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Effect of Pesticides on the Yield of Some Vegetable Crops in the Isabela Area of Puerto Rico[1]

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INTRODUCTION

The vegetable-growing business has an economic farm value of over 4 million dollars per year in Puerto Rico (*3*).[3] At present organized commercial vegetable-growing is a high economic risk because of insect pests and other factors. The climate and growing seasons are favorable for vegetable production in the Island for the import markets of the eastern seaboard of the United States, provided a high-quality product can be grown in Puerto Rico. The Island is favorably located for such production and, as result, commercial vegetable production, if successful, can provide an important source of income for agriculture.

Until now most of the recommendations on the control of vegetable insects in Puerto Rico are based on the "Manual de Recomendaciones" of the Agricultural Experiment Station of the University of Puerto Rico. Results obtained elsewhere have been used advantageously to complement this information.

Because of this it was felt that the experiment reported herewith would be of value in order to evaluate the present insecticidal treatment recommendations of the Agricultural Experiment Station on vegetable insects, complemented by those of the U.S. Department of Agriculture and State experiment stations.

MATERIALS AND METHODS

This study was started on January 29, 1960, at the Isabela Agricultural Experiment Substation, and was completed on April 25, 1960. The following vegetable crops were used for this study: Cucumber, variety Palomar;

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[3] Italic numbers in parentheses refer to Literature Cited, p. 8.

snap beans, variety Bonita Improved; sweet corn, variety Rico Dorado; and tomatoes, variety Manalucie.

TREATMENT A

Cucumbers: Parathion, 15-percent wettable powder at the rate of 1½ pounds per acre, sprayed weekly.

Snap beans: DDT, 50-percent wettable powder at the rate of 2 pounds per acre, sprayed every 2 weeks.

Sweet corn: DDT, 50-percent wettable powder at the rate of 4 pounds per acre, sprayed weekly.

Tomatoes: Parathion, 15-percent wettable powder at the rate of 1½ pounds per acre, sprayed weekly, and DDT, 50-percent wettable powder at the rate of 2 pounds per acre, sprayed every 14 days.

TREATMENT B

Cucumbers: Seed sprayed with Guthion, 17-percent, at the rate of 6 pounds per acre and 1 foliar spray 21 days after planting with the same product at the same rate per acre.

Snap beans: Guthion, 17-percent at the rate of 6 pounds per acre, sprayed 14 days after planting, and a second spray 28 days after planting.

Sweet corn: Dylox, 5-percent dust at the rate of 1 pound per acre. As ears were forming the dust was sprayed into the silks.

Tomatoes: Di-Syston, 5-percent, granular, at the rate of 10 pounds per acre. The insecticide was applied at planting time in the field around the base of the plants and was repeated again 14 days after planting.

TREATMENT C

Control: No insecticide treatments.

EXPERIMENTAL METHODS

The experimental design was a complete randomized block, with the following planting distances: Cucumbers: 4 rows, 3 feet apart and 10 feet long. Each row consisted of 5 hills, 2 feet apart with 2 plants per hill, making a total of 40 plants per plot. Snap beans: 2 rows, 3 feet apart, and 10 feet long. Seed were planted 3 inches apart, making a total of 80 plants per plot. Sweet corn: 2 rows per plot, 3 feet between rows, and 15 feet long. Each row consisted of 10 hills, 18 inches apart with 2 plants per hill, making a total of 40 plants per plot. Tomatoes: 4 rows per plot, 3 feet between rows, and 20 feet long. Plants were spaced 4 feet apart in each row, making a total of 20 plants per plot.

Each experimental plot was surrounded by a blank space 9 feet wide to control the drift while spraying with the pesticides. Between crops the

blank space was increased to 18 feet. Fungicide sprays were used on tomatoes, snap beans, and cucumbers. Tomatoes were sprayed twice a week, once with Copper A and once with Zerlate. Alternate sprays with Copper A and Zerlate were given to the snap beans and cucumbers once a week.

All plots, including check, received 2 pounds of Aldrin actual per acre, as a preplanting treatment to the soil. This was necessary in order to get a crop. Treatment A designates the Agricultural Experiment Station recommendation plots; B designates the new pesticides that were tested; and C designates check plots under no treatment except fungicides and the preplanting treatment with Aldrin.

Pesticide treatments were replicated four times for each crop.

EXPERIMENTAL RESULTS AND DISCUSSION

CUCUMBERS

The mean number of fruits produced under the different pesticide treatments were Parathion 231, Guthion 197, control 249, and the overall mean was 225.66.

The standard error and least differences required for significance between mean number of fruits are shown in the following tabulation:

Item	*5 percent*	*1 percent*
Difference between highest and lowest means	85.28	124.19
Difference between 2 adjacents	67.99	102.97

Standard error 19.65 with 6 d.f.

