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Permethrin 3.2 EC, fluvalinate aquaflow and stages of the coffee leaf miner, *Leucoptera coffeella* (Lepidoptera: Lyonetiidae)[1]

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ABSTRACT

Three greenhouse experiments were established in the Adjuntas substation of the Agricultural Experiment Station, University of Puerto Rico, to evaluate the action of fluvalinate aquaflow (Minadox) and permethrin 3.2 E.C. (Pounce) in controlling the coffee leaf miner at different life stages: larvae, pupae and moths. Data were recorded on the percentage control (P.C.) and percentage mine increase treated with fluvalinate aquaflow at three dosages (0.21, 0.42 and 0.64 ml/500 ml water) and permethrin at 1 ml/500 ml water. Permethrin at 0.64 ml (388 ml/ha) controlled 84.1% leaf miner larvae and pupae 7 days after application and 87.1% 15 days after application, respectively. Fluvalinate aquaflow also demonstrated its properties to control leaf miner moths effectively. Fluvalinate at rates of 200 and 300 ml/ha (0.42 and 0.64 ml/500 ml water) permitted mine increase in the order of 6.3 and 0%, respectively. The check treatment (no insecticide) and permethrin gave 23.7 and 18.1% mine increase, respectively. Both insecticides decreased leaf miner population.

RESUMEN

Permetrina, fluvalinato y el control del minador del cafeto en sus tres estapas

El minador de las hojas del cafeto, *Leucoptera coffeella*, es el principal insecto que ataca el café en Puerto Rico. Si no se combate a tiempo ocasiona pérdidas de hasta 40% de la producción. El insecticida foliar fluvalinato "aquaflow" (Minadox) se evaluó en años anteriores (1984 y 1985) y se obtuvieron buenos resultados. Con el propósito de obtener datos sobre el efecto del fluvalinato en las distintas etapas del ciclo de vida del minador del café (larva, ninfa y adulto) se hicieron tres ensayos en el invernadero en la subestación de Adjuntas de la Estación Experimental Agrícola. Además del fluvalinato se evaluó la permetrina (Pounce 3.2 E.C.) y ambos insecticidas se compararon con un testigo sin tratar. Se probaron tres dosis de fluvalinato: 0.21, 0.43 y 0.64 ml diluidos en 500 ml. de agua (equivalentes a 100, 200 y 300 ml./ha., respectivamente) y una dosis de

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permetrina: 0.94 ml. diluidos en 500 ml. de agua (equivalente a 388 ml./ha.). Ambos insecticidas pueden disminuir la propagación del minador del café. El fluvalinato demostró principalmente su propiedad de reprimir los adultos. A 0.42 ml. las galerías no aumentaron y a .64 ml. solo aumentaron 6.33%. En testigo sin insecticida y sin permetrina hubo 23.7 y 18.1% de aumento en galerías, respectivamente. Permetrina a 0.64 ml. disminuyó las larvas en 84.08% a los 7 días de la aplicación. También disminuyó en 87% de las ninfas a 0.64 ml. a los 15 días de la aplicación.

INTRODUCTION

The coffee leaf miner (CLM), *Leucoptera coffeella*, Guérin-Méneville (Lepidoptera: Lyonetiidae) is the main insect pest of coffee in Puerto Rico. Damage to the trees is caused by the larval stages, which tunnel the leaf and feed on the mesophyll for up to 3 weeks. Typical symptoms of infestation by this pest are large brown spots on the leaves.

The brown spots can reduce leaf photosynthetic activity by 50% and will cause 70% weight loss of stalks and 60% of roots (3). Nantes and Parra (6) found a 21.6% loss in coffee yield when 46.2% of the coffee plant leaves were damaged by the CLM.

Leucoptera coffeella was discovered by Guérin-Méneville and Perrottet on coffee in Guadeloupe and Martinique (5) as *Elachista* and later referred to by Stainton (8) as *Cemiostoma*. Through a misidentification, the common *Leucoptera* found in Africa was referred to as *L. coffeella* in nearly all the literature up to 1958, when Bradley (2) solved the confusion by distinguishing it from *L. meyricki*.

