

Evaluation of some insecticides for the control of *Aspavia armigera* Fabricius on rice (*Oryza sativa* Linn.)

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Abstract

Laboratory and field trials were carried out for two years at the International Institute for Tropical Agriculture (IITA), Ibadan and Olabisi Onabanjo University, Ago-Iwoye, Ogun State, Nigeria to determine the efficacy of deltamethrin, lambda-cyhalothrin and carbaryl against the rice bug *Aspavia armigera*. In the laboratory, mortality recorded in any of the insecticide-treated plots was significantly higher than mortality recorded for the control plots. Lambda-cyhalothrin reduced *A. armigera* population density by 39.2% at 6 hours post-treatment with 46% magnitude over other insecticides at 48 hours post-treatment. In field trials at both sites, the three insecticides tested were effective against the bug with the population density of *A. armigera* in lambda-cyhalothrin plots reduced by 56.8% followed by deltamethrin (50%) in the first year. In the second year, the percentage reduction was 58.4% and 58.3% in lambda-cyhalothrin and deltamethrin plots respectively. Similarly, the lowest number of seeds damaged ($P < 0.05$) was recorded in lambda-cyhalothrin-treated plots in both years and at the two sites thus making the insecticides the best among the tested ones for the control of *A. armigera* in rice.

Keywords: *Aspavia armigera*, Carbaryl, Deltamethrin, Insecticide, Lambda-cyhalothrin, Rice,

Introduction

Insect pest outbreaks cause serious yield losses in rice, threaten food security and reduce farmers' income (Akinsola, 1984). In Nigeria, yield losses occasioned by insect attacks range from 30% in upland to 100% in lowland varieties (Akinsola, 1984). Specifically, Ewete and Olagbaju (1990) attributed a yield loss of 39% to *A. armigera* infestation alone on rice. Although, a number of insecticides have been investigated for their efficacy and many recommended for the control of various insect pests of rice, such information for *A. armigera* is not available. For instance, Akinsola (1981) found out that lindane and carbofuran were effective for the control of termites and

mole crickets in rice fields. Similarly, the granular form of carbofuran/diazinon/lindane mixture at the rate of 2 kg a.i./ha was recommended for the control of the stalk-eyed fly (*Diopsis longicornis*) and African Rice Gall Midge (*Orseolia oryzyvora*) when applied at 20 days after planting (DAP) and for the stem borers when applied at 50 and 70 DAP (Alam, 1984; Ukwugwu, 1985).

Despite their shortcomings, insecticides have convinced man that there is possibility of maximising agricultural production through crop protection (Chatterjee and Mondal, 2014). Insecticides are very effective in suppressing many species of insect pests so as to reduce crop losses and therefore are

the first line of action in time of pest outbreaks (Afun *et al.*, 1991). Due to these realities and regardless of the potential of alternative pest management practices, it is recognised that pesticides will continue to be vital components of effective integrated pest management systems. Consequently, these crop protection chemicals have received more than usual attention in the choice of control measures for several crops including rice (Linn and Hoeng, 1984; Thorburn, 2015).

During the past three decades, insecticides have played a major role in the management of rice insect pests. They have helped to bring under control major rice pest outbreaks and have become well established as essential tools in rice insect pest management (Mohd-Fuhad *et al.*, 2012). Although there are significant advances in the development of insect-resistant rice varieties and other insect control measures, insecticides remain a common control method for these pests since no rice variety is completely resistant to all major field pests. When a variety is resistant to a few insect species and needs protection for others, insecticides play a supplementary role in this regard. Insecticides also play an important role in complementing cultural practices that reduce insect infestations in rice fields (IRRI, 1979; Heinrichs, 1979; Lin and Heong, 1984). Although the application of various forms of insecticides has been recommended for rice insect pests in Nigeria (Heinrichs *et al.*, 1981; Akinsola, 1982; Umeh *et al.*, 1991; 1992), not many have been reported for the grain suckers. Besides, many of the insecticides recommended from previous investigations are currently banned and are out of stock (Alam *et al.*, 1985). There is

therefore the need to continue to evaluate the available, less harmful approved insecticides for their effectiveness against the grain suckers for their ultimate use of farmers. Hence, the objective of the study was to investigate the efficacy of three synthetic insecticides; deltamethrin, lambda-cyhalothrin and carbaryl for the control of *Aspervia armigera* on rice.

