulsifiable concentrate, contained 2 pounds

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TABLE 2.—*Insecticides used at indicated towers and rates of application, 1950–51*

| Insecticide | 1950 | | | 1951 | | |
|---|---|---|---|---|---|---|
| | Tower No. | Rate of application | | Tower No. | Rate of application | |
| | | Insecticide per tower | Technical compound per acre | | Insecticide per tower | Technical compound per acre |
| | | | *Pounds* | | | *Pounds* |
| Aldrin | 11 | 1¼ gal. | 1 | 22 | 1¼ gal. | 1 |
| Do. | 12 | 2½ gal. | 2 | 21 | 2½ gal. | 2 |
| Chlordane | 5 | 3.25 lb. | 1 | 26 | 3.25 lb. | 1 |
| Do. | 6 | 6.50 lb. | 2 | 25 | 6.50 lb. | 2 |
| Dieldrin | 3 | 1¼ gal. | 1 | 29[1] | 1 gal. per 2½ A. | |
| Do. | 2 | 2½ gal. | 2 | 30[2] | 1 gal. per 2½ A. | |
| Ryania | 7 | 5 lb. | 2 | 17 | 5 lb. | 2 |
| Do. | 8 | 2½ lb. | 1 | 18 | 2½ lb. | 1 |
| Rhothane | 25 | 10 lb. | 2 | 7 | 10 lb. | 2 |
| Do. | 26 | 5 lb. | 1 | 8 | 5 lb. | 1 |
| BHC | 29 | 2½ gal. | 1 | 2 | 2½ gal. | 1 |
| Do. | 30 | 5 gal. | 2 | 3 | 5 gal. | 2 |
| CPR | 21 | 1¼ gal. per 2½ A. | | 13[3] | 1 gal. per 2½ A. | |
| Do. | 22 | ¾ gal. per 2½ A. | | 19 | 1½ gal. per 2½ A. | |
| Gy-phene | 23 | ½ of ⅚ gal. | 1 | 11 | ½ of ⅚ gal. | 1 |
| Do. | 24 | ⅚ gal. | 2 | 12 | ⅚ gal. | 2 |
| Marlate | 17 | 10 lb. | 2 | 6 | 10 lb. | 2 |
| Do. | 18 | 5 lb. | 1 | 5 | 5 lb. | 1 |
| Kryocide | 19 | 25 lb. | 10 | 24 | 25 lb. | 10 |
| Do. | 13 | 15 lb. | 6 | 23 | 15 lb. | 6 |

[1] Dilan was used through this tower.

[2] Heptachlor was the insecticide used through this tower.

[3] Dr. Wolf's Insecticide was used instead of CPR used in 1950.

of the technical Hyman 118 per gallon. It was applied at rates of 1 and 2 pounds of the technical compound per acre.

Chlordan or Chlordane, a product of Julius Hyman & Co., 74-percent emulsifiable concentrate, contained 8 pounds of technical Chlordane per gallon. It was applied at rates of 1 and 2 pounds of the technical compound per acre.

Dieldrin or Hyman 497, also a product of Julius Hyman & Co., known as Octalox, was a 24-percent emulsifiable concentrate, containing 2 pounds of technical Hyman 497 per gallon. It was applied at rates of 1 and 2 pounds of the technical compound per acre.

Ryania is the product obtained from the dried and powdered root of a tropical plant (*Ryania speciosa*), and was obtained from S. B. Pennick & Co., New York, N. Y., as Ryania powder, 100-percent pure for the 1950 tests, and as "Ryanicide 100", 100-percent purity, from the same manufacturer for the 1951 tests. The insecticide was used at rates of 1 and 2 pounds of the pure powder per acre.

Rhothane or DDD, was an analogue of DDT, manufactured by Rhom & Hass, Philadelphia, Pa., was obtained as a wettable powder, 50-percent concentrate, and was used at the rate of 1 and 2 pounds of the technical DDD per acre.

Benzene hexachloride or BHC was used as a concentrated emulsion; it was manufactured by the Pennsalt International Corp., Philadelphia, Pa., under the trade name of E-11, BHC Emulsion, containing 1 pound of the gamma isomer of BHC per gallon. The insecticide was applied at rates of 1 and 2 pounds of the gamma isomer per acre.

CPR emulsion concentrate, or CPR emulsifiable liquid concentrate, was manufactured by the Robert O. White Co., 1000 East Mermaid Lane, Philadelphia, Pa., and contained about 2 percent of piperonyl cyclonene, 0.20 percent of pyrethrins, and 1 percent of rotenone. It was used at rates of ¾ gallon and 1.25 gallons per 2½ acres.

Dr. Wolf's Insecticide A was used during the 1951 program as a substitute for CPR emulsion concentrate. This insecticide was based on the same active ingredients as CPR. It contained 2.12 percent of technical piperonyl cyclonene, 0.21 percent of pyrethrins, 1.06 percent of rotenone, and 2.12 percent of other cube resins as the most active ingredients. The product was manufactured by Dr. Wolf's Agricultural Laboratories, Bridgetown, N. J. It was used at rates of 1 gallon and 1½ gallons per 2½ acres.

Gy-phene E-60, concentrated emulsion, contained 6 pounds of technical Toxaphene per gallon. It was a product of Geigy Co. Inc., 89 Barclay St., New York, N. Y. It was used at rates of 1 and 2 pounds of technical toxaphene per acre.

Marlate was a Dupont product containing methoxychlor, a 50-percent wettable powder, and was used at rates of 1 and 2 pounds of the technical methoxychlor per acre.

Kryocide, a product of the Pennsalt International Corp., at Philadelphia, Pa., was a natural cryolite insecticide containing no less than 90-percent of sodium fluoaluminate. This insecticide was used at rates of 6 and 10 pounds per acre.

Heptachlor 2E Emulsion Concentrate, containing 2 pounds of the technical compound per gallon, was manufactured by the Velsicol Corp., Chicago, Ill. This product was used in one of the towers as a substitute for Dieldrin during the 1951 tests. The insecticide was applied at a rate of 1 gallon per 2½ acres.

Dilan 25 EM was used in one of the towers in substitution for Dieldrin during the 1951 tests. A product of Commercial Solvents Corp., New York, N. Y., it had the following formula:

| | Percent |
|---|---|
| 2-nitro-1,1-bis (p-chlorophenyl) propane (technical) | 8.33[1] |
| 2-nitro-1,1-bis (p-chlorophenyl) butane (technical) | 16.67 |
| Inert ingredients: | |
| Pine oil | 70.00 |
| Emulsifier | 5.00 |

[1] Sample No. 50-1064, for experimental use, prepared by Commercial Solvents Corp.

These compounds are referred to in all tables as follows:

| | |
|---|---|
| Aldrin | CPR |
| Chlordane | Dr. Wolf's Insecticide |
| Dieldrin | Gy-phene |
| Ryania | Marlate |
| Rhothane | Kryocide |
| BHC | Heptachlor |
| | Dilan |

## Procedure in Spraying Operations

The required quantities of the nine liquid insecticides as well as the four wettable powders were mixed with 6 gallons of water inside a metal barrel. The solution or suspension formed by mixing the insecticide was constantly stirred during the spraying operations. The barrel was connected directly to the main pump of the overhead irrigation system by means of a rubber hose. The diluted insecticide was mixed with the water of irrigation as it passed through the main pump. Since the tower took about 10 minutes to complete one revolution, the same time was taken to pour the total contents of the barrel through the main pipe, so that the insecticide was as evenly distributed as possible over the field to which it was applied.

There was a valve between the barrel and the rubber hose attached to the main pump. The partial opening and closing of the valve controlled the intake of insecticide from the barrel to the main pump. After practicing several times with plain water the valve was opened in such a way as to let a certain amount of insecticide in solution flow constantly and evenly into the main pump. The distribution of the insecticide was timed so that the last of it was flowing out of the barrel when one tower had just finished its revolution and before another one started working. Figures 1 and 2 show one of the nozzles used and an irrigation tower in operation with nozzle attached.