L. coffeella occurs throughout the neotropical region in almost every country where coffee is grown. It was probably brought to Puerto Rico with the first coffee plants. The first record for Puerto Rico was reported by O. W. Barret in 1903 (1). Since then, this insect has been studied by Wolcott (10), Van Zwaluvenburg (9), Seín and later on by Pérez (7).

Disulfoton (Di-syston)[3] 15 G is the main pesticide used against the CLM in Puerto Rico. In 1985 the coffee industry spent around $1 million in the chemical control of the CLM (4). Because of the potential development of resistance to disulfoton 15 G it is necessary to evaluate new insecticides that may be useful to coffee growers.

Fluvalinate aquaflow (Minadox), a foliar contact insecticide, was evaluated in 1984-85 with excellent results against the CLM. Three experiments were conducted at the Adjuntas substation to compare the performance of fluvalinate with that of permethrin (Pounce) on the stages of larvae, pupae and moths of the CLM.

[3]Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

MATERIALS AND METHODS

Three experiments were established in a greenhouse at the Adjuntas substation of the Agricultural Experiment Station to evaluate fluvalinate aquaflow and permethrin control of larvae (experiment a 1), pupae (experiment a 2) and moths (experiment a 3).

Experiment a 1

A partially balanced incomplete block design with four replications of 10 plants (2 rows of 5 plants) per plot was used. Each plot was separated by 2-foot alleyways.

Fluvalinate aquaflow was tested at three dosages (table 1 a) and permethrin 3.2 EC at one dosage. Both were compared with a check without chemical application.

TABLE 1.—*Coffee leaf miner,* Leucoptera coffeella, *larvae alive (L) and dead (D) per treatment, percentage mortality (% M) and percentage control (P.C.), at 1, 7 and 15 days after application; Adjuntas Substation, 1986*

	Leaf miner larvae[1]				
Treatments	Dosage[2]	L	D	%.M	P.C.
A[3]					
1. Fluvalinate aquaflow	0.21 ml[4]	29	0	–	–
2. Fluvalinate aquaflow	0.42 ml	31	0	–	–
3. Fluvalinate aquaflow	0.64 ml	36	0	–	–
4. Permethrin 3.2 E.C.	0.94 ml	25	0	–	–
5. Check	–	37	0	–	–
B[5]					
1. Fluvalinate aquaflow	0.21 ml[4]	26	7	21.21	8.08
2. Fluvalinate aquaflow	0.42 ml	36	5	12.19	–
3. Fluvalinate aquaflow	0.64 ml	20	10	33.33	22.22
4. Permethrin 3.2 E.C.	0.94 ml	3	19	86.36	84.08
5. Check	–	30	5	14.28	–
C[6]					
1. Fluvalinate aquaflow	0.21 ml[4]	21	8	27.58	15.09
2. Fluvalinate aquaflow	0.42 ml	27	6	18.18	4.07
3. Fluvalinate aquaflow	0.64 ml	15	6	28.57	16.26
4. Permethrin 3.2 E.C.	0.94 ml	10	15	60.00	53.10
5. Check	–	29	5	14.70	–

[1]Leaf miner larvae in 40 mines per treatment.
[2]Dosages were diluted in 0.5 L of water.
[3]One day after treatments.
[4]0.21 ml = 100 ml/ha, 0.42 ml = 200 ml/ha, 0.64 ml = 300 ml/ha and 0.94 ml = 388 ml/ha.
[5]7 days after treatments.
[6]15 days after treatments.

The two pesticides were applied with a hand sprayer that produces a mist at 275 kPa (similar to the mist produced by the motorblower used in field applications). An open box was used to cover each plot at the time of application in order to prevent spray drift to other plots.

Before treatments all the plants were placed together and inoculated with a hundred CLM moths. This was done to obtain a uniform distribution of mines in the coffee plots. Three weeks later the plants were separated into plots and the insecticides applied.

The number of mines per plot was recorded before the application (table 2) and evaluations were done at 1, 7 and 15 days after (table 1). Percentage infestation and control were determined by recording live and dead leaf miner larvae on 10 mines per plot.

