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Full Length Research Paper

Effects of *Cymbopogon citratus* (lemon grass) and *Ocimum suave* (wild basil) applied as mixed and individual powders on the eggs laid and emergence of adult *Callosobruchus maculatus* (cowpea bruchids)

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Post harvest losses of cowpea grain are a serious problem, in Africa, as much as 20 - 50% of grain is lost because of infestation due *Callosobruchus maculatus* (Cowpea bruchids). Plant mixtures containing *Cymbopogon citratus* (Lemon grass) (L) and *Ocimum suave* (Wild basil) (W) powders in the ratios (Lemon grass: Wild basil): 100:0, 80:20, 60:40, 50:50, 40:60, 20:80, 0:100 and 0:0 were used under ambient laboratory conditions with the aim of evaluating the effects of these plant powders on the eggs laid by the adults (Oviposition) and the emergence of F_1 generation of adult *C. maculatus* (F.) (Cowpea bruchids). The mixed powders were each applied at 1, 2 and 3 g concentration to 20 g of cowpea seeds. Number of eggs laid by the adult bruchids and the emerged F_1 offspring were counted. The mixture 60 L: 40 W had the least mean number of egg counts for the parent bruchids and least number adult F_1 emergence which was significantly ($p < 0.05$) reduced.

Key words: *Cymbopogon citratus, Ocimum suave, Callosobruchus maculatus,* oviposition, F_1 generation adults.

INTRODUCTION

Cowpea, (*Vigna unguiculata*) (L.) Walp is a very important and cheap source of dietary protein for many countries in the tropics (Ofuya, 2003). The seed is high in protein contents and can be consumed directly, can also be used to make flour, sprouts and weaning food for young children. Thus, reducing malnourishment and stunted growths (Philips and Deheh, 2003). A major problem in storage of cowpea seeds in the tropics is infestation by bruchids especially *Callosobruchus maculatus* Fabricus (Ofuya, 2003). These post harvest losses of cowpea grain are a serious problem and in Africa, as much as 20 - 50% of grain is lost because of infestation due to this pest. It has also been estimated that about 40% or 30,000 tonnes valued at over 30 million dollars is lost annually to *C. maculatus* (F) (Caswell and Akibu, 1980).Owing to the problems of synthetic organic chemicals, there is renewed interest on plants as alternative materials for use as stored grain protectants because they have been found to have broad spectrum insecticidal properties with reduced persistence compared to the organochlorines and organophosphates, carbamates and pyrethroids. They are easily available and can be produced within the farmers' vicinity, thus providing a more sustainable approach to pest control (FAO, 1985). They are also cheap to purchase and have no negative impact on the environment because they are easily biodegradable. Therefore, many scientists have been conducting researches over the last three decades aimed at identifying botanicals that would replace synthetic organic chemicals but the efficacies of the plant mixtures have been less investigated (Emeasor et al., 2007). This research evaluated the effect of *Cymbopogon citratus* (Lemon grass) and *Ocimum suave* (Wild basil) applied as mixed and individual powders on the oviposition and the emergence of F_1 adults of *C.*

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Table 1. Mean number of eggs laid by the adult parents *C. maculatus* on cowpea seeds treated with different mixed proportions of *C. citratus* (Lemon grass, L) and *O. suave* (Wild basil, W) plant powders and the untreated (0:0) seeds.

Mixed proportions (%) of plant materials (L:W)	Concentration of plant material (grams)			$\overline{X}$
	1	2	3	
100:0	62.0	55.0	44.0	53.7^{b}
80:20	58.5	41.0	35.5	45.0^{bc}
60:40	41.0	37.0	21.5	33.2^{c}
50:50	45.5	42.0	27.5	38.3^{bc}
40:60	56.5	44.0	38.5	46.3^{bc}
20:80	44.5	39.5	33.5	39.2^{bc}
0:100	58.0	51.5	39.0	49.5^{b}
0:0 (Control)	95.5	97.5	92.0	95.0^{a}
$\overline{X}$	57.7^{x}	50.9^{x}	41.4^{x}	

Means with the same superscript letters do not differ significantly ($p < 0.05$) using Duncans Multiple Range Test.

maculatus (Cowpea bruchids).