It is surprising how promptly these insecticides could be detected by smell even when diluted in several hundreds of gallons of water. It was possible to recognize the agreeable odor of Chlordane, Aldrin, Dieldrin, and CPR in dilution, and of course also, the disagreeable odor of BHC.

Usually after one tower was used for spraying an insecticide, the next following was a check in which plain water was used. To give the fieldmen in charge of changing the nozzles on the towers enough time for their operations, each was worked for 20 minutes. During the first 10 minutes water only was sprayed, but during the last 10 minutes the insecticide was distributed, thus a whole revolution of the nozzle was completed during the period in which the insecticide was distributed. If the next tower was also to be used in the application of an insecticide, a 10-minute interval followed to prepare the next insecticide in solution and place it in the barrel ready for distribution. If the tower following was a check tower, there were 30 minutes to wait until the next application, that is, 20 minutes for the check, 10 minutes of spare time, and then the application of the insecticide began on the last 10 minutes of the tower in operation. In this way each area irrigated by the towers received 20 minutes of artificial rainfall, regardless of whether it was a check or had received a treatment of insecticide. These were the factors which consumed so much time in the distribution of the insecticides through the overhead irrigation system.

The spraying operations were scheduled to take place with an interval of 15 days between applications, and four applications were given in each experiment during 1950 and 1951.

### Sugarcane Stalk Moth-Borer Counts

When the sugarcane was harvested in the overhead irrigation area a random sample of 100 canes was taken from around each tower, with precautions not to take samples from adjoining areas or from the areas covered by other towers. The stalks were examined, the joints counted, and the percentage of moth-borer infestation was determined. Tables 3 and 4 show the percentage of infestation in the overhead irrigation area during the 1951 and 1952 crops corresponding to the period of application of insecticides during the autumns of 1950 and 1951, respectively.

## RESULTS AND ANALYSIS

The results of the tests are shown in tables 3 for 1951 and 4 for 1952. Although the last sections of each table should be taken into consideration

FIG. 1.—Workman carrying the nozzle to one of the irrigation towers. Only 2 nozzles were used to operate 31 of the towers. The larger outlet is designed to irrigate 90 percent of the area around the tower and the smaller to irrigate the area in close proximity to the tower.

FIG. 2.—One of the irrigation towers in operation after the nozzle had been attached.

TABLE 3.—*Rate of infestation by* **Diatraea saccharalis** *(Fabricius) at overhead irrigation area, Colonia Juana Díaz, Santa Isabel, 1951*

| Tower No. | Sugarcane variety | Treatment | Stalk infestation | Joint infestation | Base infestation | Center infestation | Top infestation |
|---|---|---|---|---|---|---|---|
| | | *In ascending order based on percentage stalk infestation* | | | | | |
| | | | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 30 | P.O.J. 2878 | BHC, 2 lb. gamma isomer per A. | 7 | 0.74 | 0.05 | 0.05 | 0.63 |
| 20 | B.H. 10(12) | Check | 11 | .927 | .040 | .282 | .604 |
| 24 | P.O.J. 2878 | Gy-phene, 2 lb. Toxaphene (tech.) per A. | 16 | 1.96 | .05 | .53 | 1.37 |
| 31 | P.O.J. 2878 | Check | 20 | 1.54 | .06 | .45 | 1.02 |
| 25 | P.O.J. 2878 | Rothane, 2 lb. DDD (tech.) per A. | 21 | 2.04 | .05 | .76 | 1.22 |
| 27 | P.O.J. 2878 | Check | 24 | 1.97 | .49 | .71 | .77 |
| 26 | P.O.J. 2878 | Rothane, 1 lb. DDD (tech.) per A. | 27 | 3.22 | .11 | .52 | 2.58 |
| 18 | B.H. 10(12) | Marlate, 1 lb. Methoxychlor (tech.) per A. | 29 | 3.08 | .27 | 1.68 | 1.13 |
| 19 | B.H. 10(12) | Kryocide, 10 lb. per A. | 29 | 3.11 | .31 | 1.02 | 1.77 |
| 15 | B. 34–104 | Check | 33 | 3.33 | .35 | .35 | 2.63 |
| 23 | P.O.J. 2878 | Gy-phene, 1 lb. of Toxaphene (tech.) per A. | 33 | 4.02 | .35 | .71 | 2.95 |
| 28 | P.R. 902 | Check.................... | 33 | 2.19 | .22 | .92 | 1.05 |
| 29 | P.R. 902 | BHC, 1 lb. gamma isomer per A. | 33 | 3.07 | .17 | .81 | 2.09 |
| 9 | P.O.J. 2878 | Check | 34 | 4.73 | .37 | .69 | 3.66 |
| 16 | P.O.J. 2878 | do. | 34 | 4.54 | .27 | .83 | 3.43 |
| 22 | P.O.J. 2878 | CPR, ¾ gal. on 2½ A. | 38 | 3.68 | .35 | 1.06 | 2.26 |
| 14 | B.H. 10(12) | Check | 40 | 3.95 | .15 | 1.28 | 2.52 |
| 10 | B.H. 10(12) | do. | 46 | 5.20 | .54 | 1.28 | 3.37 |
| 21 | P.R. 902 | CPR, 1¼ gal. on 2½ A. | 52 | 5.48 | .40 | 1.24 | 3.83 |
| 1 | B.H. 10(12) | Check | 53 | 4.93 | .86 | 1.17 | 2.90 |
| 13 | B.H. 10(12) | Kryocide, 6 lb. per A. | 54 | 5.78 | .17 | 1.76 | 3.84 |
| 17 | P.O.J. 2878 B.H. 10(12) | Marlate, 2 lb. Methoxychlor per A. | 57 | 8.15 | .37 | 3.03 | 4.74 |
| 7 | P.O.J. 2878 B.H. 10(12) | Ryania, 2 lb. per A. | 71 | 11.73 | 1.13 | 2.69 | 7.90 |
| 8 | P.O.J. 2878 | Ryania, 1 lb. per A. | 72 | 10.82 | 1.37 | 3.11 | 6.33 |
| 11 | B.H. 10(12) | Aldrin, 1 lb. Aldrin (tech.) per A. | 75 | 11.84 | 1.54 | 4.72 | 5.57 |
| 4 | B.H. 10(12) | Check | 80 | 12.70 | 1.11 | 4.77 | 6.81 |
| 12 | B.H. 10(12) | Aldrin, 2 lb. Aldrin (tech.) per A. | 84 | 13.15 | .92 | 5.50 | 6.72 |
| 5 | B.H. 10(12) | Chlordane, 3.25 lb Chlordane (tech.) on 2½ A. | 93 | 20.44 | 1.49 | 6.92 | 12.02 |

