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Evaluation of Field Damage and Chemical Control of Outbreak of *Sahlbergella Singularis* Haglund in a Cocoa Plantation in Ibadan, Nigeria

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ABSTRACT

Field evaluation of damage caused by the brown cocoa mirid, *Sahlbergella singularis* was based on three parameters, namely, lesions on pods, cankers on trunks and dieback of twigs. Damage assessment based on scoring exceeded 75% for damage to the trunks and fan branches while damage to the pods was more than 50% by the second cocoa season. Laboratory evaluation of endosulphan 35 EC applied at 0.25% active ingredient compared favourably well with the standard miricide as all mirid populations were knocked down 40 minutes after exposure to filter paper impregnated with endosulphan. The endosulphan was found to be faster acting than the standard at 0.25. Control of mirids in the field was similar to results obtained in the laboratory. There was only 12% recovery 28 days after spray application with endosulphan in the field while the standard miricide gave a similar result of 15% recovery on the 28th day. No mirid mortality was recorded in the control plots. The control of mirids with endosulphan was very efficacious but cocoa beans treated with endosulphan must be analyzed to determine its residue content before final approval or rejection of the insecticide for use on cocoa.

Key words: Lesions, Cankers, Dieback, *Sahlbergella singularis,* Endosulphan 35EC.

Introduction

Cocoa is an important export crop in the West African sub-region, Ghana, Cote d'Ivoire, Nigeria, Cameroun, Togo and Sierra Leone. In 1992, 59.9 % of the world's cocoa was produced by Africa, 25.5% by Latin America and the Caribbean and the remaining 14.6% by Asia and Oceania (Opeke, 1992). Decline in cocoa production especially in Nigeria is due to the incidences of pests and diseases among other factors. The government in an effort to increase national output distributed 26 million seedlings of cocoa in year 2000 to farmers for new plantings throughout the 14 cocoa producing States in Nigeria. The States are Ondo, Ogun, Osun, Oyo, Ekiti. Kwara, and Kogi. Other states include Edo, Delta, Abia, Cross River, Adamawa, Taraba and Akwa- Ibom**.** The government also established the National Cocoa Development Committee (NCDC) for the producing States with a view to rehabilitating old farms and improving the country's rating in the world.

There is no gainsaying the fact that among the 1,500 different species of insect pests attacking cocoa, only less than two percent are of genuine economic importance (Entwistle, 1972; Wood and Lass, 1989). In Nigeria, the brown cocoa mirid, *Sahlbergella singularis* Haglund (Hemiptera: Miridae) remains the major insect pest of cocoa capable of reducing yield by a minimum of 30% in a season (Ojelade *et al.*, 2005). The brown cocoa mirid, *S. singularis* is the most harmful insect pest of the cocoa tree in Nigeria (Opeke, 1992). Mirid feeds by inserting its mouthparts into the plant and sucking the juices and at the same time, salivary secretions are injected into the tissue that results in plasmolysis of the cells. This cellular lysis results in necrosis, followed by the appearance of depressed oily spots known as lesions on the cocoa pods and suckers (Mariau 1999). Lesions are circular on pods but oval and of somewhat greater size on stems (Wood and Lass, 1989). Canker sores develop

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quickly from lesions due to invasion by cryptogamous parasites causing weakness. The combination of tissue necrosis and cryptogamic attack results in plant rot, leading to very low productivity (Mariau, 1999). Mirids have been reported to cause more than 30% loss in cocoa yield if left unabated (Ojelade *et al.*, 2005; Idowu, 1989).

So far in Nigeria, there is no organic cocoa, as synthetic pesticide spray application must be embarked upon to keep plantations productive. However, with the awareness of Integrated Pest Management concept, the number of spray applications has been further reduced. The era of blanket or calendar spraying of cocoa farms is now a thing of the past as farmers are encouraged to spray only when mirids are present on the crop and in sufficient number to cause economic damage.

It is in view of the foregoing, that a damage assessment study was carried out on a 2 hectare amazionain hybrid cocoa plantation for two cocoa seasons and thereafter controlled using endosulphan to curtail an outbreak of mirid damage in the field.

Materials and Methods

Study Site

The study was carried out at the Cocoa Research Institute of Nigeria (CRIN) Headquarters in Ibadan, Nigeria. Ibadan has an annual rainfall average of 2000mm with a bimodal pattern. It is located in the tropical rain forest ecosystem with mean solar radiation of 18mj/m2/day. It lies between the latitude 7° 30¢ N and longitude 3° 54¢ E at an altitude of 200m above sea level. The study site comprised a 2-ha plot, which was divided into four blocks. Each block contained 960 cacao trees. The cocoa plants were established in the field in year 2000.

Mirid damage assessment on cocoa plant parts

The plot was observed for mirid damage symptoms which include lesions on pods, cankers on trucks and main branches, and dieback of twigs from January 2004 to December 2006. 72 cocoa stands were evaluated in a block giving a total of 288 plants. Evaluation for mirid damage symptoms were carried out on a fortnightly basis. These plants were assessed for the following damage caused by mirids based on visual ratings and methods used by N' Guessan, 1998.