There was no significant difference between pesticide treatments used as compared with the control. However, the mean number of fruits produced showed a tendency toward a smaller number of fruits set in the plots treated with pesticides. This fact can be accounted for by the nature of this crop; since it is a cross-pollinated one, pollination being carried on mainly by insects, the presence of pesticides could possibly reduce the pollination and hence the number of fruits set. This reduction was nonsignificant.

The results on the average weight in pounds per plot of cucumber fruits, the plants of which were treated with different pesticides were Parathion 98.24, Guthion 90.57, control 76.34, and mean 88.38.

The standard error and least differences required for significance between mean green weights of cucumbers are shown in the following tabulation:

Item	*5 percent*	*1 percent*
Difference between highest and lowest means	38.58	56.18
Difference between 2 adjacents	30.76	46.58

Standard error 8.89 with 6 d.f.

These results show that there was no significant difference for yield between the pesticide treatments.

SNAP BEANS

The data on the mean yield in pounds per plot of snap beans treated with the indicated pesticide were DDT 11.44, Guthion 11.63, control 9.32, and mean 10.80.

The standard error and least differences required for significance between mean green weights of snap beans are shown in the following tabulation:

Item	*5 percent*	*1 percent*
Difference between highest and lowest means	2.12	3.10
Difference between 2 adjacents	1.69	2.57

Standard error 0.49 with 6 d.f.

There were significant differences in yield between the different pesticide treatments. Snap beans treated with DDT or Guthion yielded significantly more than the control. There was no significant difference between the DDT and Guthion treatments. This result is of practical importance for the bean farmers, whether they raise snap or field beans, because it shows that yields can be improved by means of a good pest-control program and in this way the income from this crop is enhanced.

SWEET CORN

The results of the data obtained on plant height in feet of sweet corn were DDT (A) 7.33, DDT (B) 7.24, control 6.20, and the mean 6.92.

The standard error and least differences required for significance between mean plant heights are shown in the following tabulation:

Item	*5 percent*	*1 percent*
Difference between highest and lowest means	0.65	0.95
Difference between 2 adjacents	.52	.79

Standard error 0.49 with 6 d.f.

These results show that there were highly significant differences between the pesticide treatments and the control. Plants under treatments A and B (both sprayed with DDT) were significantly taller than the ones in the control plots. There was naturally no significant difference between treatments A and B, as both had the same treatment for insect control during their vegetative cycle, except during the silking stage. Apparently, from these data, it seems that a good insect-control program on corn yields more vigorous plants and consequently a better crop.

The results on the average number of ears per plot were DDT (A) 48, DDT (B) 44.25, control 24.75, and mean 39.

The standard error and least differences required for significance between mean number of ears per plot are shown in the following tabulation:

Item	*5 percent*	*1 percent*
Difference between highest and lowest means	16.84	24.41
Difference between 2 adjacents	13.42	20.33

Standard error 3.88 with 6 d.f.

These results indicate a significant difference at the 5-percent level in the number of ears produced between plants that were treated with pesticides and the control. Plants sprayed with DDT every week during their life cycle (treatments A and B) yielded more than the untreated plots. It is of interest for farmers to notice that spraying their corn plantings with pesticides increases the number of ears produced.

The data on the mean number of marketable ears from sweet corn plants treated with different pesticides were DDT 34.50, Dylox 31.75, control 17.00, and mean 27.75.

The standard error and least differences required for significance between mean number of marketable ears per plot are shown in the following tabulation:

Item	*5 percent*	*1 percent*
Difference between highest and lowest means	17.95	25.91
Difference between 2 adjacents	14.19	22.14

Standard error 4.10 with 6 d.f.

There were significant differences at the 5-percent level between the sweet corn ears that were treated with pesticides and the control. There was no significant difference between the two pesticide treatments, DDT and Dylox.

Sweet corn is sold by the ear as fresh market corn. In this experiment it was shown that spraying the silks with DDT or Dylox increased the number of marketable ears significantly over the control; consequently, a higher income should be expected when the ears are sprayed for the control of the earworm. Research work with DDT at different experiment stations (*1* to *16*) resulted in practical measures for earworm control.

Data on the average weight in pounds per plot of sweet corn ears treated with different pesticides were DDT 23.91, Dylox 23.90, control 12.35, and mean 20.06.

The standard error and least differences required for significance between mean ear weights per plot of sweet corn are shown in the following tabulation:

Item	*5 percent*	*1 percent*
Difference between highest and lowest means	9.85	14.34
Difference between 2 adjacents	7.85	11.89

Standard error 2.27 with 6 d.f.

Spraying the sweet corn ears with DDT or Dylox resulted in an increase in weight per plot as compared with the control. It is noteworthy that spraying the sweet corn ears with the pesticides not only resulted in an increase in the number of fresh marketable ears, but also in a better quality product, with less insect damage than the control. This increase in weight was significant at the 5-percent level over the control. However, there was no significant difference between the two pesticide treatments.

