Assessment of Different Insecticides for the Suppression of an Outbreak of *Leucoptera coffeella* in Jamaica[1]

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ABSTRACT

Six insecticides were evaluated for the control of the coffee leaf miner, *Leucoptera coffeella*, on a coffee farm in Western Jamaica. Nuvacron 40, Selecron 500 EC, Trigard 75 WP, Miral 500 CS and Miral 10 G were compared with a farmer standard Furadan 10 G. Selecron and Miral 500 CS gave the best control resulting in 5% and 7% reduction respectively, in the number of mines per leaf after six weeks. The number of larvae per leaf was 0.9 after one week and 0.3 after six weeks in plots treated with Selecron and 0.5 after one week and 1.0 after six weeks in plots treated with Miral 500 CS. Larval mortality was 92% and 69% respectively, in plots treated with Selecron and 100 and 55% respectively, in plots treated with Miral 500 CS one and six weeks after treatment.

RESUMEN

Para el control del minador de la hoja del café, en un cafetal al oeste de Jamaica, se evaluaron seis insecticidas. Nuvacron 40, Selecron 500 EC, Trigard 75 WP, Miral 500 CS y Miral 10 G. Estos insecticidas fueron comparados con un insecticida agrícola "standard": Furadan 10 G. Selecron y Miral 500 CS dieron el mejor resultado de control, con un 5% y 7% respectivamente en la reducción del número de las perforaciones por hoja, después de seis semanas. El número de larvas por hoja fue de 0.9 después de una semana y 0.3 después de seis en las parcelas tratadas con Selecron; y en parcelas tratadas con Miral 500 CS, los resultados fueron 0.5 una semana después y 1.0 pasadas seis semanas. La mortalidad de las larvas fue de 92% y 69% respectivamente, en parcelas tratadas con Selecron; de 100% y 55% respectivamente, en parcelas a las que se les aplicó miral 500 CS, una y seis semanas posteriores al tratamiento.

INTRODUCTION

Coffee is an important earner of foreign exchange for Jamaica, fetching one of the highest prices on the world market. In the 1980s, production in Jamaica was threatened by the coffee berry borer (*Hypothenemus hampei*) and coffee leaf rust (*Hemileia vastatrix*). Both have proven manageable with well-planned programmes. Currently, several initiatives funded by the United Kingdom (UK), European Community (EC) and Japan are directed at substantially increasing acreage in production. However, in 1990, unusually high leaf miner populations and damage were reported from an area in Western Jamaica targeted for EC support and expansion. Excessive damage and leaf fall were causing both a reduction in yield and an increasing death of bearing trees.

L. coffeella has been a pest of coffee in Jamaica for many years, showing more pronounced damage on *C. arabica* cultivated on the lighter, bauxitic soils. It was rarely considered a problem, since control was easily achieved using diazinon or dimethoate and mineral oil. Evidence of increased pest numbers and damage was reported following widespread use of endosulfan for control of the berry borer, *H. hampei* (Reid 1982).

The coffee leaf miner, *Leucoptera* spp., is an important pest of coffee worldwide (Bardner and Mcharo 1988; Flores and Hernández 1983). In Puerto Rico, this pest reportedly causes losses of up to 40% (Gallardo-Covas *et al.* 1988). The importance of coffee to the Jamaican economy and the serious implications that such pest outbreaks would have for stable and environmentally sound integrated pest management (IPM) practices justify a thorough assessment of this problem and development of appropriate strategies for its resolution. Several groups of pesticides have reportedly been effective in reducing pest numbers and the severity of damage (Almeida *et al.* 1977; Monterrey *et al.* 1985). The present study was designed to investigate the pest outbreak, to assess candidate pesticides as effective means of arresting these outbreaks in the short term and for consideration in a longer-term appropriate IPM strategy.

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MATERIALS AND METHODS

The study was carried out on a coffee farm situated on slopes of 5° to 10° in Seven Rivers, 300 ft (91.4 m) above sea level. Annual rainfall ranged from 1826.8 mm in 1989 - 1990 to 2444.5 mm in 1988 - 1989. A six-acre (2.4 ha) section of three-year-old *C. arabica* var. *typic* in which the leaf miner population was extremely high was selected for the pesticide evaluation study. The effectiveness of six pesticides was studied using a randomized complete block design with four replications. Each plot contained seven rows of six trees. The inner six trees were used to assess effectiveness of the pesticide treatment. Pesticides used were monocrotophos (Nuvacron 40, profenofos (Selecron 500 EC), cyromazine (Trigard 75 WP), carbofuran (Furadan 10G) and isazophos (Miral 500 CS and 10 G). Monocrotophos and carbofuran were included as examples of standard farmer practices. Foliar treatments were applied using Solo motorized mist blowers, model 423, operated by spraymen from the farm. Soil treatments were broadcast in the drip circle area of each tree. Four applications were made with seven, 14 and seven-day intervals respectively between each application.

