Soil systemic insecticides to control the coffee leafminer, *Leucoptera coffeella* (Guérin-Méneville), in Puerto Rico[1]

Fernando Gallardo-Covas[2]

ABSTRACT

Soil systemic insecticides were evaluated for the control of the coffee leafminer, *Leucoptera coffeela,* in 1982, 1983 and 1984 at the Adjuntas Agricultural Experiment Substation. Aldicarb 10 G and carbofuran 10 G were compared with a standard (disulfoton 15 G) and an untreated check. In 1982, disulfoton 15 G at 12 g/m height and aldicarb 10 G at 20 and 30 g per tree (93.3, 75.3 and 73.6% control, respectively) gave a highly significant leafminer control as compared with the check. Carbofuran 10 G at 20 g per tree gave 68.6% control. For the second trial (1983) only aldicarb 10 G at 20 g gave significantly higher percentage control (20.9). In the third trial, disulfoton 15 G, aldicarb 10 G at 20 g and 30 g per tree were highly significant with 92.6, 87.8 and 88.7% control, respectively. Also carbofuran 10 G at 15 g per tree was significant. Yields in all treatments with aldicarb and carbofuran were superior to that with disulfoton 15 G for the 3-year experiment.

INTRODUCTION

Coffee is one of the main agricultural crops of the island. It is grown in the west central area. Unshaded coffee is grown on approximately 81,715 acres. In 1983-84 coffee produced a cash value of $63.22 million (4).

One of the limiting factors in coffee production is the coffee leafminer; the larvae of this small silvery moth bore into the mesophyll of the leaves and produce brown spots (fig. 1). This damage reduces 50% of the photosynthetic activity of the leaves, causes defoliation and reduces yields by up to 40% (3).

Leucoptera coffeella is the only species of the coffee leafminer complex (all belonging to the genus *Leucoptera*) found in the Neotropical region. It was discovered by Guérin-Méneville and Perrottet on coffee in Guadaloupe and Martinique (5). It was then placed in the genus *Elachista* and later referred to by Stainton (7) as *Cemiostoma.* Through a misidentification, the common *Leucoptera* found in Africa was referred to as *coffeella* in nearly all the literature up to 1958, when Bradley (2) eliminated the confusion by distinguishing it from *L. meyricki.*

The coffee leafminer (*Leucoptera coffeella*) occurs throughout the

[1]Manuscript submitted to Editorial Board May 29, 1986.

[2]Assistant entomologist, Crop Protection Department, Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P. R.

FIG. 1.—Damage caused to the coffee leaves by the coffee leafminer *Leucoptera coffeella*, Guérin-Méneville.

Neotropical region in almost every country in which coffee is grown, and was probably introduced here with the first coffee plants brought to the island. The first record for Puerto Rico was reported by O. W. Barret in 1903 (1). Since then this insect has been studied, especially by Wolcott (9), Van Zwaluwenburg (8), Seín, and later by Pérez Escolar (6). Pérez Escolar conducted field trials and achieved the chemical control of the coffee leafminer with the systemic insecticide disulfoton 15 G. This insecticide has been the only effective pesticide registered in Puerto Rico for chemical control of the coffee leafminer during the last 20 years. Because of the possible development of resistance to this insecticide it has been necessary to evaluate other pesticides.

This paper summarizes the 1982-84 field experiments to evaluate different insecticides used against the coffee leafminer in coffee groves at the Adjuntas Agricultural Experiment Substations.

MATERIALS AND METHODS

A complete randomized design was established on unshaded coffee (cv. Bourbon) plots at the Adjuntas Agricultural Experiment Substation in January 1982 and was continued to 1984. Soil systemic insecticide-nematicides previously selected from a preliminary screening were evaluated for the control of the leafminer. Carbofuran (Furadan) 10 G and aldicarb (Temik) 10 G were tested at three dosages (table 1). Disulfoton (Di-syston) 15 G at one rate was included as standard, as well as an untreated check for comparison. Four replicates with eight trees each (10 years old, planted at 1.5 × 3.3 m were used in an Alonso clay (Ultisols, pH 4.8 and 3.15% organic matter).

