academicJournals

Vol. 5(3), pp. 29-32, June 2013
DOI: 10.5897/JEN2013.0066
ISSN 2006-9855 ©2013 Academic Journals
http://www.academicjournals.org/JEN

Journal of Entomology and Nematology

Full Length Research Paper

Laboratory bioassay of selected plant extracts for the control of brown cocoa mirid, *Sahlbergella singularis* Haglund (Hemiptera: Miridae)

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Accepted 10 May, 2013

Laboratory bioassays were conducted on five-selected aqueous plant extracts for contact toxicity and residual action on the brown cocoa mirid, *Sahlbergella singularis.* The extracts were *Mangifera indica* (leaf), *Anacardium occidentale* (leaf), *Ocimiun gratissimun* (leaf), *Azadirachta indica* (stem bark) and *Acalypha wilkesiana* (leaf). Leaf extracts of *M. indica*, *A. wilkesiana* and stem bark extract of *A. indica* applied at 1:5% w/v gave an effective kill of 100, 80 and 80%, respectively, for contact toxicity. *M. indica* aqueous extract recorded a 100% mirid mortality at the three concentrations tested for 24 h post treatment for residual action, while *A. indica* gave 89% mortality of mirids at 1:5% w/v. Neem extract was observed to be slow acting. Extracts of *A. occidentale* was not efficacious and treatment was not significantly different from that of control (water) at 5% probability level.

Key words: Laboratory bioassay, brown cocoa mired, aqueous plant extracts, toxicity.

INTRODUCTION

Cocoa, *Theobroma cacao* Linnaeus, 1753, belongs to the family Sterculiaceae (Coste, 1992) and its cultivation in Nigeria dates back to 1874 when a local chief (Squiss Ibaningo) established a plantation at Bonny in the eastern region. In 1887, the government sent seedlings from the old botanical garden at Ebute-meta (Lagos) up country (Ibadan) for trials. This explains why cacao cultivation gained its first impetus around Ibadan and the western states of Nigeria (Opeke, 1992; Anikwe et al., 2009). Nigeria reported her first cocoa export in 1900 (Opeke, 1992). Nigeria's cocoa production continued to soar and by 1965, it had become the second largest producer in the world with an annual output of about 270,000 tonnes. However, decline in production is traceable to the incidences of pests and diseases.

The brown cocoa mirid, *Sahlbergella singularis* Haglund (Hemiptera: miridae) 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 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).

Indiscriminate use of pesticides has given rise to many other serious problems including toxic residues in soil and foods, environmental pollution and hazard from

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improper handling and increased cost of application. In addition, among small-scale cocoa farmers, insecticides available in the market are expensive and often not economical to use. There is therefore an urgent need to screen for safe and effective biodegradable pesticides with non-toxic effects on non-target organisms. In developing countries, botanicals insecticides and the use of crop processing waste could address all the problems associated with the use of synthetic insecticides (Singh et al., 2012). At present, there are no botanicals or biopesticide used at commercial level in Nigeria for the control of mirid. It is against this backdrop that some selected botanicals are being evaluated for their efficacies in controlling this most important insect pest of cocoa, *S. singularis.* This paper therefore reports the mortality of *S. singularis* by aqueous extracts of *Mangifera indica* (leaf), *Anacardium occidentale* (leaf), *Ocimiun gratissimun* (leaf), *Azadirachta indica* (stem bark) and *Acalypha wilkesiana* (leaf) under laboratory conditions.

MATERIALS AND METHODS

Various plant parts such as leaves of *M. indica*, *A. occidentale*, *O. gratissimum*, *A. wilkesiana* and bark of *A. indica* were obtained from the forest zone of the Cocoa Research Institute of Nigerian (CRIN) Headquarters, Ibadan. All experiments were conducted in the Entomology Research Laboratory, CRIN Headquarters, Ibadan at ambient temperature of 27 ± 2°C and relative humidity of 70 to 80%. The *S. singularis* used were collected between the hours of 6:30 am and 7:30 am from zones 7 and 8 cocoa plantations of CRIN, Ibadan. CRIN has different zones where cocoa is cultivated. Aqueous extracts were prepared by soaking 200 g/l (1:5 % w/v), 100 g/l (1:10% w/v) and 50 g/l (1:20%w/v) of each ground material for 24 h after preparation. Extracts were evaluated for residual action by applying 1 ml of each material at 1:5, 1:10 and 1:20 w/v concentrations on Petri dishes lined with fitter paper. Petri dishes were left for a while to drain-off before mirids were introduced into each Petri dish. Extracts were assessed for contact toxicity by applying 0.1 ml of each extract at 1:5, 1:10 and 1:20 w/v concentrations to the dorsal thoracic cavity of adult mirids in the laboratory. Treatments were replicated three times. Data collected were subjected to analysis of variance and significant means were separated at 5% level using the Turkey's Honestly Significant Difference (HSD).

RESULTS

Mean percentage contact toxicity of field collected *S. singularis* treated with different aqueous plant extracts at three concentration levels is summarized in Table 1. Some of the extracts gave an effective kill of the mirids as time progressed and also with increase in concentration. Leaf extracts of *M. indica*, *A. wilkesiana* and stem bark extract of *A. indica* applied at 1:5% w/v gave an effective kill of 100, 80 and 80%, respectively (Table 1).