TABLE 3.—*Continued*

| Tower No. | Sugarcane variety | Treatment | Stalk infestation | Joint infestation | Base infestation | Center infestation | Top infestation |
|---|---|---|---|---|---|---|---|
| *In ascending order based on percentage stalk infestation* | | | | | | | |
| | | | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 3 | B.H. 10(12) | Dieldrin, 1 lb. Dieldrin (tech.) per A. | 96 | 26.07 | .73 | 10.80 | 14.54 |
| 6 | P.O.J. 2878 B.H. 10(12) | Chlordane, 6.50 lb. Chlordane (tech.) on 2½ A. | 96 | 21.75 | 1.73 | 6.81 | 13.20 |
| 2 | B.H. 10(12) | Dieldrin, 2 lb. Dieldrin (tech.) per A. | 98 | 27.72 | 3.49 | 11.25 | 12.97 |
| *In ascending order based on percentage joint infestation* | | | | | | | |
| 30 | P.O.J. 2878 | BHC, 2 lb. gamma isomer per A. | 7 | 0.74 | 0.05 | 0.05 | 0.63 |
| 20 | B.H. 10(12) | Check | 11 | .927 | .040 | .282 | .604 |
| 31 | P.O.J. 2878 | do. | 20 | 1.54 | .06 | .45 | 1.02 |
| 24 | P.O.J. 2878 | Gy-phene, 2 lb. Toxaphene (tech.) per A. | 16 | 1.96 | .05 | .53 | 1.37 |
| 27 | P.O.J. 2878 | Check | 24 | 1.97 | .49 | .71 | .77 |
| 25 | P.O.J. 2878 | Rhothane, 2 lb. DDD (tech.) per A. | 21 | 2.04 | .05 | .76 | 1.22 |
| 28 | P.R. 902 | Check | 33 | 2.19 | .22 | .92 | 1.05 |
| 29 | P.R. 902 | BHC, 1 lb. gamma isomer per A. | 33 | 3.07 | .17 | .81 | 2.09 |
| 18 | B.H. 10(12) | Marlate, 1 lb. Methoxychlor (tech.) per A. | 29 | 3.08 | .27 | 1.68 | 1.13 |
| 19 | B.H. 10(12) | Kryocide, 10 lb. per A. | 29 | 3.11 | .31 | 1.02 | 1.77 |
| 26 | P.O.J. 2878 | Rhothane, 1 lb. DDD (tech.) per A. | 27 | 3.22 | .11 | .52 | 2.58 |
| 15 | B. 34-104 | Check | 33 | 3.33 | .35 | .35 | 2.63 |
| 22 | P.O.J. 2878 | CPR, ¾ gal. on 2½ A. | 38 | 3.68 | .35 | 1.06 | 2.26 |
| 14 | B.H. 10(12) | Check | 40 | 3.95 | .15 | 1.28 | 2.52 |
| 23 | P.O.J. 2878 | Gy-phene, 1 lb. Toxaphene (tech.) per A. | 33 | 4.02 | .35 | .71 | 2.95 |
| 16 | P.O.J. 2878 | Check | 34 | 4.54 | .27 | .83 | 3.43 |
| 9 | P.O.J. 2878 | do. | 34 | 4.73 | .37 | .69 | 3.66 |
| 1 | B.H. 10(12) | do. | 53 | 4.93 | .86 | 1.17 | 2.90 |
| 10 | B.H. 10(12) | do. | 46 | 5.20 | .54 | 1.28 | 3.37 |
| 21 | P.R. 902 | CPR, 1¼ gal. on 2½ A. | 52 | 5.48 | .40 | 1.24 | 3.83 |
| 13 | B.H. 10(12) | Kryocide, 6 lb. per A. | 54 | 5.78 | .17 | 1.76 | 3.84 |
| 17 | P.O.J. 2878 B.H. 10(12) | Marlate, 2 lb. Methoxychlor (tech.) per A. | 57 | 8.15 | .37 | 3.03 | 4.74 |
| 8 | P.O.J. 2878 | Ryania, 1 lb. per A. | 72 | 10.82 | 1.37 | 3.11 | 6.33 |
| 7 | P.O.J. 2878 | Ryania, 2 lb. per A. | 71 | 11.73 | 1.13 | 2.69 | 7.90 |

TABLE 3.—*Continued*

| Tower No. | Sugarcane variety | Treatment | Stalk infestation | Joint infestation | Base infestation | Center infestation | Top infestation |
|---|---|---|---|---|---|---|---|
| *In ascending order based on percentage joint infestation* | | | | | | | |
| | | | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 11 | B.H. 10(12) | Aldrin, 1 lb. Aldrin (tech.) per A. | 75 | 11.84 | 1.54 | 4.72 | 5.57 |
| 4 | B.H. 10(12) | Check | 80 | 12.70 | 1.11 | 4.77 | 6.81 |
| 12 | B.H. 10(12) | Aldrin, 2 lb. Aldrin (tech.) per A. | 84 | 13.15 | .92 | 5.50 | 6.72 |
| 5 | B.H. 10(12) | Chlordane, 3.25 lb. Chlordane (tech.) on 2½ A. | 93 | 20.44 | 1.49 | 6.92 | 12.02 |
| 6 | P.O.J. 2878 B.H. 10(12) | Chlordane, 6.50 lb. Chlordane (tech.) on 2½ A. | 92 | 21.75 | 1.73 | 6.81 | 13.20 |
| 3 | B.H. 10(12) | Dieldrin, 1 lb. Dieldrin (tech.) per A. | 96 | 26.07 | .73 | 10.80 | 14.54 |
| 2 | B.H. 10(12) | Dieldrin, 2 lb. Dieldrin (tech.) per A. | 98 | 27.72 | 3.49 | 11.25 | 12.97 |
| *In ascending order based on percentage base infestation* | | | | | | | |
| 20 | B.H. 10(12) | Check | 11 | 0.927 | 0.040 | 0.282 | 0.604 |
| 24 | P.O.J. 2878 | Gy-phene, 2 lb. Toxaphene (tech.) per A. | 16 | 1.96 | .05 | .53 | 1.37 |
| 25 | P.O.J. 2878 | Rhothane, 2 lb. DDD (tech.) per A. | 21 | 2.04 | .05 | .76 | 1.22 |
| 30 | P.O.J. 2878 | BHC, 2 lb. gamma isomer per A. | 7 | .74 | .05 | .05 | .63 |
| 31 | P.O.J. 2878 | Check | 20 | 1.54 | .06 | .45 | 1.02 |
| 26 | P.O.J. 2878 | Rhothane, 1 lb. DDD (tech.) per A. | 27 | 3.22 | .11 | .52 | 2.58 |
| 14 | B.H. 10(12) | Check | 40 | 3.95 | .15 | 1.28 | 2.52 |
| 13 | B.H. 10(12) | Kryocide, 6 lb. per A. | 54 | 5.78 | .17 | 1.76 | 3.84 |
| 29 | P.R. 902 | BHC, 1 lb. gamma isomer per A. | 33 | 3.07 | .17 | .81 | 2.09 |
| 28 | P.R. 902 | Check | 33 | 2.19 | .22 | .92 | 1.05 |
| 16 | P.O.J. 2878 | Check | 34 | 4.54 | .27 | .83 | 3.43 |
| 18 | B.H. 10(12) | Marlate, 1 lb. Methoxychlor (tech.) per A. | 29 | 3.08 | .27 | 1.68 | 1.13 |
| 19 | B.H. 10(12) | Kryocide, 10 lb. per A. | 29 | 3.11 | .31 | 1.02 | 1.77 |
| 15 | B. 34–104 | Check | 33 | 3.33 | .35 | .35 | 2.63 |
| 22 | P.O.J. 2878 | CPR, ¾ gal. on 2½ A. | 38 | 3.68 | .35 | 1.06 | 2.26 |
| 23 | P.O.J. 2878 | Gy-phene, 1 lb. Toxaphene (tech.) per A. | 33 | 4.02 | .35 | .71 | 2.95 |
| 9 | P.O.J. 2878 | Check | 34 | 4.73 | .37 | .69 | 3.66 |
| 17 | P.O.J. 2878 B.H. 10(12) | Marlate, 2 lb. Methoxychlor (tech.) per A. | 57 | 8.15 | .37 | 3.03 | 4.74 |
| 21 | P.R. 902 | CPR, 1¼ gal. on 2½ A. | 52 | 5.48 | .40 | 1.24 | 3.83 |
| 27 | P.O.J. 2878 | Check | 24 | 1.97 | .49 | .71 | .77 |
| 10 | B.H. 10(12) | do. | 46 | 5.20 | .54 | 1.28 | 3.37 |

