Efficacy of Some Plant Material for the Control of Cowpea Bruchids Callosobruchus maculatus (Fab)

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Abstract

Four plant materials were evaluated in the laboratory for their use as storage protectant against the cowpea bruchids **Callobruchus maculatus.** The materials were Piper guineanse seed, **P. guineanse** leaf, citrus peel and **Xylopia aethiopica** fruit at the rate of 1, 1.5 and 2g of plant materials per 100g of seed. Actellic dust a known synthetic storage insecticide was used along side the four plant materials at the rate of 0.03, 0.05 and 0.7 per 100g of seed while there was an untreated control as a standard check.

The result from the study showed that **P. guineanse** (see and leaf), citrus peel as well as aethiopica were found to cause heavy mortality under six days at liquid state. All the plant materials with the exception of **Xylopia aethiopica** were also found to significantly reduce the population of bruchids in powederd form via causation of mortality.

Introduction

Grain legumes also termed pulses are a major source of dietary protein in many parts of the world, particularly in countries situated along the tropical and sub-tropical belt where the availability and consumption of animal protein are rather low because of social and/or economic constraints. Pulses are much more cheaper than meat and fish as well as egg. This makes a good supplement to diets based on cereals and root crops, which are usually very low in protein and high in carbohydrates (Singh and Singh 1992). Cowpea, (**Vigna unguiculata** L. Walp) is one of the grain legumes and the most readily available and popular source of plant protein in Nigeria. Nigeria produces about 800,000 tonnes of cowpea annually, 80% of which comes from Northern State (Caswell, 1981).

Cowpea is cultivated on about 7.7 million ha worldwide of which about 6 million ha are in Arica. However, the average yield of cowpea is low (100-300kg/ ha) because of numerous constraints particularly insects and diseases. In addition to yield losses on the field, cowpea also suffers a considerable loss in storage due tobruchids. Booker (1967) identified three species of bruchids on cowpea in Nigeria; **Callosobruchus maculatus** (Fabricus), **C. rhodensianus** Pic, and **Bruchidius allrolineatus** Pic. Among these, **C. maculatus** is the most damaging. The other two are seldom found in cowpea stored for more than a month. **C. maculatus;** not only causes reduction in dry weight but also reduces grain quality and viability, making the seed unfit for consumption as well as for planting. It causes susbstantial reduction in market value.

New and relatively uninfected cowpea appears in the market between the months of September and November. Within three months, infestation by weavils mainly **C. maculatus,** becomes a storage problem. A conservation estimate put grain losses during storage at between 15 and 20% annually (Agboola, 1980). Caswell (1981) estimated that 4.5% of the annual production valued at $30 million is lost in Nigeria alone due to bruchids and some consider this to be conservative estimate.

Synthetic pesticides have been used for many years to control agricultural insect pests. However, considerable problems arose fromthe continued application of these pesticides. These problems include the development of resistance by insects, pollution of environment, health hazard from handling toxic substances and cost of application. Thus, there is a need to develop alternative cheap and safe methods of control.

This has led to the testing of many local plants for their insecticidal properties. Lathrop and Keirstead (1946) found that black peopper could be used for protecting yellow-eye beans from weavils. Williams (1983) also reported that ground component of Pipernigrum when used to surface treat a variety of maize susceptible to **S. zeamais** (L) were found toxic to some extent. In Nigeria, very little research has been done on insecticides from plant sources whose potentials appear to be quite high (Olaifa and Akingboungbe, 1986.

This study was therefore conducted with the following objectives:

1) To study the effect of liquid and powder of some locally available plants; **Pipe guineanse**; **Xylopia aethiopica** and Citrus peel on the survival and reproduction of cowpea bruchids.
2) To compare their insecticidal activity if any with that of a known synthetic insecticide (Actellic dust)

Materials and Methods

Insect culture

Callosobruchus maculatus was cultrued in brown cowpea variety IT. 124 of 12% moisture content at room temperature. Six kilner jars eachcontaining 300g of cowpea were used. 10 bruchids made of six females to four males i.e. ratio 6:4 were introduced into each of these jars. After six days, the insects were removed and emergence of young adults awaited.