Insecticide effectiveness (percentage control = PC) was estimated with a modification on Abbot's formula as follows:

$$\frac{B - A}{100 - A} \times 100 = P.C.,$$

where A = percentage mortality in the check and B = percentage mortality in the treated plots. Data obtained were subjected to statistical analysis.

Experiment a 2

A randomized complete block design with three replicas per treatment was used. Leaves with pupae were collected from rearing cages and the number of pupae was recorded in order to obtain 20 pupae per replication. Leaves with pupae were placed on a piece of wood (2′ × 1′) on the floor and the treatments were applied with the same hand sprayer used in experiment a 1. Treatments were applied one at a time and the treated pupae were placed in plastic cups (16.5 cm high × 11.4 cm wide)

TABLE 2.—*Coffee leaf miner,* Leucoptera coffeella, *mines before and after 15 days of treatment application, Experiment a 1, Greenhouse, Adjuntas Substation, 1986*

Treatments	Dosage[2]	Mines[1]		
		Before	After	Mine increase
				%
1. Fluvalinate aquaflow	0.21 ml[3]	186	225	17.33
2. Fluvalinate aquaflow	0.42 ml	185	185	0.00
3. Fluvalinate aquaflow	0.64 ml	133	142	6.33
4. Permethrin 3.2 E.C.	0.94 ml	140	171	18.12
5. Check	–	151	198	23.73

[1]Total mines per treatment.

[2]Dosages diluted in 0.5 L of water.

[3]0.21 ml = 100 ml/ha, 0.42 ml = 200 ml/ha, 0.64 ml = 300 ml/ha and 0.94 ml = 388 ml/ha.

TABLE 3.—*Coffee leaf miner,* Leucoptera coffeella, *pupae alive (L) and dead (D) per treatment, percentage mortality (% M) and percentage control (% C) 15 days after application, Adjuntas Substation, 1986*

Treatments	Leafminer Pupae[1]				
	Dosage[2]	L	D	% M	% C
1. Fluvalinate aquaflow	0.21 ml[3]	47	13	21.66	0.00
2. Fluvalinate aquaflow	0.64 ml	18	42	70.00	41.93**[4]
3. Permethrin 3.2 E.C.	0.94 ml	4	56	93.33	87.09**
4. Check	–	31	29	48.33	–

[1]Represents the total for the 3 replicas of each treatment.
[2]Dosages were diluted in 0.5 liter of water.
[3]0.21 ml = 100 ml/ha, 0.64 ml = 300 ml/ha, and 0.94 ml = 388 ml/ha.
[4]Significant at the 1% probability level.

and covered with a piece of cloth to prevent the flight of the CLM moths that might arise from the treated pupae.

Fluvalinate aquaflow at two dosages and permethrin at one dosage were compared with a check without chemical application (table 3). One application was done and treatments were evaluated 3 weeks after the application. The number of moths that arose from treated pupae was recorded and percentage control was obtained by using Abbot's formula. Data obtained were subjected to statistical analysis.

Experiment a 3

The CLM moths were previously obtained from laboratory colonies. Two hundred moths were placed in each of the rearing cages (2′ × 2′ × 2′). Three treatments replicated three times were tested (table 4). Treatments were applied with a hand sprayer. A piece of dark cloth was placed in the bottom of the cage to facilitate counting dead moths. One hour after application dead moths were recorded. Percentage control was es-

TABLE 4.—*Coffee leaf miner,* Leucoptera coffeella, *moths alive (L) and dead (D), percentage mortality (% M), percentage control (% C). One hour after application. Adjuntas Substation, 1986*

Treatments	Leafminer moths[1]				
	Dosage[2]	L	D	% M	% C
Water	.5 L	600	0	–	–
Fluvalinate	.64 ml[3]	600	540	90.00	90.00
Check	–	600	0	–	–

[1]Represents the total for the three replications of each treatment.
[2]Dosages were diluted in 0.5 liter of water.
[3]0.64 ml = 300 ml/ha.

timated with Abbot's formula. Data obtained were subjected to statistical analysis.

