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FULMEKIOLA SERRATA KOBUS (THYSANOPTERA:TEREBRANTIA) ON SUGAR CANES IN BARBADOS

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ABSTRACT

In late 1980, sugarcane in Barbados was attacked by thrips for the first time. Indications are that the insects were introduced by the winds of hurricane "Allen" in August 1980.

Island-wide surveys conducted in 1980-81 on ten popular varieties of sugarcane indicated that B62163 and B63118 suffered substantial early damage. In 1981-1982 ratoons of these two varieties were surveyed and population levels were generally higher. The two varieties together comprise over 70% of all sugarcane grown locally. The thrip shows a marked preference for young plants.

All stages of the life cycle of the insect occur on the leaves of sugar canes, with the vast majority of the insect population being found in the rolled central spindle of young leaves.

Population levels are reduced significantly by heavy rains as well as by soil applications of carbofuran, disulfoton and isozaphos at rates of 1.12 and 2.24 kg/ha. No instances of parasitism or predation have so far been observed.

INTRODUCTION

Sugarcane, the major export crop in Barbados, is attacked by many pests and disease organisms of varying economic importance. The major insect pests are the sugarcane moth-borer, Diatraea saccharalis and the sugarcane root-borer, Diaprepes abbreviatus. Present indications are that D. saccharalis is controlled by predators and parasites (Cadogan 1978, Alam 1980, Jones 1980), but an acceptable long term control measure is still to be achieved for D. abbreviatus. Some other insects and a few plant diseases reach pest status occasionally. In October 1980, it was observed that leaf tips of young plant-canes began to dry suddenly, and drying worsened despite frequent heavy rains.

Close examination indicated that most damaged plants contained large populations of thrips. These insects had not been reported previously on sugarcane in Barbados, although there have been many records of thrips

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severely damaging sugar canes in other sugar growing countries. It is believed that this insect was introduced on winds of hurricane "Allen" in 1980. Reports have been received from Martinique, St. Kitts and more recently from Grenada and Antigua of similar attacks on sugarcane by this insect.

Williams (1931) described the effect of a number of different thrips on sugar canes in the Hawaiian Islands, and Box (1953) listed over 60 different species on sugarcane throughout the world, the vast majority being recorded from Asia. Puerto Rico, Trinidad & Tobabo and Cuba were the West Indian islands mentioned in this list. Williams (1956) described the varietal susceptibility of sugar canes to Fulmekiola serrata Kob. in Mauritius.

Because of the interest created by the sudden appearance of this insect on sugarcane in Barbados and the visual impact of the symptoms, a study was immediately undertaken. In this paper, the biology of the insect is outlined briefly and the effect of feeding on the most common sugarcane varieties as well as the effectiveness of some selected insecticides on thrips population levels, both in the field and on artificially thrips-infested sugarcane plants in the greenhouse is assessed.

LIFE CYCLE

Eggs

Eggs of F. serrata are elongated reniform in shape, measuring approximately 0.35 mm long and 0.1 mm wide (based on 25 measurements). They are smooth with no recognizable markings on the chorion. All eggs are laid singly within punctures in the leaf blade. Apparently these punctures are made by the ovipositor of the female during egg laying. All eggs were found within the leaf tissue (by using a binocular microscope) lying parallel to and between the vascular strands. Freshly laid eggs are opaque, but as embryonic development occurs, they become shiny and transparent, with the red eyespots of the first larva being quite distinct anteriorly. Eggs hatch in about 4-5 days at room temperature (25-26°C) but hatching is presumably quicker in the higher temperature conditions of the field.

Larvae

The larvae are pale cream in colour, with the first stage being barely visible to the naked eye. Development is quite rapid, and two distinct larval stages have been identified (based on head-capsule measurements). There is also a pre-pupa and a pupa both of which are pale in colour. The pre-pupa is an inactive stage but the pupa, although normally inactive, becomes quite active when it is disturbed. The pupa can be further differentiated from the pre-pupa by its backwardly directed antennae. Development from egg to adult takes between 12-15 days in greenhouse conditions.

Adults

The adults of this insect are small and black. The dark pigmentation and the presence of fully developed wings distinguish them from the much paler immature stages. Adults are usually very active and will crawl or leap if disturbed. They produce a sharp sting when handled. Bailey (1936) reported a similar behaviour in onion thrips, Thrips tabacci, "the larvae of which were more apt to bite; producing a prickling sensation which resulted in a slight itching but no swelling". F. serrata congregate within the younger rolled leaves of sugarcane plants (perhaps avoiding extremes of temperature and light), where eggs are laid and subsequent development occurs. There appears to be approximately twice as many females as males in populations, as a random sample of 518 adults contained 352 females and 166 males. Females are quite easily differentiated from males by the presence of a well developed ovipositor and a more conical terminal abdominal segment.