TABLE 3.—*Continued*

| Tower No. | Sugarcane variety | Treatment | Stalk infestation | Joint infestation | Base infestation | Center infestation | Top infestation |
|---|---|---|---|---|---|---|---|
| *In ascending order based on percentage base infestation* | | | | | | | |
| | | | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 3 | B.H. 10(12) | Dieldrin, 1 lb. Dieldrin (tech.) per A. | 96 | 26.07 | .73 | 10.80 | 14.54 |
| 1 | B.H. 10(12) | Check | 53 | 4.93 | .86 | 1.17 | 2.90 |
| 12 | B.H. 10(12) | Aldrin, 2 lb. Aldrin, (tech) per A. | 84 | 13.15 | .92 | 5.50 | 6.72 |
| 4 | B.H. 10(12) | Check | 80 | 12.70 | 1.11 | 4.77 | 6.81 |
| 7 | P.O.J. 2878 B.H. 10(12) | Ryania, 2 lb. per A. | 71 | 11.73 | 1.13 | 2.69 | 7.90 |
| 8 | P.O.J. 2878 | Ryania, 1 lb. per A. | 72 | 10.82 | 1.37 | 3.11 | 6.33 |
| 5 | B.H. 10(12) | Chlordane, 3.25 lb. Chlordane (tech.) per A. | 93 | 20.44 | 1.49 | 6.92 | 12.02 |
| 11 | B.H. 10(12) | Aldrin, 1 lb. Aldrin (tech.) per A. | 75 | 11.84 | 1.54 | 4.72 | 5.57 |
| 6 | P.O.J. 2878 B.H. 10(12) | Chlordane, 6.50 lb. Chlordane (tech.) on 2½ A. | 96 | 21.75 | 1.73 | 6.81 | 13.20 |
| 2 | B.H. 10(12) | Dieldrin, 2 lb. Dieldrin (tech.) per A. | 98 | 27.72 | 3.49 | 11.25 | 12.97 |

in the main in analyzing the results of the tests on the effectiveness of the insecticides tested, other data have been included for both years to demonstrate how the percentages of joint and stalk infestation are affected by the action of the insecticides.

The results in tables 3 and 4 are expressed in ascending order of borer infestation, that is: from the lowest infestation found near any of the towers, followed by the next highest, and so on, until the highest infestation is reached at the end of the table. For this study the cane stalk was divided into three sections: Top, center, and base. The percentage of borer infestation was determined for all three, as well as for the joint and stalk in each plot. The figures for the infestation in the center and top of the stalks are not included, since they have no bearing on the experiment.

As mentioned earlier, the data on base infestation are of most importance. The insecticides were applied during the period of growth of the lower or basal section of the stalk, known as the base. Thus, control of the borer was estimated to cover that period, and if any insecticides proved effective, that period of protection by the insecticide was longer or shorter, depending upon its residual properties, if any.

To check on the effectiveness of the insecticides in the control of the

TABLE 4.—*Rate of infestation by **Diatraea saccharalis** (Fabricius) at overhead irrigation area, Colonia Juana Díaz, Santa Isabel, 1952*

| Tower No. | Sugarcane variety | Treatment | Stalk infestation | Joint infestation | Base infestation | Center infestation | Top infestation |
|---|---|---|---|---|---|---|---|
| *In ascending order based on percentage stalk infestation* | | | | | | | |
| | | | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 4 | B.H. 10(12) | Check | 18 | 2.33 | 0.38 | 1.71 | 0.24 |
| 1 | B.H. 10(12) | do. | 37 | 3.39 | .27 | 2.26 | .86 |
| 5 | B.H. 10(12) | Marlate, 1 lb. Methoxychlor (tech.) per A. | 49 | 5.43 | 1.19 | 2.10 | 2.14 |
| 27 | P.O.J. 2878 | Check | 50 | 7.74 | .34 | 2.58 | 4.82 |
| 2 | B.H. 10(12) | BHC, 1 lb. gamma isomer per A. | 51 | 5.59 | 1.18 | 2.68 | 1.73 |
| 18 | P.O.J. 2878 | Ryania, 1 lb. per A. | 53 | 6.25 | .45 | 2.99 | 2.80 |
| 10 | B.H. 10(12) | Check | 60 | 6.95 | .38 | 2.03 | 4.54 |
| 16 | P.O.J. 2878 | do. | 61 | 8.38 | .14 | 2.46 | 5.78 |
| 24 | B.H. 10(12) | Kryocide, 10 lb. per A. | 61 | 9.45 | .67 | 3.72 | 5.06 |
| 29 | P.R. 902 | Dilan, 1 gal. on 2½ A. | 63 | 7.50 | .27 | 1.71 | 5.51 |
| 7 | P.O.J. 2878 B.H. 10(12) | Rhothane 2 lb. DDD (tech.) per A. | 65 | 8.09 | .94 | 3.08 | 4.07 |
| 23 | P.O.J. 2878 | Kryocide, 6 lb. per A. | 65 | 10.35 | .55 | 2.62 | 7.17 |
| 14 | B.H. 10(12) | Check | 69 | 10.51 | 1.01 | 4.76 | 4.73 |
| 17 | P.O.J. 2878 B.H. 10(12) | Ryania, 2 lb. per A. | 69 | 9.45 | .81 | 5.69 | 2.95 |
| 19 | B.H. 10(12) | Dr. Wolf's Insecticide, 1½ gal. on 2½ A. | 74 | 12.61 | 1.31 | 7.84 | 3.46 |
| 8 | P.O.J. 2878 | Rhothane, 1 lb. DDD (tech.) per A. | 76 | 15.95 | 1.30 | 8.00 | 6.65 |
| 15 | B. 34-104 | Check | 77 | 11.96 | .38 | 6.24 | 5.33 |
| 13 | P.O.J. 2878 | Dr. Wolf's Insecticide, 1 gal. on 2½ A. | 79 | 10.92 | .87 | 5.86 | 4.18 |
| 9 | P.O.J. 2878 | Check | 80 | 14.93 | .83 | 7.39 | 6.71 |
| 12 | B.H. 10(12) | Gy-phene, 2 lb. Toxaphene (tech.) per A. | 83 | 13.90 | 3.10 | 8.34 | 2.46 |
| 3 | B.H. 10(12) | BHC, 2 lb. gamma isomer per A. | 85 | 9.17 | 1.36 | 5.42 | 2.39 |
| 6 | P.O.J. 2878 B.H. 10(12) | Marlate, 2 lb. Methoxychlor (tech.) per A. | 88 | 12.49 | 2.14 | 5.53 | 4.81 |
| 20 | B.H. 10(12) | Check | 88 | 15.89 | 1.98 | 8.71 | 5.20 |
| 11 | B.H. 10(12) | Gy-phene, 1 lb. Toxaphene (Tech.) per A. | 89 | 15.85 | 2.51 | 9.58 | 3.76 |
| 28 | P.R. 902 | Check | 89 | 15.97 | 1.17 | 7.04 | 7.76 |
| 22 | P.O.J. 2878 | Aldrin, 1 lb. Aldrin (tech.) per A. | 90 | 13.69 | .52 | 8.00 | 5.16 |
| 30 | P.O.J. 2878 | Heptachlor, 1 gal. on 2½ A. | 91 | 20.36 | .76 | 7.82 | 11.78 |
| 26 | P.O.J. 2878 | Chlordane, 1 lb. Chlordane (tech.) per A. | 92 | 20.82 | 2.66 | 11.32 | 6.84 |