Materials and Methods

The three insecticides tested were: (a) deltamethrin (Decis EC^(R) produced by Bayer, France) (b) lambda-cyhalothrin (Karate EC^(R)) produced by Sygenta, Switzerland) and (c) Carbaryl (Vetox 85WP produced by Bayer, Germany). The screening of the three insecticides was carried out in a laboratory bioassay at the International Institute of Tropical Agriculture (IITA), Ibadan while the field experimentations were run both at IITA, Ibadan and Olabisi Onabanjo University, Ago-Iwoye, Ogun State. Rice variety ITA 132 and CAN 4143 sourced from IITA, which are of the same degree of susceptibility from previous studies, were used for the experiment depending on availability during the study.

Laboratory bioassay technique

The method adopted for the bioassay was that of Way and Wallace (1990) and Kay *et al.* (1993) as follows:

A 14 m² strip of land was sown to rice variety CAN 4143 and divided into four plots. Three of the plots were sprayed with each insecticide at the manufacturer's recommended rates: deltamethrin at 12.5 g a.i/ha, lambda-cyhalothrin at 20 g a.i/ha and carbaryl at 1700 g a.i/ha. Plot 4 was the control. The panicles used for the laboratory bioassay were collected from the strip.

This trial was set up within 2 hours of insecticidal spray to test the initial efficacy of the insecticide (at 6 hours after spraying and at 48 hours). Several panicles were randomly harvested from the 14 m² strip which was sprayed in sections designated for each insecticide and taken to the laboratory. Groups of three panicles were randomly selected from these harvests. The cut ends of the three panicles were wrapped in sterilised cotton wool and inserted in a glass vial of distilled water to keep them fresh. Each panicle was inserted into a plastic cage (14 x 6 x 9 cm) covered with polythene mesh held on the cage by a rubber band. Adults of *A. armigera* collected from the untreated plots in the neighbouring rice fields using sweep nets were used for the bioassay experiment.

In the laboratory, ten adults (5M: 5F) were placed on the rice panicles in each cage. There were four replicates (i.e. four cages of ten insects) for each treatment with a control which comprised ten insects each confined on unsprayed panicles. Mortality rates were recorded 6 hours and 48 hours after the insects were confined on the treated panicles. The percentages of *A. armigera* killed as a result of feeding on the panicles were calculated and were later corrected for natural mortality in the control using Abbott's Formula (Abbott, 1925). Analysis of Variance was done on arc-sine transformed percentage mortality data and Duncan's Multiple Range Tests were used to separate the significant means.

Field evaluation

The field evaluation of the three insecticides was carried out at two sites located at ES-17 plot area, International Institute for Tropical Agriculture (IITA), Ibadan and Olabisi Onabanjo University, Ago-Iwoye, Nigeria

using ITA 132. The experimental design used was Randomised Complete Block Design (RCBD) with five replicates. For both trials, rice planting distance was 20cm x 20cm in a plot size of 2m x 5m with a border of 2m between the plots. The three insecticides represented the treatments while the control plots were sprayed with distilled water only. The plots were maintained through hand-weeding and application of NPK fertiliser at the rate of 80-60-60 ha⁻¹. The insecticide mixture was applied at the milk grain stage (9 WAP) when the bugs were first noticed on the field and thereafter once a week with a knapsack sprayer equipped with poly-jet nozzle calibrated to deliver 120 l/ha of the solution at a pressure of 6 pounds per square inch (psi). The nozzle was held close to the rice panicles, most especially at the edge of each plot to minimise drift.