The data obtained in the sweet corn experiment indicate that:

1. Spraying the plants with DDT once every week during their vegetative cycle resulted in more vigorous plants as determined by the plant-height data.
2. Treating the silks with DDT or Dylox caused an increase in the number of marketable ears.
3. Fresh market ears of better quality were produced when the silks were treated with pesticides to control the earworm.

TOMATOES

Data on the average yield in pounds per plot of tomato fruits, the plants of which were sprayed with different pesticides were DDT-Parathion 77.16, Di-Syston 45.64, control 63.32, and the mean 62.04.

The standard error and least differences required for significance between mean weights of tomato fruits are shown in the following tabulation:

Item	*5 percent*	*1 percent*
Difference between highest and lowest means	46.22	67.31
Difference between 2 adjacents	36.85	55.81

Standard error 10.65 with 6 d.f.

Spraying the tomato plants with Parathion, DDT, and Di-Syston did not cause a significant increase in the yield of tomatoes; nevertheless, according to the results obtained in this trial, there is a tendency for the systemic insecticide to lower the yield. Visual observations on the plants treated with Di-Syston detected some stunting of the plants and, presumably because of this condition, a lower yield was obtained with this treatment. Further investigation in regard to concentration and frequency of application of this pesticide is suggested in order to reach final conclusions.

The data on the average weight in pounds per plot of commercial tomato fruits from the plants treated with different pesticides were DDT-Parathion 77.16, Di-Syston 45.64, control 63.32, and the mean 62.04.

The standard error and least differences required for significance between mean weights of commercial fruits are shown in the following tabulation:

Item	*5 percent*	*1 percent*
Difference between highest and lowest means	46.22	67.31
Difference between 2 adjacents	36.85	55.81

Standard error 10.65 with 6 d.f.

The data show a similar trend to those obtained for total fruit yield. There was no significant difference between the pesticide treatments, and the systemic insecticide produced the lowest yield of all treatments.

SUMMARY

The effects of different pesticides, namely, Parathion, DDT, Guthion, Di-Syston, and Dylox on the yield and quality of vegetable crops, were studied in the Isabela Area. The following major results were obtained:

1. Cucumbers: Sprays with Parathion or Guthion had no effect on the yield and number of fruits produced.

2. Snap beans: DDT application at the rate of 2 pounds per acre gave a significant increase in yield. Guthion, sprayed at the rate of 6 pounds per acre per spray, also produced a significant increase in the yield.

3. Sweet corn: DDT applications at the rate of 4 pounds per acre, sprayed on weekly, controlled foliage injury and, consequently, healthier and more vigorous plants were obtained. Foliar sprays of DDT, at the same rate as above, increased the number of ears produced. Spraying the silks with DDT at the rate of 4 pounds per acre per application, or dusting them with Dylox granular, 1 pound per acre, improved the quality of the ears produced.

4. Tomatoes: Foliar sprays with DDT and Parathion did not cause a significant increase in yield nor in the number of marketable fruits produced. Granular Di-Syston at the rate of 10 pounds per acre, had no effect on the yield or number of marketable fruits in this experiment.

RESUMEN

Se estudió el efecto de las aplicaciones de insecticidas a pepinillos, habichuelas tiernas, maíz dulce y tomates, para determinar sus efectos sobre la calidad y rendimientos de estas cosechas.

Los resultados fueron los siguientes:

1. Pepinillos: Las aspersiones foliares con Parathion, a razón de 1½ libras por acre, no causaron aumentos significativos ni en el peso ni en el número de frutas. Cuando se trató la semilla con Guthion, a razón de 6 libras por acre, y también se aplicó una aspersión foliar a los 21 días después de la siembra, esto no surtió efecto significativo alguno sobre el rendimiento y número de frutas.

2. Habichuelas tiernas: Las aspersiones foliares con DDT, a razón de 2 libras por acre cada 14 días, aumentaron significativamente la produción. Las aplicaciones de Guthion a razón de 6 libras por acre a los 14 y 28 días después de la siembra, sumentaron significativamente la producción.

3. Maíz dulce: El DDT, a razón de 4 libras por acre, asperjado al follaje cada 7 días redujo en forma muy significativa el daño del gusano cogolleroí por lo que estas plantas se desarrollaron más vigorosas que las que no se

trataron. El maíz de las parcelas tratadas con DDT en la forma arriba mencionada, produjó mayor número de mazorcas que el de las que no se trataron. Cuando se trataron las barbas de las mazorcas con DDT y Dylox, esto causó un aumento significativo en el número de mazorcas comerciales producidas sobre las que no se trataron.

4. Tomates: Las aspersiones foliares con Parathion y DDT y las aplicaciones granulares con Di-Syston a la base de las plantas, no causaron efecto alguno sobre el rendimiento en peso o sobre el número de frutas.

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