SYMPTOMS

Perhaps the most reliable indicator of the presence of thrips on sugar canes is the type of the damage symptoms resulting from feeding. As all stages of the life cycle of F. serrata occur on the leaves of sugarcane, this thrip is unlike many others of economic importance, where pupation occurs in the soil. Like other sucking insects, this thrip shows a pronounced preference for young; soft leaves and in the sugarcane these comprise the central spindle (whirl). The concentration of feeding activity in this region causes yellowing and finally drying of leaf tips of the spindle. The insect retreats from the dried portion and there appears to be a noticeable increase in the rate of development of winged adults and their subsequent migration to young green sugarcane plants. When this occurs the leaves are not able to unroll completely as in a healthy leaf, but remain firmly joined at the tips, unless separated by the wind. Other symptoms like discoloration of leaves, are usually typical of less severely affected plants and more random feeding activity. In the field, most of the thrips are present in the tip region of the central leaf spindle, but in both greenhouse and laboratory studies conducted under cooler conditions, thrips left the security of the rolled leaves and crawled and fed on young unrolled ones. It is very likely that they behave similarly in the field.

Feeding on young leaves also produced distinct patches which ranged in colour from yellow through shades of red and brown. In sunlight older attacked leaves are usually silvery in colour. As would be expected the damage is more severe under dry conditions and young plants may be killed.

VARIETAL SUSCEPTIBILITY

The sudden drying of leaves of sugar canes in an experimental plot where one of the newer experimental varieties was being tested, prompted a survey of the more commonly grown varieties, to determine whether *F. serrata* exhibited any varietal preference, so that this factor could be utilized in a control strategy. Barbados is divided into three rainfall zones; high, intermediate and low, based on annual rainfall. The first survey was conducted between November 1980 and April 1981 on 52 plantations scattered throughout the island and covering all three zones. Ten sugarcane varieties were examined, with a few of them restricted to a single rainfall zone. Most samples were collected from B62163 and B63118 (Table 1) as these two varieties, combined, presently account for more than 70% of the total sugarcane area under cultivation. The second survey was conducted from November 1981 -- January 1982 and here only B62163 and B63118 ratoons were sampled (Table 2).

A wide range of varieties is grown in the high rainfall area because sugarcane is not irrigated in Barbados, and few varieties yield satisfactorily in low rainfall conditions.

Sampling

Preliminary sample data showed that more than 95% of the thrips on infested plants in the field were found within the apical 25 cm of the central leaf whirl. This portion was therefore selected as the sample unit. Plants were less than 1 m tall at the time of sampling; since thrips seem to prefer young plants. Twenty random samples per field were collected for the most popular varieties and 10 samples for the others. Samples were placed in labelled plastic bags, and brought back to the laboratory where thrips were transferred to alcohol in petri dishes and then counted. It was eventually decided not to count first instar larvae because their extremely small size and large numbers made accurate counting almost impossible.

Results

The mean number of thrips found on plant cane varieties B73385 and B71235 in the high rainfall zone was appreciably higher than for any of the other varieties (Table 1). However, because only a few samples of these varieties were collected, more extensive sampling, over a longer period is required to fully determine the accuracy of this statement. The same is true for variety B72177 in the low rainfall zone. Its mean of only 4.8 is appreciably smaller than all other varieties from any zone, but as only 30 samples were examined further data is required.

The mean number of thrips per sample on B63162 and B63118 ratoons (Table 2) is smaller than those collected on plant cane during the previous year. However, while an average of 3 plants per cane hole were present in plant canes during the survey period, ratoons averaged 10-12 plants per hole. This represents a substantial increase in population levels of thrips in ratoons, over plant canes only a year after the insect was introduced. Observations made both in the field and in the

Table 1.--Infestation levels of *F. serrata* on different sugarcane varieties in high, intermediate and low rainfall areas of Barbados from November 1980 - April 1981.