TABLE 4.—*Continued*

| Tower No. | Sugarcane variety | Treatment | Stalk infestation | Joint infestation | Base infestation | Center infestation | Top infestation |
|---|---|---|---|---|---|---|---|
| *In ascending order based on percentage stalk infestation* | | | | | | | |
| | | | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 21 | P.R. 902 | Aldrin, 2 lb. Aldrin (tech.) per A. | 94 | 19.66 | .59 | 9.32 | 9.75 |
| 25 | P.O.J. 2878 | Chlordane, 2 lb. Chlordane (tech.) per A. | 97 | 24.43 | 1.03 | 12.24 | 11.16 |
| 31 | P.O.J. 2878 | Check | 97 | 23.33 | 2.46 | 13.22 | 7.65 |
| *In ascending order based on percentage joint infestation* | | | | | | | |
| 4 | B.H. 10(12) | Check | 18 | 2.33 | 0.38 | 1.71 | 0.24 |
| 1 | B.H. 10(12) | do. | 37 | 3.39 | .27 | 2.26 | .86 |
| 5 | B.H. 10(12) | Marlate, 1 lb. Methoxychlor (tech.) per A. | 49 | 5.43 | 1.19 | 2.10 | 2.14 |
| 2 | B.H. 10(12) | BHC, 1 lb. gamma isomer per A. | 51 | 5.59 | 1.18 | 2.68 | 1.73 |
| 18 | P.O.J. 2878 | Ryania, 1 lb. per A. | 53 | 6.25 | .45 | 2.99 | 2.80 |
| 10 | B.H. 10(12) | Check | 60 | 6.95 | .38 | 2.03 | 4.54 |
| 29 | P.R. 902 | Dilan, 1 gal. on 2½ A. | 63 | 7.50 | .27 | 1.71 | 5.51 |
| 27 | P.O.J. 2878 | Check | 50 | 7.74 | .34 | 2.58 | 4.82 |
| 7 | P.O.J. 2878<br>B.H. 10(12) | Rhothane, 2 lb. DDD (tech.) per A. | 65 | 8.09 | .94 | 3.08 | 4.07 |
| 16 | P.O.J. 2878 | Check | 61 | 8.38 | .14 | 2.46 | 5.78 |
| 3 | B.H. 10(12) | BHC, 2 lb. gamma isomer per A. | 85 | 9.17 | 1.36 | 5.42 | 2.39 |
| 17 | P.O.J. 2878<br>B.H. 10(12) | Ryania, 2 lb. per A. | 69 | 9.45 | .81 | 5.69 | 2.95 |
| 24 | B.H. 10(12) | Kryocide, 10 lb. per A. | 61 | 9.45 | .67 | 3.72 | 5.06 |
| 23 | P.O.J. 2878 | Kryocide, 6 lb. per A. | 65 | 10.35 | .55 | 2.62 | 7.17 |
| 14 | B.H. 10(12) | Check | 69 | 10.51 | 1.01 | 4.76 | 4.73 |
| 13 | P.O.J. 2878 | Dr. Wolf's Insecticide, 1 gal. on 2½ A. | 79 | 10.92 | .87 | 5.86 | 4.18 |
| 15 | B. 34–104 | Check | 77 | 11.96 | .38 | 6.24 | 5.33 |
| 6 | B.H. 10(12)<br>P.O.J. 2878 | Marlate, 1 lb. Methoxychlor (tech.) per A. | 88 | 12.49 | 2.14 | 5.53 | 4.81 |
| 19 | B.H. 10(12) | Dr. Wolf's Insecticide, 1½ gal. on 2½ A. | 74 | 12.61 | 1.31 | 7.84 | 3.46 |
| 22 | P.O.J. 2878 | Aldrin, 1 lb. Aldrin (tech.) per A. | 90 | 13.69 | .52 | 8.00 | 5.16 |
| 12 | B.H. 10(12) | Gy-phene, 2 lb. Toxaphene (tech.) per A. | 83 | 13.90 | 3.10 | 8.34 | 2.46 |

TABLE 4.—*Continued*

| Tower No. | Sugarcane variety | Treatment | Stalk infestation | Joint infestation | Base infestation | Center infestation | Top infestation |
|---|---|---|---|---|---|---|---|
| *In ascending order based on percentage joint infestation* | | | | | | | |
| | | | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 9 | P.O.J. 2878 | Check | 80 | 14.93 | .83 | 7.39 | 6.71 |
| 11 | B.H. 10(12) | Gy-phene, 1 lb. Toxaphene (tech.) per A. | 89 | 15.85 | 2.51 | 9.58 | 3.76 |
| 20 | B.H. 10(12) | Check | 88 | 15.89 | 1.98 | 8.71 | 5.20 |
| 8 | P.O.J. 2878 | Rhothane, 1 lb. DDD (tech.) per A. | 76 | 15.95 | 1.30 | 8.00 | 6.65 |
| 28 | P.R. 902 | Check | 89 | 15.97 | 1.17 | 7.04 | 7.76 |
| 21 | P.R. 902 | Aldrin, 2 lb. Aldrin (tech.) per A. | 94 | 19.66 | .59 | 9.32 | 9.75 |
| 30 | P.O.J. 2878 | Heptachlor, 1 gal. on 2½ A. | 91 | 20.36 | .76 | 7.82 | 11.78 |
| 26 | P.O.J. 2878 | Chlordane, 1 lb. Chlordane (tech.) per A. | 92 | 20.82 | 2.66 | 11.32 | 6.84 |
| 31 | P.O.J. 2878 | Check | 97 | 23.33 | 2.46 | 13.22 | 7.65 |
| 25 | P.O.J. 2878 | Chlordane, 2 lb. Chlordane (tech.) per A. | 92 | 24.43 | 1.03 | 12.24 | 11.16 |
| *In ascending order based on percentage base infestation* | | | | | | | |
| 16 | P.O.J. 2878 | Check | 61 | 8.38 | 0.14 | 2.46 | 5.78 |
| 1 | B.H. 10(12) | do. | 37 | 3.39 | .27 | 2.26 | .86 |
| 29 | P.R. 902 | Dilan, 1 gal .on 2½ A. | 63 | 7.50 | .27 | 1.71 | 5.51 |
| 27 | P.O.J. 2878 | Check | 50 | 7.74 | .34 | 2.58 | 4.82 |
| 4 | B.H. 10(12) | do. | 18 | 2.33 | .38 | 1.71 | .24 |
| 10 | B.H. 10(12) | do. | 60 | 6.95 | .38 | 2.03 | 4.54 |
| 15 | B. 34–104 | do. | 77 | 11.96 | .38 | 6.24 | 5.33 |
| 18 | P.O.J. 2878 | Ryania, 1 lb. per A. | 53 | 6.25 | .45 | 2.99 | 2.80 |
| 22 | P.O.J. 2878 | Aldrin, 1 lb. Aldrin (tech.) per A. | 90 | 13.69 | .52 | 8.00 | 5.16 |
| 23 | P.O.J. 2878 | Kryocide, 6 lb. per A. | 65 | 10.35 | .55 | 2.62 | 7.17 |
| 21 | P.R. 902 | Aldrin, 2 lb. Aldrin (tech.) per A. | 94 | 19.66 | .59 | 9.32 | 9.75 |
| 24 | B.H. 10(12) | Kryocide, 10 lb. per A. | 61 | 9.45 | .67 | 3.72 | 5.06 |
| 30 | P.O.J. 2878 | Heptachlor, 1 gal. on 2½ A. | 91 | 20.36 | .76 | 7.82 | 11.78 |
| 17 | P.O.J. 2878 B.H. 10(12) | Ryania, 2 lb. per A. | 69 | 9.45 | .81 | 5.69 | 2.95 |
| 9 | P.O.J. 2878 | Check | 80 | 14.93 | .83 | 7.39 | 6.71 |
| 13 | P.O.J. 2878 | Dr. Wolf's Insecticide, 1 gal. on 2½ A. | 79 | 10.92 | .87 | 5.86 | 4.18 |
| 7 | P.O.J. 2878 B.H. 10(12) | Rhothane, 2 lb. DDD (tech.) per A. | 65 | 8.09 | .94 | 3.08 | 4.07 |