Data collected included number of adult bugs at 24 hours before spraying each time using visual count method to determine the percentage population reduction. Harvested grains from 10 randomly selected rice stands per plot were sun-dried and moisture content determined by a digital moisture battery-operated meter. The moisture content was maintained at 14% before weighing. An estimate of grain damage, which was based on weight of damaged grains divided by total grain yield, and grain yield per plot was extrapolated to per hectare. All data collected on insect numbers and yield were analysed using Analysis of Variance (ANOVA) and Duncan's Multiple range test was used to separate significant means at $\alpha = 0.05$.

Results

In the laboratory, mortality recorded in insecticide-treated plots was significantly

higher ($P < 0.05$) than that recorded for the control plots. At 6 hours post-treatment, lambda-cyhalothrin reduced the density of *A. armigera* by 39.2% which was not significantly different from the mortality recorded for other insecticides. But at 48 hours post-treatment, mortality due to lambda-cyhalothrin treatment was 46% higher than in other treatments (Table 1).

At IITA Ibadan experimental site, the mean percentage population reduction of *A. armigera* on insecticide-treated plots was significantly higher than that of the control plots. However, there were no significant differences in the percentage population reduction of *A. armigera* in the lambda-cyhalothrin- and deltamethrin-treated plots with 56.8 and 50% recorded respectively. Although there was a considerable reduction in the population of *A. armigera* in carbaryl-treated plots (46.3% and

52.1%) and deltamethrin (50 and 58.3%) in both years, lambda-cyhalothrin treatment gave the highest percentage population reduction of the insect. Similarly, relative to others, the mean percentage seed damage on insecticide-treated plots was the lowest for lambda-cyhalothrin (13.2 and 14.1%, respectively) in both years although not significantly different from that of carbaryl. That of deltamethrin (15.6%) was not significantly different from that of the control plot in year 2 (Table 2).

At Ago-Iwoye in both years, lambda-cyhalothrin-treated plots recorded the highest percentage population reduction relative to other treatments. The lowest seed damage (12.8 and 20.4%, respectively) was obtained in the lambda-cyhalothrin-treated plots. Significantly higher percentage seed damage (28.8 and 34.4%) was recorded in these two years in the control plots

Table 1: Percentage mortality of *Aspavia armigera* on sprayed rice panicles in laboratory at 6 h and 48 h.

Insecticide	Dosage (g a.i./ha)	Percent mortality	
		6 h	48 h
Carbaryl	1700.00	26.6a	6.8b
Lambdacyalothrin	20.0	39.2a	12.6a
Deltamethrin	12.5	37.2a	6.8b
Control	0.0	6.8b	1.0c

Data in percentages were arc-sine transformed before ANOVA

Means followed by same letter in a column are not significantly differently from one another using DMRT ($P < 0.05$).

Table 2: Mean percentage population reduction of *Aspavia armigera* and seed damage at the rice experimental field at the International Institute for Tropical Agriculture (IITA), Ibadan.

Insecticide	Population Reduction (%)		Seed damage (%)	
	Year 1	Year 2	Year 1	Year 2
Carbaryl	46.3±7.4b	52.1±1.6a	25.6±3.8a	12.4±2.2b
Lambdacyalothrin	56.8±4.7a	58.4±3.6a	13.2±3.2c	14.1±3.8b
Deltamethrin	50.0±6.9a	58.3±3.7a	19.2±6.8b	15.6±2.8a
Control	4.7±1.8c	22.9±5.5b	32.0±8.7a	18.0±1.9a

Data in percentages were arc-sine transformed before ANOVA

Means followed by same letter in a column are not significantly different from one another using DMRT ($P < 0.05$).

Table 3: Mean percentage population reduction of *Aspavia armigera* and seed damage at the rice experimental field at Ago-Iwoye.