Water Extract Preparation Leaf Extract Preparation:

100g (0.1kg) of powdered dried leaves of **Piper guineanse** was boiled in one litre of distilled water at 100°C for one hour. The extract was then allowed to cool down. Sieving was done and followed by f iltration. The filtered extract then served as stock solution. The stock solution was calculated to be 100,000 parts per million (PPM) using a standard dilution factor equation shownbelow:

1 mg/L	=	1 pm
1000mg	=	g
100 x 100mg/L	=	100,0000ppm
where mg	=	milligram
L	=	Litres
g	=	gram
Ppm	=	Parts per million

Other concentrations prepared from the stock solution are 5000 parts per million (ppm) 10,000ppm, 25,000ppm, 50,000ppm, by diluting certain quantities with required volume of distilled water e.g. for 500ppm, 5ml of stock solution was diluted with 95ml of distilled water. 10ml of stock solution was diluted with 90ml of water to give 10,000ppm etc. The concentration of distilled water was 0ppm i.e. as control.

Preparation of Seed Extracts:

100g each of powder fruit **Xylopia aethiopica** and **Piper guineanse** were boilded in one litre of water separately at 100°C for 60 minutes. The solution was then cooled, sieved and filtered to remove debris from the extract. This filtered solution served as the stock solution calculated to be 100,000ppm using the filuting factor equation shown previously. From the parent stock solution, the following concentrations were prepared; 5000, 10,000, 25,000 and 50,000.

Preparation of citrus peel extracts:

100g of dried peel of citrus was boiled in one litre of distilled water for one hour. The solution was then cooled, sieved and filtered to remove debris.

The filitered solution now served as stock solution calculated to be 100,000ppm using the earlier dilution/fraction equation. 5000,10,00025,000 and 50,000ppm were other concentrations prepared from the parent stock. Distilled water which was 0ppm in concentrationserved as the control.

Preparation of Tes Plants (in Powdered form)
Xylopia fruit poweder

Dry fruit of **Xylopia aethiopica** were washed, sundried and ground with a high speed blender into fine particles. It was then sieved. The same procedure was also applied to **Piper guineanse** seed and leaf separately, and citrus peel so as to obtain the powder of these test plant parts.

Liquid Extracts Application

Extracts from Piper, Xylopia and citrus were applied at various concentrations i.e. 5000, 10,000, 25,000, and 50,000 parts per million while distilled water served as control which is 0 parts per million.

2ml of the extract was introduced into each petridish lined with two layers of filter paper. Each concentration was repolcated three times.

Ten bruchids were introduced into each of the petridishes in ratio of six females to four males. Mortality record was taken on daily basis.

Cold Treatment of Cowpea

The cowpea that was to be used for the test was first frozen in deep freezer for seven days so as to kill any bruchid present in the seed irrespective of their stage of development.

Treatment Application

Xylopia, Piper and citrus powder were applied to 100g of cowpea in speciment bottles at various concentrations i.e. 1g/100g, 1.5g/100g and 2g/200g of cowpea. The control was also set up. No treatment was applied to the control. Cowpea seeds were also treated with actellic dust at the rate of 0.03, 0.05, 0.07/100g of cowpea seeds.

Bioassay

This was done five hours after treatment. Each bottle of treated cowpea seeds and untreated control was infested with 10 **Callosobruchus maculatus** at the ratio of 6 females to 4 males. Observation was then taken and recorded based on the survival of adults.

Result

The Effect of Liquid Materials on the Mortality of Bruchids.

On day one after treatment, there were no significant differences among the various treatment groups, but as from day two onwards, significant differences were observed (Table 1).

The variòus liquid treatments caused a significant higher mortality than the control where no mortality was recorded during the first three days. The Piper fruit treatment at 50,000ppm was superior to other treatments on day two.

In all treatments, percentage mortality increased with increase in concentration of liquid extract. On day five, all the liquid extract treatment resulted in 100% mortality as opposed 32% mortality in the control.