TABLE 4.—*Continued*

| Tower No. | Sugarcane variety | Treatment | Stalk infestation | Joint infestation | Base infestation | Center infestation | Top infestation |
|---|---|---|---|---|---|---|---|
| *In ascending order based on percentage base infestation* | | | | | | | |
| | | | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 14 | B.H. 10(12) | Check | 69 | 10.51 | 1.01 | 4.76 | 4.73 |
| 25 | P.O.J. 2878 | Chlordane, 2 lb. Chlordane (tech.) per A. | 97 | 24.43 | 1.03 | 12.24 | 11.16 |
| 28 | P.R. 902 | Check | 89 | 15.97 | 1.17 | 7.04 | 7.76 |
| 2 | B.H. 10(12) | BHC, 1 lb. gamma isomer per A. | 51 | 5.59 | 1.18 | 2.68 | 1.73 |
| 5 | B.H. 10(12) | Marlate, 1 lb. Methoxychlor (tech.) per A. | 49 | 5.43 | 1.19 | 2.10 | 2.14 |
| 8 | P.O.J. 2878 | Rhothane, 1 lb. DDD (tech.) per A. | 76 | 15.95 | 1.30 | 8.00 | 6.65 |
| 19 | B.H. 10(12) | Dr. Wolf's Insecticide, 1½ gal. on 2½ A. | 74 | 12.61 | 1.31 | 7.84 | 3.46 |
| 3 | B.H. 10(12) | BHC, 2 lb. gamma isomer per A. | 85 | 9.17 | 1.36 | 5.42 | 2.39 |
| 20 | B.H. 10(12) | Check | 88 | 15.89 | 1.98 | 8.71 | 5.20 |
| 6 | P.O.J. 2878 B.H. 10(12) | Marlate, 2 lb. Methoxychlor (tech.) per A. | 88 | 12.49 | 2.14 | 5.53 | 4.81 |
| 31 | P.O.J. 2878 | Check | 97 | 23.33 | 2.46 | 13.22 | 7.65 |
| 11 | B.H. 10(12) | Gy-phene, 1 lb. Toxaphene (tech.) per A. | 89 | 15.85 | 2.51 | 9.58 | 3.76 |
| 26 | P.O.J. 2878 | Chlordane, 1 lb. Chlordane (tech.) per A. | 92 | 20.82 | 2.66 | 11.32 | 6.84 |
| 12 | B.H. 10(12) | Gy-phene, 2 lb. Toxaphene (tech.) per A. | 83 | 13.90 | 3.10 | 8.34 | 2.46 |

borer, they were shifted from one tower to another far from it, in the 1950–51 sprayings. The check plots were the same for both years.

Partial results of tables 3 and 4 for 1951–52 are summarized in tables 5 and 6. In these tables the percentage of moth-borer infestation at the base of the cane is shown in order of ascending infestation for the 10 plots having the lowest infestation. The figures for ascending infestation for the 10 lowest plots are also given in addition, based on joints and stalks bored.

### Base Infestation

In the 1951 crop, the plot showing the lowest base infestation was a check (tower 20) followed by one on which 2 pounds per acre of Gy-phene were used, (tower 24) etc., as shown in table 5. It will be noticed that 4 check plots are included in these 10 plots having lowest base infestation.

In the 1952 crop, the two plots having the lowest base infestation were

TABLE 5.—*Rate of moth-borer infestation expressed as percentage of stalk, joint, and base, in ascending order of percentage infestation in plots sprayed by 10 towers, 1951–1952*

[Data extracted from tables 3 and 4]

| 1951 | | | 1952 | | |
|---|---|---|---|---|---|
| Tower No. | Insecticide and quantity | Infestation rate | Tower No. | Insecticide and quantity | Infestation rate |
| *Results with stalks* | | | | | |
| | | *Percent* | | | *Percent* |
| 30 | BHC, 2 lb. per A. | 7 | 4 | Check | 18 |
| 20 | Check | 11 | 1 | do. | 37 |
| 24 | Gy-phene, 2 lb. per A. | 16 | 5 | Marlate, 1 lb. per A. | 49 |
| 31 | Check | 20 | 27 | Check | 50 |
| 25 | Rhothane, 2 lb. per A. | 21 | 2 | BHC, 1 lb. per A. | 51 |
| 27 | Check | 24 | 18 | Ryania, 1 lb. per A. | 53 |
| 26 | Rhothane, 1 lb. per A. | 27 | 10 | Check | 60 |
| 18 | Marlate, 1 lb. per A. | 29 | 16 | do. | 61 |
| 19 | Kryocide, 10 lb. per A. | 29 | 24 | Kryocide, 10 lb. per A. | 61 |
| 15 | Check | 33 | 29 | Dilan, 1 gal. per 2½ A. | 63 |
| *Results with joints* | | | | | |
| 30 | BHC, 2 lb. per A. | 0.74 | 4 | Check | 2.33 |
| 20 | Check | .93 | 1 | do. | 3.39 |
| 31 | do. | 1.54 | 5 | Marlate, 1 lb. per A. | 5.43 |
| 24 | Gy-phene, 2 lb. per A. | 1.96 | 2 | BHC, 1 lb. per A. | 5.59 |
| 27 | Check | 1.97 | 18 | Ryania, 1 lb. per A. | 6.25 |
| 25 | Rhothane, 2 lb. per A. | 2.04 | 10 | Check | 6.95 |
| 28 | Check | 2.19 | 29 | Dilan, 1 gal. per 2½ A. | 7.50 |
| 29 | BHC, 1 lb. per A. | 3.07 | 27 | Check | 7.74 |
| 18 | Marlate, 1 lb. per A. | 3.08 | 7 | Rhothane, 2 lb. per A. | 8.09 |
| 19 | Kryocide, 10 lb. per A. | 3.11 | 16 | Check | 8.38 |
| *Results with bases* | | | | | |
| 20 | Check | 0.04 | 16 | Check | 0.14 |
| 24 | Gy-phene, 2 lb. per A. | .05 | 1 | do. | .27 |
| 25 | Rhothane, 2 lb. per A. | .05 | 29 | Dilan, 1 gal. per 2½ A. | .27 |
| 30 | BHC, 2 lb. per A. | .05 | 27 | Check | .34 |
| 31 | Check | .06 | 4 | do. | .38 |
| 26 | Rhothane, 1 lb. per A. | .11 | 10 | do. | .38 |
| 14 | Check | .15 | 15 | do. | .38 |
| 13 | Kryocide, 6 lb. per A. | .17 | 18 | Ryania, 1 lb. per A. | .45 |
| 29 | BHC, 1 lb. per A. | .17 | 22 | Aldrin, 1 lb. per A. | .52 |
| 28 | Check | .22 | 23 | Kryocide, 6 lb. per A. | .55 |

TABLE 6.—*Rate of moth-borer infestation based on attacks of the borer at the base of the cane, in ascending order of percentage infestation in plots sprayed by 10 towers, 1951–1952*

[Data extracted from tables 3 and 4]

| 1951 crop | | | 1952 crop | | |
|---|---|---|---|---|---|
| Tower No. | Insecticide and quantity | Infestation rate | Tower No. | Insecticide and quantity | Infestation rate |
| | | *Percent* | | | *Percent* |
| 20 | Check | 0.04 | 16 | Check | 0.14 |
| 24 | Gy-phene, 2 lb per A. | .05 | 1 | do. | .27 |
| 25 | Rhothane, 2 lb. per A. | .05 | 29 | Dilan, 1 gal. per 2½ A. | .27 |
| 30 | BHC, 2 lb. per A. | .05 | 27 | Check | .34 |
| 31 | Check | .06 | 4 | do. | .38 |
| 26 | Rhothane, 1 lb. per A. | .11 | 10 | do. | .38 |
| 14 | Check | .15 | 15 | do. | .38 |
| 13 | Kryocide, 6 lb. per A. | .17 | 18 | Ryania, 1 lb. per A. | .45 |
| 29 | BHC, 1 lb. per A. | .17 | 22 | Aldrin, 1 lb. per A. | .52 |
| 28 | Check | .22 | 23 | Kryocide, 6 lb. per A. | .55 |

also check plots (towers 16 and 1), followed by Dilan (tower 29), and then by four more check plots (towers 27, 4, 10, 15). This means that for this crop, 6 check plots were included in the 10 lowest plots insofar as base infestation by the borer was concerned.