Variety	No. of plants examined	Mean No. of thrips/ plant	Range of thrips/ plant	S.E.
		Low Rainfall Zone		
B62163	170	15.9	3 - 51	4.8
B63118	140	14.2	3 - 29	3.2
B73385	25	19.9	2 - 25	-
B72177	30	4.8	4 - 5	-
		Intermediate Rainfall Zone		
B62163	260	17.5	2 - 44	3.4
B63118	130	16.1	3 - 31	4.3
B73385	40	18.9	15 - 22	1.9
B59136	40	15.5	9 - 23	-
B7316	50	11.6	2 - 22	4.3
		High Rainfall Zone		
B62163	420	22.6	7 - 53	2.5
B63118	170	23.1	15 - 34	2.3
B73382	20	12.6	4 - 17	-
B73385	20	52.1	12 - 91	-
B74541	25	10.3	8 - 12	-
B71235	40	32.3	25 - 35	-
B7316	80	24.8	9 - 46	-
B7274	20	13.9	12 - 15	-

Table 2.--Infestation levels of F. serrata on ratoons of two varieties of sugarcane in high, intermediate and low rainfall areas of Barbados from November 1981-January 1982

Variety	No. of plants examined	Mean No. of thrips/plant	Range of thrips/plant
		Low Rainfall Zone	
B62163	160	7.8	1 - 21
B63118	100	5.5	1 - 9
		Intermediate Rainfall Zone	
B62163	460	4.6	1 - 16
B63118	260	2.0	2 - 8
		High Rainfall Zone	
B62163	700	11.3	1.5 - 41
B63118	280	11.0	1.5 - 32

greenhouse, indicate that young cane plants are far more susceptible to attack than mature ones. Sixty field samples collected from mature B62163 plants contained only 13 thrips while 20 thrips were found on 40 field samples of mature B63118 plants.

INFESTATION LEVEL

The infestation level of thrips on sugarcane fluctuated considerably throughout the duration of this study. This was very noticeable in weekly field samples collected from the controlled untreated insecticidal trial areas. Neither predators nor parasites were observed in the colonies of thrips examined, and population fluctuations could not therefore be attributed to these biotic factors. Other factors were therefore considered. Close examination of sampling data indicated that the most dramatic decline in population levels occurred almost immediately following heavy rains, and when the total weekly rainfall was plotted against the number of thrips obtained from weekly samples, a close relationship was obtained (Fig. 1). Apparently, thrip populations build up relatively unchecked in dry conditions and light showers have minimal effect on reducing this build up. As most thrips were found within the rolled central leaf spindle, it appears very unlikely that they could be seriously affected by rain, but they leave this shelter under cool conditions and roam over the leaf surface. Small droplets of water remain on the leaves after heavy rains and under such cool conditions, thrips could be trapped in the water droplets or fall prey to any predators that may be present. Small drops of liquid were also found within the spindle and numphs were sometimes trapped therein.

INSECTICIDAL CONTROL

The control of any new insect pest on sugarcane in Barbados is influenced considerably by programs already in progress. One such program has been ongoing for close to 50 years, and involves the biological control of the sugarcane moth borer, *D. saccharalis*, by a number of parasites and predators, the most important ones being *Apanteles flavipes* and *Lixophaga diatraea*.

Because of this program, foliage sprays are seldom used on sugarcane in Barbados and any new control strategy must therefore recognize this limiting factor. There are few records of predators or parasites associated with thrips on sugarcane. Williams 1931 found little wasps, *Thripoctenus* sp., which parasitize them. This is not surprising, as the location of these insects within the tightly rolled spindle makes them inaccessible to most organisms, particularly the much bigger predators. An insecticidal control program was therefore initiated, using mainly systemic soil insecticides, in an attempt to reduce thrip population levels on sugarcane.