MATERIALS AND METHODS

Insect stock culture

Adult bruchids were obtained from already infested cowpea and identified as *C. maculatus* by the assistance of the Nigerian storedproduct research institute (NSPRI) Sapele, Delta State Nigeria. The *C. maculatus* adults obtained were introduced into undamaged cowpea (*Vigna unguiculata*) L seeds of the Kano white variety 1696 and maintained in large specimen bottles with fine mesh gauze covering the opened end, for them to mate and oviposit under laboratory conditions. Adult emergence was checked daily and the newly emerged adults were then used for the experiment.

Experimental cowpea

Undamaged and clean cowpea seeds that were used were purchased from Abraka market, Delta state. Each seed was examined under microscope to make sure there were no damages, eggs laid and exit holes on them. They were then kept by deep freezing for two weeks and left for 24 h under ambient conditions (Ofuya et al., 2007).

Preparation of insecticidal plant powder

Two researched plants identified as *C. citratus* and *O. suave* by Botany Department of Delta state University were used for the experiments. The plants were obtained from Issele-Azagba (Aniocha North) Local Government Area of Delta State. Fresh leaves from each plant were slowly dried for 3 weeks in an open wooden cabinet (1.0 x 0.5 x 1.0 m) under room temperature before pulverization in a motorized high speed grinder. The powder was passed through a sieve of 0.1 mm mesh size. The particles were then put in an air tight container to prevent active components from evaporating. This method was adopted from Denloye et al. (2007) (with slight modification, Denloye et al. (2007) constructed the cabinet with a 100 watt bulb.

Formulation of insecticidal plant materials into treatment combinations

The powders obtained were mixed in the following ratios (Lemon grass: Wild basil): 100:0, 80:20, 60:40, 50:50, 40:60, 20:80 and 0:100 .Each combination was replicated two times. The untreated combination (0:0) served as the control for the experiment. Each combination was admixed with 20 g of experimental cowpea seeds at 1, 2 and 3 g concentrations of rates of application.

Efficacy test

Each formulated treatment combination were admixed with 20 g of cowpea seed of various sizes at different concentration of 1, 2 and 3 g and put into Petri dishes with lid. 3 pairs of adult *C. maculatus* (3 males and 3 females) were introduced into each Petri dishes and kept under laboratory conditions of 32°C and 70% relative humidity.

Data collection

The adult bruchids were allowed to lay eggs for 5 days after which they were removed (dead and alive) and eggs were counted between 5 and 8 days after infestation (DAI) with the aid of magnifying lens. Adults emerged 21 DAI and daily count was made for 3 consecutive weeks. Each adult that emerged was put into a Petri dish.

Statistical analysis

All data collected were subjected to Analysis of Variance (ANOVA) and Multiple Comparison using Duncan's Multiple Range Test and LSD.

RESULTS

Oviposition (number of eggs laid)

There was a significant difference ($p < 0.05$) in the mean

Table 2. The mean number of adults (F_1 generation) *C. maculatus* adult that emerged from cowpea seeds treated with different mixed proportions of *C. citratus* (Lemon grass, L) and *O. suave* (Wild basil, W) plant powder on the untreated (0:0).