Two branches from each sample tree were randomly selected and tagged. Before each treatment, records were taken of the incidence and intensity of leaf miner damage on these branches. Counts were made of the number of leaves with lesions and the number of lesions per leaf. Pest mortality was measured by taking three leaves from untagged branches of each tree. In the laboratory, half of these were kept in plastic containers and adult emergence recorded. Lesions present on the remaining leaves were dissected and larval mortality determined. The study lasted for approximately nine weeks from July to September 1991. During this period, the frequency and amount of rainfall was seven days (152 mm) in July, seven days (143 mm) in August and nine days (116 mm) in September. Relative humidity ranged from 80% - 90% and daytime temperatures from 26°C -32°C.

The data used for analysis include the number of leaves with miner damage, the total number of leaves examined in a plot and the number of mines on the leaves in a plot. Analyses of variance were performed on the change in the proportion of miner-damaged leaves before treatment (July 15, 1991) and one week after treatment, and before treatment and six weeks after treatment. Similar analyses were performed on the average number of mines per leaf before treatment, one week after treatment and six weeks after treatment, and the change in the total number of leaves before treatment and six weeks after treatment.

RESULTS

Effect of candidate pesticides on leaf damage and retention

Data on the change in average number of mines per leaf and the proportion of miner damaged leaves are summarized in Table 1. Before treatment, the number of mines per leaf averaged 1.1 (S.E. 0.06) with no significant difference ($p = 0.45$) between treatments. One week after treatment, the incidence of damaged leaves increased significantly ($p = 0.03$), but the rate of increase was less for plants treated with Selecron. Differences became more pronounced after six weeks, with fewer mines per leaf being observed for Selecron and Miral 500 CS and more mines for the other chemicals.

Table 1. Effect of different pesticide treatments on the average number of mines per leaf.

	Average number of mines per leaf			
Pesticide	Before treatment	One week after after treatment	Six weeks after treatment	Change in proportion of miner-damaged leaves July 15- Sept. 3
Furadan	1.0	1.8	0.9	8.0
Miral -10 g	1.2	1.6	1.0	21.4
Nuvacron	1.2	2.1	1.1	17.7
Trigard	1.2	2.1	1.1	12.0
Selecron	0.9	1.2	0.5	-4.9
Miral-500 CS	1.0	1.4	0.6	-6.9
SED (DF=15)	0.21	0.30	0.11	7.09

Notes: SED - Standard error of the difference between two means on any one date
DF - Degrees of freedom

Table 2. Effect of different pesticide treatments on the number of leaves per branch.

Pesticide	Changes in the number of leaves per branch
Furadan (control)	-6
Miral - 10 g	-6
Nuvacron	-7
Trigard	-2
Selecron	1
Miral - 500 cc	1
SED (DF = 15)	1.6

Notes: SED - Standard error of the difference between two means.
DF - Degrees of freedom.

Similar, six weeks after treatment significant differences (p = 0.005) were noted in the change in proportion of damaged leaves which fell for plots treated with Selecron or Miral 500 CS. Data on the effect of different treatments on the total number of leaves retained after six weeks are presented in Table 2. Plots treated with Selecron or Miral 500 CS retained a significantly larger number of leaves (p < 0.001) than those treated with Furadan. Plots treated with Trigard showed the smallest reduction in number of leaves.

Effect on different stages of *L. coffeella*

The total number of larvae in leaves sprayed with Selecron or Miral 500 CS was significantly lower one and six weeks after treatment (p = 0.01 and p = 0.09, respectively) than on plots treated with Furadan (Table 3). Leaves of larval mortality were also higher (p < 0.001) one week after treatment in plots sprayed with Selecron or Miral 500 CS than those with Furadan. After six weeks, the mortality associated with Miral 500 CS was still higher than that of Furadan (p = 0.05). The mortality associated with Selecron and Nuvacron was notably higher than Furadan, though not statistically significant.

The effect of different treatments on the number of cocoons is given in Table 4. Fewer cocoons were found in plots treated with Selecron and Miral 500 CS than other plots after one week (p = 0.029). After six weeks, plots treated with Miral 500 CS, Selecron and Trigard had fewer cocoons (p < 0.001).