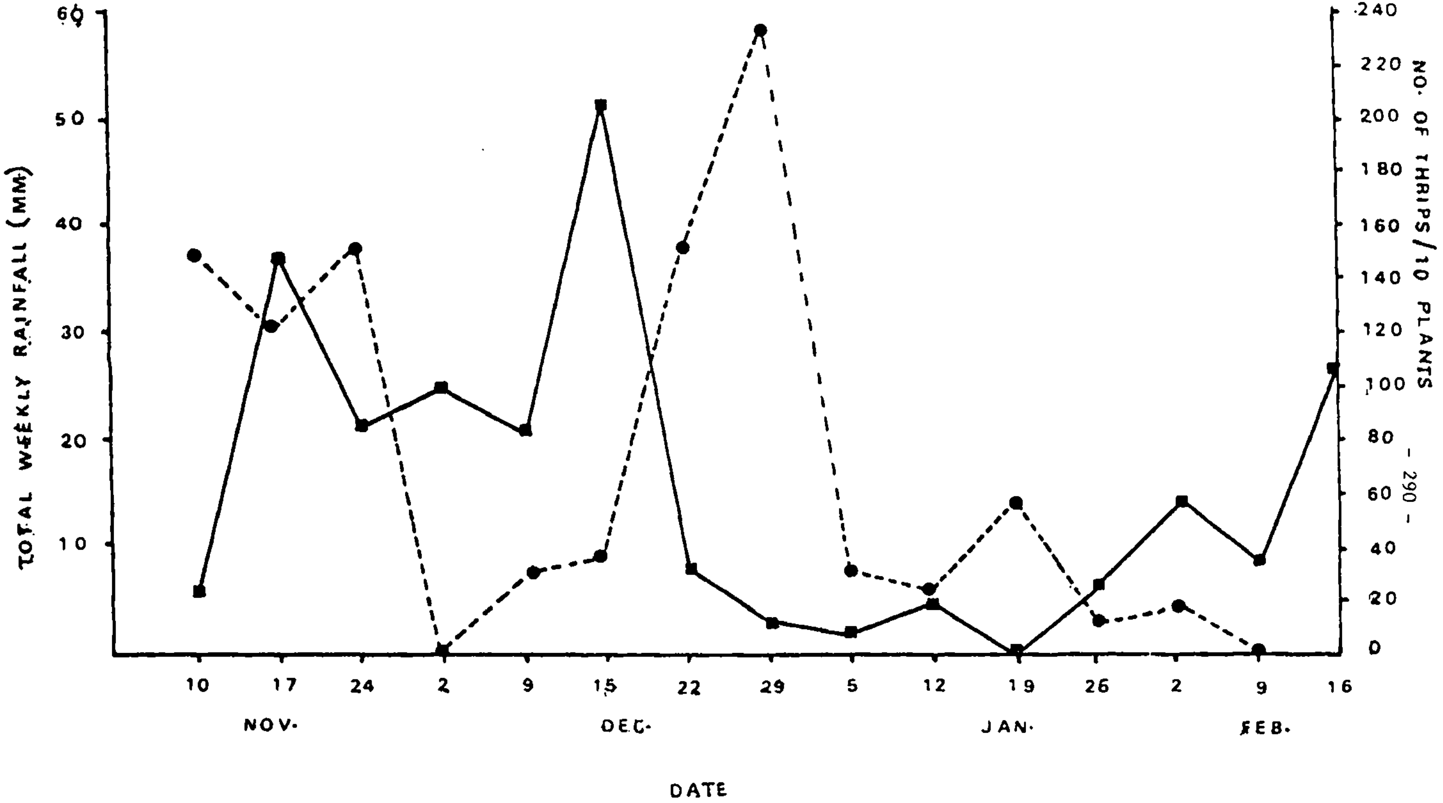

Fig. 1: Total weekly rainfall (■) and number of thrips per 10 plants (●) from November 1980 - February 1981 at Graeme Hall, Christ Church.

MATERIALS AND METHODS

Two fields and one greenhouse trials were set up in 1981 to test the effect of insecticides on F. serrata. One field trial was set up in a high rainfall area and the other in a low area. Experiments were arranged in completely randomized block designs, with each plot measuring 10 m long and consisting of a single row of plants spaced approximately 0.5 m apart. Each row was separated by furrows on either side. Treatments were replicated 3 times. The experiments were set up in plant canes (variety B62163) which measured between 0.5 and 1 m in height at the time of treatment. Insecticides were broadcast around the base of the plants and 10 samples per treatment were collected every week for a period of 10 weeks, with the first samples being collected a week after the first heavy rainfall. As sugarcane is not irrigated in Barbados, rain is required to dissolve the pesticides. Sample units were similar to those for the varietal experiments outlined above and percentage control achieved was estimated at the 4th and 10th week sampling stages. As was the case with the varietal samples, first instars were not included in counts.

In the greenhouse experiment, eight insecticides were tested on young artificially thrip-infested sugarcane plants of variety B62163. These plants were grown from cuttings in 15 cm plastic pots which were filled with soil. When the plants reached approximately 0.5 m high, 50 adult thrips, collected from sugarcane in the field, were transferred to each plant using a soft camel hair brush. Insecticides were applied to the soil around the base of the plant 2 days later. Each insecticide treatment was replicated 20 times; and plants were watered twice weekly. Counts were made of adult thrips on 4 plants per treatment at intervals of 0.5, 1.0, 1.5 and 2.0 weeks after exposure to the insecticides. The thrips were transferred to alcohol as outlined above, and counted under a binocular microscope.

RESULTS

The results of the field trials are given in Table 3. In the high rainfall area Miral 10G, Furadan 10G, Basudin 60 WP and Disyston 10G reduced thrips significantly at the 4-week stage, and this was also achieved at the 10-week stage for all except Basudin.