Mixed proportions (%) of plant materials (L:W)	Concentration of plant material (grams)			$\overline{X}$
	1	2	3	
100:0	21.5	16.0	11.0	16.2^{b}
80:20	24.0	19.0	13.0	18.7^{b}
60:40	16.5	11.0	9.0	12.2^{b}
50:50	22.5	11.0	12.0	15.2^{b}
40:60	29.0	14.5	11.0	18.2^{b}
20:80	25.0	18.5	11.0	18.2^{b}
0:100	24.5	16.5	12.5	17.8^{b}
0:0 (Control)	56.0	57.0	55.0	56.0^{a}
$\overline{X}$	27.4^{x}	20.4^{x}	16.8^{x}	

Means with the same superscript letters do not differ significantly ($p < 0.05$) using Duncans Multiple Range Test.

number of eggs laid (oviposition) by the adult *C. maculatus* in cowpea seeds treated with different mixed proportions of *C. citratus* (Lemon grass, L), and *O. suave* (Wild basil, W) and the untreated seeds (Table 1) However, the Duncans' multiple range test could not differentiate where the difference lay. There was significant difference ($p < 0.05$) between the treatment concentrations of the plant materials and the untreated in the number of eggs laid.

Number of adult emergence (F_1 generation)

The mean number of adult *C. maculatus* that emerged from cowpea seeds treated with different concentrations of mixed (%) combinations of *C. citratus* (Lemon grass, L) and *O. suave* (Wild basil, W) and the untreated seeds (Table 2). There was significant different ($p < 0.05$) between the concentrations of the plant materials (1 - 3 g) in the number of F_1 adults that emerged. However, the Duncans' multiple range tests could not differentiate where the significant lies. There was significant difference ($p < 0.05$) between treatment combinations of the plant materials in the number of F1 adult that emerged.

DISCUSSION

The number of eggs laid by adult *C. maculatus* in the proportions of plant mixtures significantly reduced as the concentration increased from 1 – 3 g / 20 g cowpea seeds with 60L: 40W having the least number of eggs laid. This may be due to the fact that there was addictive effect of the plant mixtures when used in that plant ratio. The reduction in eggs laid may also be that some females may have died so could not lay eggs and the males that were alive mated with fewer females. This would have affected mating and thus producing reduced number of eggs. The decrease in the eggs laid may also be as a result of the repellent effects of the plant materials such that the insects could not mate properly thus reducing oviposition. Hassanli et al. (1990) suggest that oils from *O. suave* showed repellency against *Sitophilus zeamais* when assessed 1 h after application in an olfactometre. Oparaeke et al. (1998) also observed that seeds and leaf powders of *Azadirachta indica* and Pirimiphos-methyl reduced the eggs laid by *C. maculatus*.

At 60L: 40W, the number of adult emergence was lowest. It may be that the plant mixtures, contains insecticides that adhered to the eggs which created obstacles that prevented them from rupturing. It may have a kind of physiological changes resulting in failure of hatching. Dike and Mbah (1992) suggested that *C. citratus* may be ovicidal or larvicidal in their action. The reduced number of adults that emerged may be as a result of competition of the larvae for space and food within cowpea seeds especially if there were multiple eggs laying on same seeds. It could also be that the plant materials made the male sterile that the females produced non-viable eggs.

This is in line with Emeasor et al. (2007) who observed that F_1 adult emergence (*C. maculatus*) was reduced when cowpea was treated with mixed fruits seeds of *Piper guineense* and *Thevetia peruviana.* Shazia et al. (2006) have observed that some botanicals reduced the F_1 emergence of *C. maculatus* while Abolusoro (2000) noted that F_1 emergence was reduced in the cowpea treated with *P. guineense* and *Xylopia aethiopica.* Oparaeke et al. (2002) recorded reduced progeny development in cowpea treated with *Ocimum gratissimum* (African curry) and *Hyptis suaveolens* (African bush tea).

In conclusion, this study has shown that mixed

proportions of *C. citratus* (Lemon grass) and *O. suave* (Wild basil) especially at 60L: 40W could be most effective because it has the least number of egg counts for adult bruchids and least F_1 adult emergence. However, there is need for researchers to identify mixed proportion of other plant materials that are environmentally friendly that could be used in storage against the disturbing infestation of *C. maculatus*.

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