DISCUSSION AND CONCLUSION

Clear differences were noted in the effectiveness of different pesticides. Selecron 500 EC and Miral 500 CS both performed best in reducing the number of mines per leaf and in ensuring a higher level of leaf retention. Of the other treatments, Trigard 75 WP showed the greatest promise. Little impact was made with Nuvacron 40, Furadan 10 G or Mirail 10 G. Admittedly, the granular formulations of these last pesticides require different climatic conditions, particularly the availability of sufficient soil moisture. Also, their mode of action would show results later than the contact insecticides. However, soil moisture was adequate at the time of application and damage reduction continued to be low after six weeks, even though soil moisture was

Table 3. Effect of different pesticide treatments on the number of *L. coffeella* larvae and incidence of larval mortality.

Pesticide	Number of larvae per leaf		Larvae mortality (%)	
	After one week	After six weeks	After one week	After six weeks
Furadan (control)	2.3	4.1	18.8	22.2
Miral - 10 g	1.7	4.4	31.2	16.0
Nuvacron	1.7	3.4	26.0	52.3
Trigard	2.5	2.6	25.6	20.5
Selecron	0.9	0.3	91.7	68.7
Miral - 500 CS	0.5	1.0	100.0	55.0
SED (DF = 15)	0.51	1.55	10.89	18.31

Notes: SED - Standard error of the difference between two means on any one date
DF - Degrees of freedom

Table 4. Effect of different pesticide treatments on the average number of cocoons on leaves.

Pesticide	Number of cocoons per leaf	
	After one week	After six weeks
Furadan (control)	10.2	8 6
Miral (10 g)	8 8	9 0
Nuvacron	7 5	10.0
Trigard	7 3	4 0
Selecron	2.6	3.1
Miral (500 cc)	2 1	2.1
SED (DF = 15)	2 53	1.34

Notes: SED - Standard error of the difference between two means on any one date
DF - Degrees of freedom.

adequate at the time of application. While the use of granular insecticides has been recommended in Africa and Latin America (Almeida *et al.* 1977; Wanjala and Dooso 1979) results obtained are not consistent.

The relatively poor performance of Nuvacron, an insecticide regularly used at many farms, combined with the consistently poor performance of diazinon, raises the spectre of possible *L. coffeella* resistance to some organophosphorous compounds. This has already been reported by Bardner and Mcharo (1988) for Tanzania, where seven organophosphorous pesticides are no longer effective in spite of improved spray coverage and increased rates of application. The need for careful timing of applications deserves special emphasis. At present in Jamaica, farmers do not follow any set guidelines in applying an insecticide for leaf miner control. Hence, contact insecticides may be applied when foliar damage has been observed after the adult flight is over. Similar consideration in necessary if the candidate product is a hormone analogue. Absence of these considerations contributes to the unnecessary frequency of application and the resulting problems of resistance and resurgence. In several parts of Africa, Puerto Rico, Cuba and Latin America, cost-effective chemical control of *Leucoptera* spp. depends upon use of simple action thresholds and selection of an insecticide suited to the particular stage of the pest (Solis *et al.* 1987; Villacorta and Sánchez 1984).

Unfortunately, the coffee leaf miner now has the potential in Jamaica to become the most serious threat to production. There is also the possibility that Jamaica now has two, rather than one, species of the coffee leaf miner. *L. caffeina* has been reported in Cuba (Motle 1976). This species is normally found in Africa and is known to occur more frequently in shaded plantations, as opposed to the sunny conditions favoured by *L. coffeella*. This should be investigated, since it would affect any control strategy planned. Finally, urgent attention must be given to the development of a cohesive program which carefully integrates control of the three main pest problems-berry borer, leaf miner and leaf rust- in a manner which is cost-effective and environmentally sound

LITERATURE CITED

ALMEIDA, P R DE; ARRUDA, H V ; PEREIRA, L C E 1977. Efficiency of several granular systemic insecticides in controlling coffee leaf miner, *Perileucoptera coffeella* (Guerin-Men , 1842). Biologico (Bra.) 43(1-2):29-31.

BARDNER, R ; MCHARO, E Y 1988. Confirmation of resistance of the coffee leaf miner *Leucoptera meyricki* Ghesquiere (Lepidoptera, Lyonetiidae) to organophosphate insecticide sprays in Tanzania. Tropical Pest Management (UK) 34(1):53-54.

FLORES, D ; ROJAS DE HERNANDEZ, M 1983. Fluctuación de la población del minador de las hojas del café. Revista Colombiana de Entomología 7(3/4):29-38.