RESULTS AND DISCUSSION

Experiment a 1

Data obtained in experiment a 1 was statistically analyzed with Duncan's Multiple Range test and *F* test. No significant differences were obtained among treatments, although permethrin 3.2 EC controlled leaf miner larvae well (84.1%) 7 days after the application. Control decreased to 53.1% at 15 days (table 1 a). Also treatments of fluvalinate aquaflow at 0.42 ml and 0.64 ml prevented the development of new CLM mines (table 2). In the check treatment there was a 23.73% mine increase; with fluvalinate at 0.42 ml and 0.64 ml there was 0.0 and 6.33% mine increase, respectively.

Experiment a 2

A Duncan's Multiple Range test was performed for the data obtained in this experiment. Control by treatment 3, permethrin 3.2 EC, when compared with that by the check, was significantly higher at the 5% level and when compared with treatment 1 (fluvalinate aquaflow) was significantly higher at the 1% level. Also, treatment 3 (fluvalinate aquaflow at 0.64 ml) when compared with treatment 1 (fluvalinate aquaflow at 0.21 ml) differed significantly at the 1% level.

Experiment a 3

Because of the high rate of mortality (90%) of the CLM moths 1 hour after treatment with fluvalinate aquaflow, the data collected could not provide a significant difference among treatments (table 4). Results showed that fluvalinate aquaflow at 0.64 ml (300 ml/ha) effectively controlled the CLM moths.

CONCLUSIONS

Permethrin 3.2 E.C. (Pounce) at 0.64 ml (388 ml/ha) controlled 84.1% of the leaf miner larvae and pupae 7 days after application, and 87.1% 15 days after application. Fluvalinate aquaflow (Minadox) mainly controlled moths instead of pupae or larvae (table 4). Also, fluvalinate aquaflow (Minadox) at 0.42 ml (200 ml/ha) and 0.64 ml (300 ml/ha) prevented mine increase at 0.00 and 6.33%, respectively (table 2). The check and permethrin treatments had 23.73 and 18.12% mine increase, respectively. Both insecticides decreased leaf miner populations.

LITERATURE CITED

1. Barret, O. W., 1904. Ann. Rep. P. R. Agric. Exp. Stn. 1903, pp. 42950, Washington, D.C.
2. Bradley, J. D., 1958. Taxonomic notes on *Leucoptera meyricki*: Chesquiere and *Leucoptera coffeella* (Guérin-Méneville). *Bull. Ent. Res.* 48, 417-19, London.
3. Cibes, H. R. and Pérez, M., 1958. Minador de la hoja disminuye en grado considerable el vigor de los cafetos. *El café de El Salvador*, 28: 325-26.
4. Deynes-Soto, R. 1985. Informe económico de la empresa de café. Reunión de Empresa del Café, marzo 18, 1985. Univ. P. R.—Recinto de Mayagüez, P. R.
5. Guérin-Méneville and Perrottet, 1842. "Mémoir sur un insecte et un champignon que ravagent les caféiers aux Antilles, "Min. Marine, 1-32, 2 pl, Paris.
6. Nantes, J.F.D., Parra, J.R.P., 1977. Avalição dc danos causados por *Perileucoptera coffeella* (Guérin-Méneville, 1842) (Lepidoptera: Lyonetiidae), em três variedades de café (*Coffea* sp.). *Solo*. 69: 26-9.
7. Pérez-Escolar, M. E., 1962. Recomendaciones para controlar el minador del café con el insecticida sistemático Di-syston. Publ. Misc. 42, Esta. Exp. Agric., Río Piedras, P. R.
8. Stainton, H. T., 1961. Entomology Weekly Intelling, X, pp. 110-11.
9. Van Zwaluwenberg, R. H., 1917. Insects affecting coffee in Puerto Rico, *J. Econ. Ent.* 10 (6): 513-17. Concord, N. H.
10. Wolcott, G. N., 1947. A quintessence of sensitivity: The coffee leafminer, *J. Agric. Univ. P. R.*, 31 (3): 215-19. Río Piedras, P. R.