In the low rainfall area, the same four insecticides gave significant kill at both intervals while Primicid 50G reduced thrip numbers significantly at the 10-week stage. The reason for Primicid's performance is uncertain, but the generally superior performance of most of the chemicals at the 10-week stage in the low rainfall area, as compared with the high, may be attributed to the faster rate of removal of the chemicals by rain water. This performance of the granular formulations may be further due to the inherently more toxic nature of these chemicals, as well as the more controlled and much slower release of poison from

Table 3.--Effect of insecticides on thrips on sugar canes in high (A) and low (B) rainfall areas in Barbados

Insecticide	Common Name	A.I. (kg/ha)	Mean No. of thrips/10 plants	% control (after 4 weeks)	Mean No. of thrips/10 plants	% control (after 10 weeks)
		"A"				
Miral 10G	isozaphos	1.68	4	97 b	23	89 b
Primicid 10G	pirimiphos-ethyl	2.24	120	2 a	347	- a
Furadan 10G	carbofuran	1.68	3	98 b	30	85 b
Basudin 60 WP	diazinon	2.24	20	79 b	125	39 a
Disyston 10G	disulfoton	1.68	5	97 b	15	93 b
Control (untreated)	-	-	123	a	206	a
		"B"				
Miral 10G	isozaphos	1.68	18	92 b	44	23 a
Primicid 10G	pirimiphos-ethyl	2.24	173	26 a	19	67 ab
Furadan 10G	carbofuran	1.68	20	91 b	1	98 b
Basudin 60 WP	diazinon	2.24	6	97 b	1	84 b
Disyston 10G	disulfoton	1.68	4	98 b	1	98 b
Control (untreated)	-	-	233	a	57	a

Means followed by the same letter are not significantly different at 5% level of probability.

this formulation when compared with emulsifiable concentrates and powders (Nation 1972).

Under more controlled conditions in the greenhouse experiment, closer examination of the performance of insecticides could be made. The first indicator of insecticide activity on the thrips was the change in behaviour. Many of them became hyperactive and crawled very disorientatedly over the leaves. Such behaviour was never observed in normal thrip populations in the field.

A week after treatment many of the insecticides gave 100% kill (Table 4). Again the granular insecticides were most impressive although Anthio 33, Metasystox-R (E.C's) and Orthene (WP) gave satisfactory results as well.

CONCLUSION

Although the full effect of recent attacks by F. serrata on sugar canes in Barbados is incompletely known, preliminary investigations suggest that it may be considerable.

The location which the insect occupies within the whirl of central leaves, offers it excellent protection. Food is also readily available to the insect at this site and it is therefore not necessary for it to search for food elsewhere, unless forced to do so. However, these insects, particularly large instars and adults have been observed roaming freely in cool conditions. This may be as much a part of the normal behaviour of the insect as a method of reducing competition for food in a restricted region of the plant, since extensive feeding results in the drying of this portion of the plant. Perhaps a survival mechanism is involved.

Young cane plants are the ones most seriously affected by attacks of F. serrata and control efforts should preferably be concentrated on this stage. Sugarcane varieties presently grown in Barbados have shown no obvious resistant qualities and although systemic insecticides have given good control, it is unlikely that large scale use of these expensive chemicals would be economically feasible. Also applications of insecticides to ratoon canes, which usually have a thick trash cover, would be very difficult.

The contact insecticides used for control have not given encouraging results and although parasites and predators have not been observed in any of the dozens of thrip colonies examined, these natural enemies could be used as control agents in subsequent programs.

It may well be, therefore, that an integrated pest management program which incorporates varietal characteristics of the sugarcane with biological control agents and the timely application of selected systemic insecticides, will be the most realistic approach to tackling this pest problem.

Table 4.--Effect of selected systemic soil insecticides on thrips on sugarcane plants in the greenhouse

Insecticide	Common Name	Application rate	% mortality after different exposure time (weeks)			
			0.5	1	1.5	2
		Kg/ha				
Anthio 33	formothion	1.12	50	100	100	100
		2.24	80	100	100	100
Basudin 60 WP	diazinon	1.12	28	50	60	50
		2.24	20	55	100	100
Disyston 10G	disulfoton	1.12	100	100	100	100
		2.24	100	100	100	100
Furadan 10G	carbofuran	1.12	80	94	100	100
		2.24	85	86	100	100
Kilval 40 EC	vamidothion	1.12	78	100	100	100
		2.24	87	100	100	100
Metasystox-R 25 EC	oxydemeton-methyl	1.12	85	100	100	100
		2.24	70	100	100	100
Miral 10G	isozaphos	1.12	40	100	100	100
		2.24	70	100	100	100
Orthene 75 S	acephate	1.12	60	100	100	100
		2.24	85	100	100	100
Control (untreated)		-	10	15	15	15

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