(i) Presence of cankers on the trunk and on the main branches
(i i) Dieback of twigs
(i i i) Damage to pods

Canker damage on the trunk and branches

The rating took into account the cankers that have accumulated on the trunk and branches over several years. A 5 – point rating scale from 0 (no damage) to 4 (Severe damage) was used, as indicated below:

0= no damage
1= ¼ of the trunk and branch surface showing canker
2=2/4 of the trunk and branch surface showing canker
3= ¾ of the trunk and canopy shows canker
4= Almost the entire trunk and branches covered with canker

Twig dieback

These were new damage that resulted in the dieback of twigs and drying up of leaves. A 5-point scale was also used as indicated below:

0= no dieback
1= ¼ of the canopy shows dieback
2=2/4 of the canopy shows dieback
3= ¾ of the canopy shows dieback
4= Almost the entire canopy shows dieback

Lesions on pods

A 5-point scale was also used for the fruit damage assessment, as indicated below:
0= no damage on pods and cherelles
1= 25% of the fruits show mirid attack
2= 50% of the fruits show mirid attack
3= 75% of the fruits show mirid attack
4= Almost all the fruits show mirid attack
The values obtained were analyzed as quantitative data.

Laboratory Test

The efficacy of endosulphan 35% was investigated in the Entomology laboratory of CRIN at ambient temperature of 27 ±2°C and 70±5 relative humidity and tested at three concentrations of 0.125%, 0.25% and 0.5%. Adults of *S. singularis* collected from cocoa plantations at CRIN Headquarters, Ibadan in October 2006, were exposed to filter paper impregnated with various concentrations of the insecticide inside micro cages of transparent plastic petri-dishes with perforated lids. Five mirids were placed in each cage. A standard miricide was used for comparison while distilled water was used as control. The experimental design was completely randomized design with 10 replications per treatment. Mortality of the mirids was recorded at ten minutes intervals until 100% mortality was achieved in one of the cages.

Field control of S. singularis outbreak

In September 2006, chemical intervention through the use of endosulphan 35 % a.i. was embarked upon to curtail an outbreak of mirid infestation on the cocoa plantation. Synthetic insecticidal control was necessary to bring down mirid numbers below levels that could cause economic damage.

Pre-treatment counts of mirid population were carried out on a hundred randomly tagged cocoa trees per block 24 hours before spraying commenced. In each block, out of the 100 tagged trees, 50 trees were treated with endosulphan, 25 trees treated with the standard miricide and 25 trees left untreated (control) and all the other trees from which no further data were collected were treated with endosulphan applied at the rate of 0.25% a.i. The number of mirids found on the tagged treated trees was recorded 24 hours, 7, 14, 21, 28 and 35 days after spraying to determine the post treatment effect of the insecticides on cocoa mirid populations. Second applications of insecticides were repeated on the 42nd day to kill the residual mirid population and mirid numbers were monitored at intervals as indicated above, until the residual mirid numbers were considered too low to warrant further spraying. Mirid records were also taken on the untreated (control) trees.

Results and Discussion

Table 1 shows the mean field damage scores of the brown cocoa mirid, *S. singularis* on cocoa with respect to three damage parameters viz, lesions on pods, cankers on trunks and twig dieback for two seasons. Very high scores of above 50% were recorded in the field for the tested parameters (Table 1) and these scores increased in 2005/06 cocoa season before chemical intervention was employed to save the plantation. A situation where damage to the trunks and fan branches exceeded 75% (mean scores of 3.13 and 3.46, respectively) was alarming as this will ultimately affect yield negatively.

Mirid mortality increased gradually from 0%-100% as insecticide concentrations and time of exposure increased (Table 2). The endosulphan was found to be faster acting than the standard at 0.25 and 0.5% active ingredients, respectively. At one hour after treatment, concentrations evaluated were significantly different than the control in terms of mirid mortality. The standard miridcide achieved 100% mirid mortality 20 minutes after endosulphan at 0.5% and 10 minutes later at 0.25%. Field control of mirids was therefore based on spraying endosulphan 35EC at 0.25% since it performed very well in the laboratory at this concentration. The control recorded no mortality two hours after treatment with distil water.

The efficacy of endosulphan 35 EC was compared to that of a standard insecticide in the field (Table 3). Twenty-four hours after the first spraying, mirid numbers crashed to zero in treated plots whereas those in the untreated (control) plot remained virtually steady. The situation remained so up till about 28 days after spray application after which plots treated with Endosulphan 35 EC showed 12% recovery and by the 35th day, expressed 23% recovery. The standard miricide also gave a similar result of 15% recovery on the 28th day and 27% recovery on the 35th day. Subsequent to the second spraying on the 42nd day, the residual mirid populations crashed again and did not recover to economic threshold levels. The commencement of the rains later in March 2007 further led to the populations of mirids being kept at abysmally low levels. By contrast, Mirid populations in the control plot were sustained and even occasionally increased due to probable influx of mirids from contiguous cocoa plots.