Table 2 presents the mean mortality of mirids as a result of the residual action of different aqueous plant extracts. In a similar trend with the contact activity, *M. indica* aqueous extract recorded 100% mirid mortality at the three concentrations tested 24 h post treatment, while *A. indica* gave 89% mortality of mirids at 1:5% w/v. Neem extract was observed to be slow acting. Extracts of *A. occidentale* was not efficacious as treatment was not significantly different from that of control (water) at 5% probability level.

DISCUSSION

The results of the laboratory bioassays show that the mechanisms by which aqueous extracts of plants were evaluated could be as a result of outright kill upon contact and/or through residual action. *M. indica* and *A. indica* produced significant kill of *S. singularis* in the laboratory twenty four hours after treatment using both methods (Tables 1 and 2). Extracts from many plants have been reported to be toxic to several insect pests. Anikwe and Ojelade (2005) reported the toxicity of *Tetrapleura tetraptera* against the kolanut weevil, *Balonogastris kolae* in storage. Extracts of *A. indica, Jatropha curcas* and other local plant materials have been screened at the Cocoa Research Institute of Ghana at both laboratory and small-scale field levels and the results are promising (Padi, 1997). *A. indica* was particularly observed to be slow acting but at the end of 24 h, 89% mirid mortality was recorded as a result of residual action of extract. This observation is therefore in consonance with the reports of Jackai (1993) and Lale (2002) that *A. indica* is known to show inhibition of feeding activity to both storage and field insect pests.

M. indica is a higher plant belonging to the family Anarcadeaceae, ironically the same family as Cashew which was innocuous in this bioassay, gave an outstanding result in terms of mirid mortality and also fast acting in the outright kill of mirid and residual action. The pesticide components of this plant are yet to be determined. Dales (1996) reported that higher plants are known to contain a vast amount of secondary metabolites which include acids, alcohols, aldehydes, alkaloids, esters, fatty acids, flavones, glycosides, hydrocarbons, lactones, nitrogen-containing compounds, sterols, phenols and terpenoids and these confer pesticidal activity on these plants.

A vast array of plants abounds for screening for the control of cocoa mirids. The use of non-persistent plant extracts, which have low mammalian toxicity, will help reduce the environmental hazards and other objections associated with conventional insecticides. The Sustainable Tree Crop Programme has advocated for the use of botanicals for the control of mirids and this has been introduced in its participatory curricula with cocoa farmers. The use of non-persistent plant extracts, which have low mammalian toxicity, will help reduce the environmental hazards and other objections associated with conventional insecticides. The use of botanical pesticide coupled with sound cocoa agronomic practices would create conditions unfavourable to pests and pathogens, without

Table 1. Percentage contact toxicity of some selected botanical insecticides to the brown cocoa mirid, *S. singularis* in the laboratory.

Extracts/concentration (g/l)	Time of exposure (minutes)/ Mean percentage mortality						
	20	40	60	80	100	120	24HAT
Mangifera indica							
200	0	70	80	100	100	100	100[a]
100	0	20	40	40	50	60	90[a]
50	0	0	10	20	20	20	30[d]
Anarcardium occidentale							
200	0	0	0	0	0	0	10[e]
100	0	0	0	0	0	0	0[e]
50	0	0	0	0	0	0	0[e]
Ocimium gratissimum							
200	0	0	0	10	10	20	50[c]
100	0	0	0	0	0	0	20[d]
50	0	0	0	0	10	10	10[d]
Acalypha wilkesiana							
200	30	40	50	50	50	50	80[b]
100	0	0	20	20	20	30	30[d]
50	0	0	0	0	0	0	10[e]
Azadirachta indica							
200	20	30	30	40	40	40	80[b]
100	0	20	20	20	20	30	50[c]
50	0	0	0	0	0	0	10[e]
Control (water)	**0**	**0**	**0**	**0**	**0**	**0**	**0[e]**

Means in columns with different letters are significantly different from each other at 5% level of probability by Tukey test. HAT: Hours after treatment.

Table 2. Mean residual action of some selected botanical insecticides on the brown cocoa mirid, *S. singularis* in the laboratory.

Extracts/concentration (g/l)	Time of exposure (minutes)/ mean mortality							
	20	40	60	80	100	120	24HAT	%
Mangifera indica								
200	0	0.67	1.33	1.67	2.0	2.0	3.0	100[a]
100	0	0.33	1.33	2.0	2.0	3.0	3.0	100[a]
50	0	0	1.0	1.33	1.33	2.0	3.0	100[a]
Anarcardium occidentale								
200	0	0	0.33	0.33	0.33	0.33	0.33	11[d]
100	0	0	0	0	0	0	0.33	11[d]
50	0	0	0	0	0	0	0	0[d]
Ocimium gratissimum								
200	0	0	0.67	0.67	1.0	1.33	1.33	44.3[c]
100	0	0	0	0	0	0.33	0.33	11[d]
50	0	0	0	0	0	0	0	0[d]

Table 2. Contd

Acalypha wilkesiana								
200	0	0	0	0.33	0.67	1.0	2.33	77.7[b]
100	0	0	0	0	0.33	0.33	1.33	44.3[c]
50	0	0	0	0	0	0	0.33	11[d]
Zadirachta indica								
200	0	0	0	0	0	1.0	2.67	89[b]
100	0	0	0	0	0	0.33	2.33	77.7[b]
50	0	0	0	0	0	0	1.0	33.3[c]
Control (water)	0	0	0	0	0	0	0	0[d]

Values represent means of three replicates (n = 3); means in columns with different letters are significantly different from each other at 5% level of probability by Tukey test.

affecting beneficial insects and other organisms including pollinators and natural enemies, hence the development of an Integrated Pest Management (IPM) strategy for *S. singularis.*

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