The Effect of the Powdered Plant Materials and Actellic dust on the survival of Bruchid

The effect of powdered dried test plants and actellic dust on insect mortlity are shown in Table 2. On day one of data collection, there was no significant differences among the various treatments but significant differences occurred from day two to day ten of data collection. All the powders of dried plants materials with the exception of **Xylopia aethiopica** brought about an increased mortality of the bruchids when compared with control. The Piper seed and citrus peel treatment were superior to all the other treatments. The xylopia treatment at all the various doses tested was not effective in killing the bruchids.

Discussion

Piper guineanse seed and leaf and citrus peel powder used caused a high mortality of **Callosobruchus maculatus** under one week.

The toxicity of P. guineanse has been attributed to the presence of active components. Uyanne (1993) attributed the toxicity of **P. guineanse** to action of piperine acting in synergism with **P. guineanse** on active component of **P. guineanse.**

Xylopia aethiopica however is effective in liquid state but not effective in powder form. This might be due to high efficiency of the active component at liquid state than in powder form. Mejule **et al** (1988) reported that **Xylopia aethiopica** had no toxic effect

on **Tragoderna gramarium** a storage pest of grains.

Citrus peel was found to be effective in both liquid and powder form. The effectiveness might be due to the presence of active component in the peel. Helen et al (1972) reported toxicity of citrus peel oil to cowpea weavil **Callosobruchus maculatus**. Babatola (1989) reported that citrus fruit canning waste is very effective in controlling the nematodes of tomato. Actellic dust applied at the rate of 0.03, 0.05 and 0.07g per one hundred grammes of cowpea seeds was found to be effective in causing mortality except for 0.03g that took a longer time before a reasonable level of mortality was observed. This agrees with findings of earlier researchers Tun (1979), Adesuyi (1979) and Coghurn (1973) who reported high toxicity of actellic dust to cowpea bruchids **C. maculatus** and to **Sitophilus oryzae**

Conclusion

Both **Piper guineanse** (seed and leaf) as well as citrus peel were found to be toxic to bruchids by reducing its population through mortality. More researchwork should be channeled towards extracting this active ingredient so as to improve on the efficacy of these plant materials with a view to recommending them for use in cowpea storage and the storage of other related grains.

Since Xylopia fruit was effective in controlling **Callosobruchus maculatus** in liquid state, more work should be carried out to determine what inhibited the potency of this plant material in the powder form and to also identify the active component in the liquid form.

Table 1: Percentage Mortality of Callosobruchus maculatus Adults due to Treatment with Water Extracts of the Plants

PERCENTAGE MORTALITY (CUMULATIVE)

TREATMENT (PPM)		DAYS 1	2	3	4	5
Piper guineanse (Seed)	5,000	6.2^{a}	23.2^{d}	53.2^{c}	80.1^{bc}	100^{a}
	10,000	8.1^{a}	37.1^{c}	63.1^{bc}	80^{bc}	100^{a}
	25,000	10.0^{a}	47.3^{bc}	80.2^{ab}	93.1^{a}	100^{a}
	50,000	12.6^{a}	67.2^{a}	93.0^{a}	100^{a}	100^{a}
Piper guineanse Leaf	5,000	3.2^{a}	23.1^{d}	53.0^{c}	80^{bc}	100^{a}
	10,000	7.3^{a}	30.0^{c}	63.2^{bc}	83.0^{bc}	100^{a}
	25,000	10.1^{a}	46.3^{c}	63.4^{b}	90.2^{ab}	100^{a}
	50,000	11.1^{a}	53.2^{b}	83.1^{a}	100^{a}	100^{a}
Xylopia fruit	5,000	1.2^{a}	17.1^{de}	56.2^{c}	78.2^{bc}	100^{a}
	10,000	3.4^{a}	27.2^{cd}	63.1^{bc}	83.0^{bc}	100^{a}
	25,000	7.1^{a}	33.0^{c}	63.4^{b}	90.2^{ab}	100^{a}
	50,000	12.0^{a}	43.1^{a}	83.1^{a}	100^{a}	100^{a}
Citrus Peel	5,000	2.2^{a}	20.1^{d}	63.2^{bc}	24.4^{d}	100^{a}
	10,000	5.1^{a}	23.2^{d}	66.3^{b}	83.2^{bc}	100^{a}
	25,000	6.2^{a}	34.0^{c}	80.0^{b}	93.1^{a}	100^{a}
	50,000	9.2^{a}	34.0^{c}	80.6^{ab}	98.1^{a}	100^{a}
Control	0	0^{a}	0^{c}	0^{d}	20^{d}	33.4^{b}