This alone might lead to the conclusion that the insecticides were inef-

TABLE 7.—*Rate of moth-borer infestation based on attacks of the borer at the base of the cane, demonstrating the highest infestation in plots sprayed by 10 towers, 1951–52*

[Data extracted from tables 3 and 4]

| 1951 crop | | | 1952 crop | | |
|---|---|---|---|---|---|
| Tower No. | Insecticide and quantity | Percentage of base infestation | Tower No. | Insecticide and quantity | Percentage of base infestation |
| 3 | Dieldrin, 1 lb. per A. | 0.73 | 5 | Marlate, 1 lb. per A. | 1.19 |
| 1 | Check | .86 | 8 | Rhothane, 1 lb. per A. | 1.30 |
| 12 | Aldrin, 2 lb. per A. | .92 | 19 | Dr. Wolf's Insecticide 1½ gal. for 2½ A. | 1.31 |
| 4 | Check | 1.11 | 3 | BHC, 2 lb. per A. | 1.36 |
| 7 | Ryania, 2 lb. per A. | 1.13 | 20 | Check | 1.98 |
| 8 | Ryania, 1 lb. per A. | 1.37 | 6 | Marlate, 2 lb. per A. | 2.14 |
| 5 | Chlordane, 1 lb. per A. | 1.49 | 31 | Check | 2.46 |
| 11 | Aldrin, 1 lb. per A. | 1.54 | 11 | Gy-phene, 1 lb. per A. | 2.51 |
| 6 | Chlordane, 2 lb. per A. | 1.73 | 26 | Chlordane, 1 lb. per A | 2.66 |
| 2 | Dieldrin, 2 lb. per A. | 3.49 | 12 | Gy-phene, 2 lb. per A. | 3.10 |

fective in the control of the borer. The check plots had only plain water as a spray, and yet they showed low borer infestation at the base of the stalk.

Suppose we assume that Gy-phene at a rate of 2 pounds per acre (tower 24) and Rhothane, at rates of 2 pounds and 1 pound per acre, respectively, (towers 25 and 26) were effective insecticides in the control of the borer because they top the list shown in table 5. Then the same effectiveness should have been demonstrated in the test for 1952. Yet the results were not the same, for Gy-phene applied to the 1952 crop at a rate of 2 pounds per acre by tower 12, showed the highest base infestation for the experiment that year (see table 7). Rhothane at rates of 2 pounds and 1 pound per acre, respectively, was sprayed through towers 7 and 8 during the 1952 crop

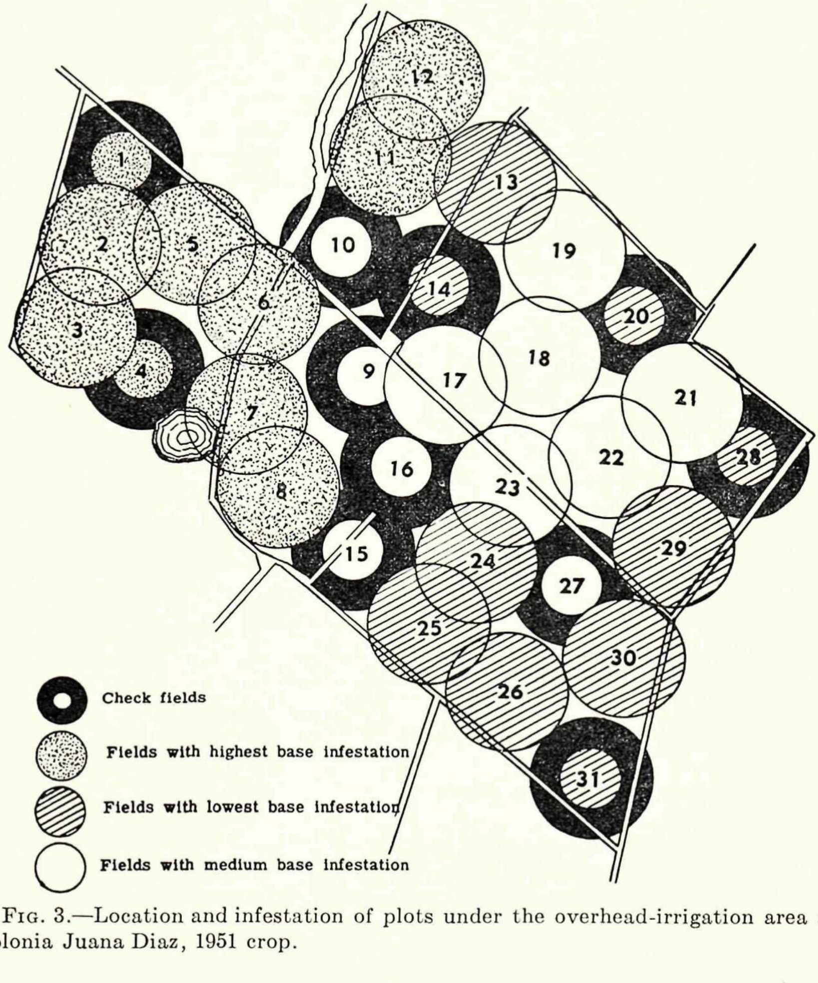


FIG. 3.—Location and infestation of plots under the overhead-irrigation area at Colonia Juana Diaz, 1951 crop.

season. The insecticide did not give the same results as in 1951, but was far down on the list for 1952, in the seventeenth and twenty-third place, respectively. If we continue to analyze the effects of the other insecticides we find much the same results.

Why should Kryocide applied at a rate of 6 pounds per acre through tower 13 for the 1951 crop be more effective than the same insecticide applied at a rate of 10 pounds per acre through tower 19 for the same crop? Then why should Ryania at a rate of 1 pound per acre, Aldrin at 1 pound per acre, and Kryocide at 6 pounds per acre, applied through towers 18, 22, and 23, respectively, for the 1952 crop, be more effective than the same insecticides at 2 pounds per acre, 2 pounds per acre, and 10 pounds per

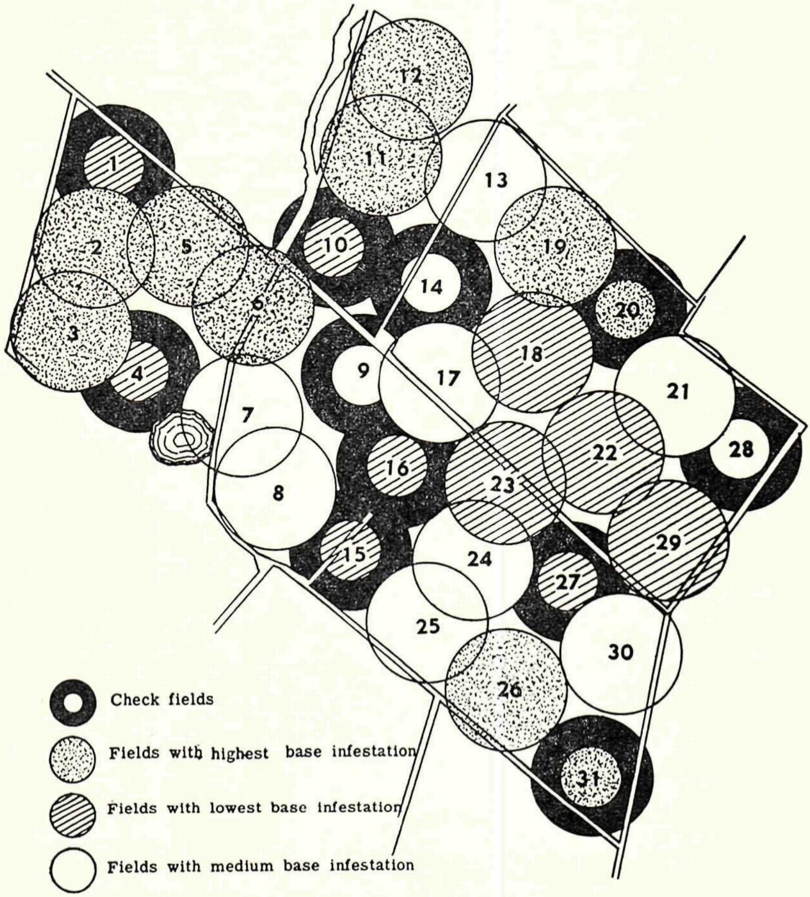


FIG. 4.—Location and infestation of plots under the overhead-irrigation area at Colonia Juana Diaz, 1952 crop.

acre, respectively, when applied elsewhere to the same crop? It is very illogical that the effectiveness of an insecticide should diminish when the quantity applied is doubled or nearly doubled. The reverse would be logical.