Insecticide	Population Reduction (%)		Seed Damage (%)	
	Year 1	Year 2	Year 1	Year 2
Carbaryl	56.1±7.5b	34.5±4.4b	22.9±8.8b	26.1±1.1b
Lambda-cyhalothrin	68.3±8.8a	45.4±6.2a	12.6±1.0c	20.4±2.2c
Deltamethrin	64.2±5.0a	35.3±6.1b	23.1±7.1b	24.5±3.1b
Control	19.7±11.7c	4.7±6.4c	28.8±5.3a	23.4±5.5a

Means followed by same letter in a column are not significantly different from one another using DMRT ($P < 0.05$).

Table 4: Mean paddy yield (kg/ha) of rice at the rice experimental field at IITA, Ibadan and Ago-Iwoye.

Insecticide	IITA, Ibadan		Ago-Iwoye	
	Year 1	Year 2	Year 1	Year 2
Carbaryl	0.58a	1.35a	0.29a	2.04a
Lambda-cyhalothrin	0.50a	1.47a	0.46a	2.09a
Deltamethrin	0.44a	1.17a	0.30a	2.08a
Control	0.44a	1.35a	0.30a	2.02a

Means followed by same letter in a column are not significantly different from one another using DMRT ($P < 0.05$).

(Table 3). However, insecticide treatment appeared not to have an effect on yield at the two experimental sites since no significant increase in yield was recorded from insecticide-treated plots (Table 4).

Discussion

All the insecticides tested in this study reduced considerably the number of *A. armigera* recorded on rice. In previous studies, Alam *et al.* (1985) and Way and Wallance (1990) reported that the use of insecticide is an effective method of controlling rice grain suckers. Furthermore, in this trial, lambda-cyhalothrin was identified as the most efficient, giving a better control of the pest than the other insecticides tested. Other authors have similarly indicated the pyrethroid to be effective in the control of flower thrips and

pod bugs of cowpea with up to ten-fold increase in yield with 2-4 applications (Franks *et al.* 1987; Afun *et al.*, 1991). Lambda-cyhalothrin was also reported to effectively control the velvet bean caterpillar (*Anticarsia germinatilis*) in Brazilian soya bean (White, 2000) and major pests of cucumber (Jinadu, 2005; Pitan *et al.*, 2013). Jackai and Adalla (1997) also listed lambda-cyhalothrin as one of the most commonly used insecticides for the control of *Maruca vitrata*, foliage beetles, flower thrips and pod bugs on cowpea in the tropics.

Although the reductions in the density of *A. armigera* caused by carbaryl were low compared to the values obtained for the other insecticides tested, the insecticide was as well considered effective against *A. armigera* in this study. The reason for this

lower value in the numbers of *A. armigera* recorded in carbaryl-treated plots might be that since the chemical is a systemic poison, it took a longer time to penetrate the rice system for it to provide protection. Nevertheless, this result agrees with that of Argente and Heinrichs (1983) and El-Sebae (1977). The authors reported that carbaryl was very effective against the pink bollworm *Pectinophora gossypiella* in South Asia. Similarly, in Australia, Kay *et al.* (1993) reported the effective use of carbaryl at 1040 g a.i./ha and 1120 g a.i./ha on the rice bug *Leptocorisa acuta* which caused about 90% population reduction.

In conclusion, lambda-cyhalothrin application resulted in 39% *A. armigera* mortality followed by deltamethrin (37%) and carbaryl (26%) which gave the least mortality value. This indicates that carbaryl did not act fast and may not be recommended for the control of a strong flier such as *A. armigera*. Way and Wallace (1986) reported similar findings on carbaryl as causing the death of only 7.5% stink bugs when applied at 1.68 kg a.i./ha at 6 hours and 2.5 bugs at 2 days after application. The significantly high reduction in the population density of *A. armigera* when treated with lambda-cyhalothrin indicated that the insecticide is effective in controlling this bug and it is therefore recommended for the control of the pest. However, its impact on beneficial organisms in the rice ecosystem should be further investigated.

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