Table 1: Mean field damage scores of the brown cocoa mirid, *Sahlbergella singularis* on cocoa in Ibadan, Nigeria

Damage Parameters	Cocoa seasons	
	2004/05	2005/06 (mean±SE)
Lesions on Pods and Cherrelles	2.05 ± 0.65	2.34 ± 1.04
Cankers on Trunks and Main branches	2.96 ± 0.80	3.13 ± 0.85
Dieback of Twigs	2.38 ± 1.18	3.46 ± 1.04

Table 2: Laboratory toxicity of Endosulphan 35 EC on the brown cocoa mirids, Sahlbergella singularis in Nigeria.

%	Exposure periods (minutes)											
Concentration	10	20	30	40	50	60	70	80	90	100	110	120
	% Mirid mortality											
0.125	20b	20d	20c	40c	60b	60b	100a	100	100	100	100	100
0.25	20b	60b	80b	100a	100a	100a	100a	100	100	100	100	100
0.5	60a	80a	100a	100a	100a	100a	100a	100	100	100	100	100
Std	20b	40c	80b	80b	100a	100a	100a	100	100	100	100	100
Control	0c	0e	0d	0d	0c	0c	0b	0	0	0	0	0

- Each value represents mean of ten replicates
- Means in columns with different letters are significantly different from each other at 5% level of probability by Tukey test.

Table 3: Comparative Toxicities of Endosulphan 35ec and Standard Miridcide to the Brown Cocoa Mirid, *Salbergella Singularis* in Nigeria
Location: Ibadan, Crin Headquarters, Oyo State.

	FIRST APPLICATION AT 0.25 CONC% (ON INITIAL POPULATION)							SECOND APPLICATION AT 0.25% CONC. Day 42(ON RESIDUAL POPULATION)						
	First Pre-Spray* Mean.	First Post-Spray Mirid Mortality (%)*						Second Pre-Spray Mean	Second Post-Spray Mirid Mortality (%)*					
INSECTICIDES	No. of Mirids per 25 trees	1 Day	7 Days	14 Days	21 Days	28 Days	35 Days	No. Of Mirids per 25 trees	1 Day	7 Days	14 Days	21 Days	28 Days	35 Days
ENDOCEL 35 EC	85	100	100	100	100	88	77	35	100	100	100	100	100	98
STANDARD MIRICIDE	92	100	100	100	100	85	73	37	100	100	100	100	100	96
CONTROL (Unsprayed)	47	2.1	-6.4	-4.3	0	-11	4.3	68-	4.2	2.1	6.3	13	8.3	6.3

*Each value for Endosulphan 35 EC represents mean of four Replicates
** Negative values indicate infestation resulting from either further breeding of resident mirid colonies or, mirid influx from neighboring unsprayed plantatio

Discussion

The steady increase in field damage due to mirid as observed in this work is in consonance with the observation made by Padi (1997) in Ghana who observed a yield loss of 75% in cocoa farms attacked by mirid within a period of three years. Idowu (1989) advocated that mirid damage threshold should be determined before control measures could be applied to combat attack in order to rationally use insecticide that will be cost efficient and at the same time ecologically sound. As at the time this paper was being written, CRIN has eight different insecticides recommended for routine protection of cocoa farms in Nigeria and myriads of novel insecticides belonging to different groups are being screened for their efficacy for mirid control at the Cocoa Research Institute (Anikwe, 2006, Pers. Comm.). The following insecticides have been approved by CRIN, viz; Agrothion 10EC (Fenitrothion), Basudin 600EC (Diazinon), Dursban 4EC (Chlorpyrifos), Elocron 50EC (Dioxacarb), Mipcin 75WP (Isoprocarb), Unden 20EC (Propoxur), Thiodan 35EC (Endosulfan), Decis-Dan/Cracker 282EC (Endosulfan+Deltamethrin). However, the endosulphan used for the control of mirid in this work is Endocel 35 EC, which is different from Thiodan but contains the same percentage active ingredient per litre.

The control of the brown cocoa mirid, *S. singularis* with endosulphan 35 EC was found to be as efficacious as the standard insecticide approved for routine protection of cocoa in Nigeria. This is in consonance with the results obtained by Idowu (1989) when Dursban 4 EC, Ekalux 50 EC and Mipcin 75 WP were evaluated in the field for the control of *S. singularis* in Nigeria. The effectiveness of endosulphan 35% shows that the product could be used for routine spraying of mature and fruiting cocoa farms at the recommended rate of 0.25% active ingredient of the insecticide. After the second spray with endosulphan 35%, the population of mirid in the treated plots did not rise to a threshold level that would warrant a third spray application. This also is in alignment with the assertion by (Idowu, 1989) that cocoa farms require two to three sprays of insecticide during the mirid season to effectively protect farms from economic loss resulting from mirid damage.

This study shows that endosulphan is very effective for the control of the brown cocoa mirid, however, because of its persistence in the soil, it is therefore imperative to carry out residue analysis of cocoa beans harvested from plantations treated with this insecticide to determine the amount of residue left in the beans. Final approval could only be given for use of this insecticide on cocoa if the Maximum Residue Limit is within acceptable level for a commodity crop like cocoa.

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