Table 7 shows the infestation by the moth-borer at the base of the stalks for the 10 worst infested plots in both years, 1951 and 1952. As shown, insecticides like Gy-phene, BHC, Rhothane, and Aldrin, which are on the list in table 6 as producing low base infestation are also found in the list for the highest infestation.

Everything tended to indicate that the moth-borer infestation in the overhead irrigation area is mostly a question of position of the plots. For example, examinations of figures 3 and 4, which show the results of the moth-borer infestation, discloses that plots Nos. 1, 2, 3, 4, 5, 7, 8, 11, and 12 were the ones with the highest base infestation. These plots are located at the west and northwest ends of the area. When this is compared with the results for the 1952 crop, it is obvious that plots Nos. 2, 3, 5, 6, 11, and 12 were also high in infestation regardless of the insecticides used. Apparently the infestation by the borer in the northwest and west sections of the overhead-irrigation area is practicaly uniform, year after year.

Table 8 shows the percentage of infestation by the sugarcane moth-borer a Colonia Juana Díaz as compared with the infestation in the overhead-irrigation area. Since 1949, the borer infestation has been on the increase in this particular zone in both the overhead-irrigation area and the rest of the Colonia where the cane is irrigated by gravity methods. This natural

TABLE 8.—*Sugarcane moth stalk-borer infestation at Colonia Juana Díaz, 1949–52*

| Year | Fields | Percentage of sugarcane moth-borer infestation in cane fields outside of the overhead-irrigation area | | | | | Percentage of sugarcane moth-borer infestation in cane fields in the overhead-irrigation area | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Top | Center | Base | Joint | Stalk | Top | Center | Base | Joint | Stalk |
| | *Number* | | | | | | | | | | |
| 1949 | 10 | — | — | — | 7.3 | — | — | — | — | 5.8 | — |
| 1950 | 38 | 4.30 | 2.64 | 2.06 | 9.01 | 65 | 3.28 | 2.68 | 1.61 | 7.57 | 57 |
| | 9[1] | 4.44 | 2.33 | 2.43 | 9.20 | 67 | | | | | |
| 1951 | 37 | 4.36 | 2.66 | 1.46 | 8.49 | 58 | 5.18 | 3.68 | .83 | 10.36[2] | 54 |
| | 10[1] | 3.38 | 1.60 | 1.04 | 6.03 | 46 | 2.75 | 1.26 | .44 | 4.48[3] | 37 |
| 1952 | 62 | 4.28 | 3.91 | 1.95 | 10.14 | 70 | 4.88 | 6.08 | 1.23 | 12.19[2] | 76 |
| | 10[1] | 4.50 | 4.43 | 2.70 | 11.63 | 76 | 4.65 | 5.12 | .84 | 10.61[3] | 66 |

[1] Fields around the overhead-irrigation area, but not irrigated with the overhead-irrigation system.

[2] Fields or area around towers which were sprayed with organic insecticides for the control of the sugarcane moth stalk-borer.

[3] Fields or area around towers which were sprayed with water only, and served as check plots.

increase of borers might be due to a decrease in precipitation (both natural and artificial, the latter as supplied by the overhead-irrigation system) from year to year, since 1949 up to 1952. Table 1 show sthese rainfall differences as well as amount of water received by the cane naturally and artificially.

Comparing the 20 sprayed plots in general with the 11 check plots, as shown in table 8, there was less base infestation in the latter than in the former. This is true for both 1950 and 1951, in which crop years the check plots showed 0.44-percent and 0.84-percent base infestation, respectively, vs. 0.83-percent and 1.23-percent base infestation for the sprayed plots for both years.

## CONCLUSIONS

The following conclusions appear justified by the work here reported:

The application of insecticides by the overhead-irrigation system for the attempted control of the moth stalk-borer, *Diatraea saccharalis* (Fabricius) during 2-year tests at Central Cortada, reversing the position of the insecticides the second year, indicates that this method, successful as it may be for the application of fertilizers or the control of soil-inhabiting insects, is valueless against the moth-borer.

This may be due to the large amount of water which must be used for a single revolution of the tower, which so dilutes the insecticide that it has no effect on the caterpillars. It is possible that other methods of application of some of the 12 insecticides tested might prove at least partially effective in control, but application by overhead irrigation gave no indication that any insecticide had value when it was applied to a different plot of cane in the following year.

## SUMMARY

The use of the overhead-irrigation system established at Colonia Juana Díaz, near Central Cortada, Santa Isabel, P. R., makes possible the application of fertilizers dissolved in water, and of insecticides for the control of soil-insect pests. Experiments were conducted during the crop years 1950 and 1951, using the overhead-irrigation system as a means of applying insecticides, in an attempt to control the sugarcane moth-stalk borer, *Diatraea saccharalis* (Fabricius).

Thirteen different kinds of insecticides, namely: Aldrin, Chlordane, Dieldrin, Ryania, Rhothane (DDD), Benzene hexachloride, CPR Emulsion Concentrate, Gy-phene (Toxaphene), Marlate (Methoxychlor), Kryocide (natural cryolite insecticide), Dilan 25 EM, Heptachlor 2E Emulsion Concentrate, and Dr. Wolf's Insecticide A, were used. Each insecticide was applied at two different concentrations. Thirty-one plots planted with sugarcane, each having an area of 2½ acres, were used in the experiment, 20 of them being treated with insecticides and 11 being used as checks.

The insecticides were applied at 15-day intervals; there were four sprayings during each season. The experiments were initiated during the fall of 1950 and 1951, respectively, when the sugarcane plants were still small and had just begun to develop the first joints at the base of the stalks.

The tables and analyses of the work conducted demonstrated that these insecticides, at least when applied by this method of spraying, were completely ineffective in the control of the insect. In many cases the check plots showed less borer infestation than those treated with insecticides; in others, the insecticide was more effective at low concentration than when used at twice that concentration.

The ineffectiveness of the insecticides might be due, in part, to the large amount of water used which reduced the concentration of the chemical so much as to make it valueless in controlling the moth-borer.

RESUMEN

El uso del sistema de riego artificial aéreo establecido en la Colonia Juana Díaz, cerca de la Central Cortada, Santa Isabel, P. R., hace posible la aplicación de los abonos disueltos en agua y de los insecticidas para la represión de los insectos que viven en el terreno. Para combatir el taladrador del tallo de la caña, *Diatraea saccharalis* (Fabricius) se iniciaron dos experimentos durante los años 1950 y 1951, en los cuales se usó este método de dispersión de los insecticidas.

Se usaron 13 clases de insecticidas, a saber: Aldrín, Clordano, Dieldrín, Ryania, Rotano, Hexaloruro de benceno, Emulsión concentrada CPR, Gyphene, Marlate, Kryocide, Dilan, Heptachlor e Insecticida Dr. Wolf. Cada uno de estos insecticidas se aplicó en dos concentraciones distintas. Ambos experimentos incluyeron 31 parcelas sembradas de caña, 20 de éllas tratadas con insecticidas y 11 testigos. Los insecticidas se aplicaron a intervalos de 15 días, esto es 4 aspersiones durante la temporada. Los experimentos se llevaron a cabo durante las temporadas de otoño de 1950 y 1951, respectivamente, cuando la caña estaba aún pequeña y empezaba a formar canutos en la base de los tallos.

Las tablas y un análisis del trabajo efectuado, demuestran que estos insecticidas, por lo menos cuando se usó el método de riego artificial aéreo, fueron completamente ineficaces para controlar el insecto. En muchos casos la infestación en las parcelas testigos fué menor que en aquellas a las cuales se les aplicaron insecticidas; en otros casos los insecticidas de concentraciones bajas resultaron más eficaces para el combate del insecto que los mismos usados en concentraciones más altas.

Es muy posible que la ineficacia de los insecticidas fuese motivada, en parte, por la gran cantidad de agua que se usó en su dispersión. No hay duda sobre que ésto redujo la concentración del insecticida hasta hacerlo completamente ineficaz para controlar el taladrador del tallo de la caña.