GALLARDO-COVAS, F.; GONZALEZ-MUNIZ, W ; HERNANDEZ-LOPEZ, E 1988 Susceptibility of 53 coffee cultivars (*Coffea arabica*) to damage by the coffee leaf miner, *Leucoptera coffeella* in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 72(1):165-168

MONTERREY, J A.; AVILES, R ; GADEA, A. 1985. Phosphorus and pyrethoid insecticides against the coffee leaf miner in Nicaragua. Ciencia de la Agricultura 22:21-27

MONTE, G 1976. Investigations on biology and control of coffee leaf miner (*Leucoptera coffeella*) in unshaded coffee (*Coffea arabica* var. Caturra) in Cuba. **In** Diez años de colaboración científica Cuba-RDA. La Habana, Cuba, Academia de Ciencias de Cuba. p. 40-45

REID, J C 1982. Economic importance and problems in the control of the coffee berry borer *Hypothenemus hampei* Ferr in Jamaica. **In** Urgent plant and disease problems in the Caribbean. Meeting of the Society for Plant Protection in the Caribbean (1.). Proceedings. C.W.D. Brathwaite, G.V. Pollard (Eds.) p. 21-45.

SOLIS PERAZA, M.; VALDES RUIZ, J.O ; RODRIGUEZ RODRIGUEZ, V 1987. Comportamiento de la *Leucoptera coffeella* Guerin durante tres años aplicando el método de señalización en zonas cafetaleras de la empresa cultivo varios de Trinidad. Revista del Centro Agrícola 14(1):44-49.

VILLACORTA, A ; SANCHEZ RODRIGUEZ, P L. 1984. Action threshold in the use of insecticides for controlling the coffee leaf miner (*Perileucoptera coffeella* Guerin-Mereville 1842 (Lepidoptera:Lyonetiidae) in Parana State, Brazil Annaes da Sociedade de Entomologia (Bra) 13(1):157-165.

WANJALA, F.M.E ; DOOSO, B.S. 1979. Effect of rainfall on systemic insecticides in the control of *Leucoptera meyricki* in Kenya. Turrialba (C.R.) 29(4):311-315.

RESEÑA DE LIBROS

AMERICAN SOCIETY OF AGRONOMY; CROP SCIENCE SOCIETY OF AMERICA; SOIL SCIENCE SOCIETY OF AMERICA. 1993. Forage cell wall structure and digestibility. Jung, H.G., *et al.* (Eds.). Madison, Wisconsin, USA. 794 p.

La pared celular de los forrajes constituye una fuente inmensa y renovable de energía para la alimentación de los rumiantes Es por este motivo que entre las principales preocupaciones sobre nutrición animal y campos afines, se encuentran la determinación de la composición química de la pared celular, el estudio del efecto de la matriz de la misma sobre su degradabilidad y aprovechamiento y el desarrollo de métodos que contribuyan a mejorar su utilización Con la finalidad de discutir de manera detallada e integral los avances en estos campos en los últimos años, de determinar los limites del conocimiento, de analizar la orientación que debe tener la investigación en el futuro y de reunir ese cúmulo de conocimientos en este libro de referencia, la *American Society of Agronomy*, la *Crop Science Siciety of America* y la *Soil Science Society of America* organizaron el Simposio Internacional sobre la Estructura y la Digestibilidad de la Pared Celular, en la ciudad de Madison, Wisconsin, en octubre de 1991.

Este volumen consta de 27 capítulos, donde se discuten desde una perspectiva nutricional los siguientes grandes temas de la utilización de la pared celular:

— Aspectos anatómicos de la planta y del animal relacionados con la degradación de la pared celular.

— Técnicas analíticas usadas para el análisis de la pared celular; destacándose en esta sección el capítulo escrito por la Dra. Catherine Lapierre sobre la aplicación de nuevos métodos no destructivos para investigar la estructura de la lignina

— Composición y organización de la pared celular.

— Interacciones entre la matriz de la pared celular y su degradación

— Mecanismos microbiales y moleculares que regulan la degradación de la pared celular

— Degradabilidad de la pared celular en el rumiante y el efecto de las prácticas de alimentación sobre el aprovechamiento de la misma

— Mecanismos para alterar la utilización de la pared celular y mejorar su aprovechamiento. Esta última sección incluye un capítulo muy extenso y con una excelente bibliografía sobre los procesos bioquímicos que conducen a la síntesis de la pared celular, conocimiento esencial en el desarrollo de forrajes más digestibles.

Como es costumbre en este tipo de libros, algunos autores aceptaron el reto de presentar sus modelos conceptuales sobre el desarrollo de la pared celular y su degradación en el rumen.

Este libro constituye un hito en la literatura sobre la estructura y la digestibilidad de la pared celular de los forrajes. Ante su elevado nivel técnico, se recomienda para especialistas y estudiantes graduados en nutrición de rumiantes y campos conexos tales como química agrícola, microbiología, vegetal y mejoramiento de forrajes.

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