Granules were spread and lightly worked around the root area or dripping line of the coffee shrub. All chemicals, except disulfoton 15 G, were applied twice during the year, the first application in February-

TABLE 1.—*Percentage infestation, control and yield of coffee treated with different pesticides against the coffee leafminer,* Leucoptera coffeella, *in Puerto Rico, 1982 trial*

Treatments	Dosage g/tree	Percent		Yield	
		Infestation	Control	kg/tree	Percent increase
Carbofuran 10 G	10	53.5	44.9	6.9	16.0
Carbofuran 10G	15	62.7	35.4	6.1	5.2
Carbofuran 10G	20	30.5*[1]	68.6	7.9**[2]	26.1
Aldicarb 10G	10	64.5	33.6	8.0**	27.0
Aldicarb 10G	20	24.0**	75.3	7.6**	23.2
Aldicarb 10G	30	25.7**	73.6	10.3**	43.7
Disulfoton 15G	12 g/m high	6.5**	93.3	3.3	—
Check	—	97.2	—	5.8	—

[1]Significantly different from the check at P = 0.05.
[2]Significantly different from the check at P = 0.01.

April and the second in June-July in accordance with the seasonal activity of the coffee leafminer. Disulfoton 15 G was applied once a year in February. All the agronomical practices common to the coffee region were followed in these experiments.

Counts to determine infestation percentage were done 2 months after each application. Four branches, randomly selected from each cardinal point of the tree, were observed and the number of mines recorded.

Observations were made between 1 and 2 m from the ground, where heavy populations of leafminer are frequently found.

Chemical effectiveness (percent control or P.C.) was estimated with a modification of the Abbott's formula as follows: $\frac{A-B}{A} \times 100$, where A is infestation percentage in the check and B the infestation percentage in the treated foliage. Percentage of insect control was statistically analyzed and differences between means evaluated for significance according to Student's "*t*" or Duncan's new multiple range tests. Data on yield and phytotoxicity were also recorded.

RESULTS AND DISCUSSION

In the 1982 experiment (table 1) disulfoton 15 G at the rate of 12 g/m height gave the best percentage of leafminer control (93.31), which was highly significant ($P<0.01$) when compared with the check. It was followed by aldicarb 10 G at the rate of 20 and 30 g per tree, with 75.3 and 73.6% control respectively ($P = 0.01$) when compared with the check. Yield was higher with these treatments than with those of disulfoton 15 G and the check ($P<0.01$). The highest yield, 43.8 %, was obtained in plots treated with aldicarb 10 G at the rate of 30 grams per tree when compared with the check. All treatments reduced a coffee leafminer populations. No phytotoxicity was observed in any of the treated plots.

For the second trial, 1983 (table 2), only aldicarb 10 G at the rate of 20 g/tree gave significant control percentage (20.9) over other treatments ($P<0.05$). The remaining treated plots were not significantly different from the check. Low population of leafminer was observed during this trial in the field. No significant differences were observed in yield nor phytotoxicity on the treated plants. Nevertheless, some yield increase (18.0%) was obtained in plots treated with aldicarb 10 G at the rate of 10 g/tree.

A third experiment conducted in 1984 (table 3) showed that disulfoton 15 G at the rate of 12 g per 1 m-high tree gave the best leafminer control (92.6%), significant ($P = 0.01$) when compared with the check. It was followed by aldicarb 10 G at 30 and 20 g/tree with 88.7 and 80.8% control, respectively. Also carbofuran 10 G at 20 g/tree with 73.8% control was significantly different from the check ($P = 0.01$). Carbofuran 10 G at the rate of 15 g/tree with 65.8% control was significant ($P = 0.05$) when

TABLE 2.—*Percentage infestation, control and yield of coffee treated with different pesticides against the coffee leafminer,* Leucoptera coffeella, *in Puerto Rico, 1983 trial*

Treatments	Dosage g/tree	Percent		Yield	
		Infestation	Control	kg/tree	Percent increase
Carbofuran 10 G	10	47.7	—	9.0	9.3
Carbofuran 10G	15	42.2	7.9	7.9	—
Carbofuran 10G	20	42.3	7.7	8.7	6.6
Aldicarb 10G	10	47.5	—	9.9	18.0
Aldicarb 10G	20	36.3*[1]	20.9	8.6	5.0
Aldicarb 10G	30	39.6	13.8	8.9	9.0
Disulfoton 15G	12 g/m high	46.8	—	9.1	11.0
Check	—	45.9	—	8.1	—

[1]Significantly different from the check at P = 0.05.