Same letters after figure in a column denotes lack of significant difference between means according to Turkey test at P = 0.05

Table 2: Percentage Mortality of Callosobruchus Maculatus Adults due to Treatment with Powdered Materials of the Test Plant

PERCENTAGE MORTALITY(CUMULATIVE)

TREATMENT (g)		DAYS									
		1	2	3	4	5	6	7	8	9	10
Piper guineanse											
Seed	1.0	0^{a}	0^{b}	10.0^{cd}	31.3^{b}	31.3^{b}	43.3^{b}	60^{ab}	7.0^{ab}	70.0^{ab}	8.0ab
	1.5	0^{a}	20.8^{b}	23.3^{bc}	42.0^{ab}	50.0^{a}	62.3^{ab}	63.0^{ab}	80.0^{ab}	80.0^{a}	100^{a}
	2.0	10^{a}	10.0^{b}	32.2^{ab}	50.4^{ab}	53.3^{a}	70^{a}	80^{a}	90.0^{a}	100^{a}	100^{a}
Piper guineanse											
Leaf	1.0	0^{a}	0^{b}	11.3^{cd}	22.0^{bc}	23.0^{bc}	25.0^{b}	43.0^{bc}	45.4^{b}	53.3^{c}	62.3^{b}
	1.5	0^{a}	10.0^{b}	22.3^{bc}	22.4^{bc}	24.3^{bc}	40.0^{b}	40.0^{b}	60.0^{b}	60.0^{b}	70.0^{b}
	2.0	0^{a}	10.0^{b}	23.3^{bc}	23.4^{bc}	4.0^{a}	$40.^{b}$	71.4^{ab}	71.4^{ab}	82.3^{a}	84.0^{ab}
Citrus Peel	1.0	10.0^{a}	10.0^{b}	20^{bc}	31.0^{b}	31.3^{b}	50.0^{ab}	60.0^{ab}	80.0^{ab}	90.0^{ab}	100^{a}
	1.5	10.0^{a}	30.0^{a}	32.3^{ab}	42.0^{ab}	43.4^{ab}	60.0^{ab}	70.0^{a}	70.0^{ab}	80.0^{ab}	100^{a}
	2.0	10.0^{a}	30.0^{a}	44.3^{a}	63.3^{a}	65.4^{a}	72.3^{b}	8.3^{a}	90.0^{a}	100^{a}	100^{a}
Xylopia aethiopica											
Fruit	1.0	0^{a}	0^{b}	0^{d}	0^{c}	0^{c}	0^{c}	0^{d}	0^{c}	10.0^{d}	10.0^{c}
	1.5	0^{a}	0^{b}	0^{d}	0^{c}	0^{c}	0^{c}	0^{d}	0^{c}	20.0^{cd}	20^{c}
	2.0	0^{a}	0^{b}	0^{d}	0^{c}	0^{c}	0^{c}	0^{d}	0^{c}	220^{d}	20^{c}
Actellic dust											
	0.03	0^{a}	0^{b}	0^{d}	0^{c}	0^{c}	20^{bc}	30^{c}	50.0^{b}	50^{d}	60^{b}
	0.05	0^{a}	10^{b}	12.03^{cd}	20.0^{bc}	30.0^{b}	30.0^{b}	40.0^{bc}	70.0^{ab}	80.0^{ab}	80.0^{ab}
	0.07	0^{a}	10^{b}	20.0^{bc}	2.0^{bc}	40.0^{ab}	40.0^{ab}	40.0^{ab}	60.4^{ab}	100^{a}	100^{a}
Control	0	0^{a}	0^{b}	0^{d}	0^{c}	0^{c}	0^{c}	0^{d}	0^{c}	20.0^{cd}	20.0^{c}

N.S = Not significant

Same letters after figure in a column denotes lack of significant difference between means according to Turkey test at P = 0.05

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