TABLE 3.—*Percentage infestation, control and yield of coffee treated with different pesticides against the coffee leafminer,* Leucoptera coffeella, *in Puerto Rico, 1984 trial*

Treatments	Dosage g/tree	Percent		Yield	
		Infestation	Control	kg/tree	Percent increase
Carbofuran 10 G	10	9.7	48.7	9.4	—
Carbofuran 10G	15	6.5*[1]	65.8	12.0	15.8
Carbofuran 10G	20	4.9**[2]	74.0	10.9	7.9
Aldicarb 10G	10	8.7	54.0	10.9	8.0
Aldicarb 10G	20	3.6**	80.8	10.8	6.8
Aldicarb 10G	30	2.1**	88.7	10.2	0.9
Disulfoton 15G	12 g/m high	1.4**	92.6	10.2	1.4
Check	—	19.0	—	10.1	—

[1]Significantly different from the check at P = 0.05.
[2]Significantly different from the check at P = 0.01.

compard with the check. No significant differences were established between yields of treated plots and the check. However, plots treated with carbofuran 10 G at 15 g/tree showed an increase of 15.8% when compared with the check. No phytotoxicity was observed in treated plots.

The total accumulated control percentage of the coffee leafminer for the 3 years (table 4) showed that disulfoton 15 G and aldicarb 10 G at 20 and 30 grams per tree gave the highest value, followed by carbofuran 10 G at the rate of 20 g/tree. The lowest control percentage (29.1) was obtained with aldicarb 10 G at 10 g/tree. All the treatments were effective in controlling the coffee leafminer.

The total yield for the 3 years (table 4) showed that aldicarb 10 G at 30 g/tree gave the highest yield (9.8 kg/tree) followed by aldicarb 10 G at 10 g and carbofuran 10 G at 20 g/tree. All the treated plots were higher

TABLE 4.—*Average percentage control of the coffee leafminer,* Leucoptera coffeella, *and average yield per tree on coffee plot treated with different soil systemic insecticide-nematicides, 1982-84 trial, Adjuntas, P. R.*

Treatments	Dosage g/tree	Average		
		Percent control	Yield kg/tree	% Yield increase
Carbofuran 10G	10	31.2	8.4	11.7
Carbofuran 10G	15	36.3	8.7	12.0
Carbofuran 10G	20	50.1	9.2	12.7
Aldicarb 10G	10	29.2	9.6	24.0
Aldicarb 10G	20	59.0	9.0	12.5
Aldicarb 10G	30	58.7	9.8	24.5
Disulfoton 15G	12 g/m height	62.0	7.6	—
Check	—	—	8.0	—

in yield than those treated with disulfoton 15 G, probably because of the nematicidal action of aldicarb and carbofuran. In conclusion, these experiments showed that aldicarb 10 G and carbofuran 10 G have the potential to control the coffee leafminer.

RESUMEN

Insecticidas sistémicos para reprimir del minador de la hoja del cafeto, *Leucoptera coffeella* (Guérin-Méneville), en Puerto Rico

Se evaluaron varios insecticidas-nematicidas para controlar el minador del cafeto, *Leucoptera coffeella*, en la Estación Experimental Agrícola, Subestación de Adjuntas, Puerto Rico, de el 1982 a 1984. Aldicarb 10 G y carbofuran 10 G, ambos en 3 dosis, se aplicaron en un ensayo en 1981. Se incluyó, además, el insecticida disulfoton 15 G como testigo para compararlos. En el primer ensayo (1982) disulfoton 15 G fue altamente significativo en el control del minador (93.3%) al compararlo con el del testigo. Con aldicarb 10 G en dosis de 20 y 30 gramos por árbol se obtuvo 75.3 y 73.6% de control, respectivamente. El control de carbofuran 10 G en dosis de 20 gramos por árbol fue singificativo al 5% al compararlo con el del testigo. En el segundo año solamente aldicarb 10 G en dosis de 20 gramos controló el minador significativamente al 5% al compararlo con el del testigo. No fue posible determinar si hubo diferencias significativas entre los demás tratamientos. En el tercer año, los resultados demostraron que disulfoton 15 g con 92.6% de control, aldicarb 10 G en 30 y 20 gramos con 88.7 y 80.8% de control, respectivamente, fueron altamente significativos. Con carbofuran 10 G a 15 gramos por árbol se obtuvo un control significativo al 5%. Con todos los tratamientos de aldicarb 10 G y carbofuran 10 G, lo cual podría atribuirse a la acción nematicida de dichos productos. En conclusión, ambos productos, aldicarb y carbofuran, demostraron ser eficaces en el control del minador del cafeto en Puerto Rico.

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