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The Use of Leaf Powders of *Ocimum gratissimum* and *Vernonia amygdalina* for the Management of *Sitophilus oryzae* (Lin.) in Stored Rice

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Abstract: In this trial, some aspects of the biology: oviposition, development, survival, fecundity and damage cause by *Sitophilus oryzae* on stored rice and the control of the weevil, using leaf powders of *Ocimum gratissimum* and *Vernonia amygdalina* were studied under ambient laboratory conditions (temperature range 28-30°C and 60-77% relative humidity). Toxicity tests consist of exposing adult weevils to various levels of 0, 1, 2, 3, 4 and 5 g per 20 g grain. The leaf powders were admixed with rice grains. The results showed that the tested leaf powders have insecticidal activities. Based on the percentage mortality, number of egg laid, number of emerged adult, percentage weight loss and percentage punctured grain. The trial also revealed that *Ocimum gratissimum* was more effective than *Vernonia amygdalina* as stored grain protectants at all dosage level of application.

Key words: *Sitophilus oryzae*, *Ocimum gratissimum*, *Vernonia amygdalina*, rice grains

INTRODUCTION

Grains include all legume and cereal crops that are grow for dried seeds such as rice, maize and cowpea etc. Due to their comparative high carbohydrate content and moderate protein contents, ease of handling, transportation and storage grains are of great importance in their role in the diet of Africans, followed by root and tuber crops. However, grains are subject to attack by many groups of bio-deteriorative agents, of which curculionids are the most important. In Nigeria and other developing countries of Sub-Saharan Africa, rice is a staple food and *Sitophilus oryzae* (Lin) is a major storage pest of the crop (Haines, 1991). It is a major constrain to profitable grain crop production in Nigeria, since it causes a considerable losses in storage. This losses means that the resources such as time, labour and money spent in growing the crop are wasted. Control of this pest is usually achieved by the use of conventional insecticides, which has serious drawbacks, such as the development of non-sensitive strains and toxic residues and it is not cost-effective to resource-poor farmer. In the earlier times, oils were used to protect stored grains from insect attack especially in India (Su, 1977).

In recent years, many workers have given greater attention to the control of stored grain pests using vegetable, essential and mineral oils. Jadhav and Jadhav (1984) used some vegetable oils, plant extracts and synthetic insecticides as protectants for stored grains. Onolemhenhen (1991) demonstrated the control of *Calosobruchus maculatus* (F.) by rubber seed oil. Enobakhare and Law-Ogbomo (2002a) used some plant products to control post-harvest loss caused by *S. zeamais*. *Ocimum gratissimum* and *Vernonia amygdalina* as grain protectants have been observed to be effective in the management

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of *S. oryzae* (Enobakhare and Law-Ogbomo, 2002b). Law-Ogbomo and Enobakhare (2004) demonstrated the effectiveness of palm oil, rubber seed oil and palm kernel oil in the control of *S. oryzae*.

This study focused on the potential use and efficacy of leaf powders of *O. gratissimum* and *V. amygdalina* in protecting rice grains against *S. oryzae*.

MATERIALS AND METHODS

This trial was conducted in the Agricultural laboratory of Benson Idahosa University, Benin City in 2004. The grain used for this trial was FARO 15 obtained from Edo State Agricultural Development programme, Benin City. The grain was sun dried to a constant weight and then placed in a large transparent bag. Grain moisture content was determined for rice grain after moisture equilibration at 70.0±0.5 relative humidity by method of Dobie (1984) and was 12%. The rice grains were sterilized before being used for the trial by cleaning the grains in 70% ethanol solution to free them from any pre-infestation (Pereira, 1983).

Leaves of *O. gratissimum* and *V. amygdalina* were sun dried and then ground separately into a fine powder in a dry blender for 3-4 min. The powdered products were admixed with rice grains at the rates of 0, 1, 2, 3, 4 and 5 g per 20 g grain in plastic dishes (8 cm diam). Four replications of treated grains as well as untreated grains (control) were set up. Batches of fifteen 1-3 day old (sex ratio 2:1) of which 2 female: 1 male taken from a laboratory culture maintained on locally produced rice was introduced into each plastic dish which was then capped with a piece of muslin is (10 mesh mm^{-1}). The muslin allowed ventilation but prevented entry and exit of insects. The weevils were sexed using the criteria highlighted by Haines. The treatments were left for 21 days under ambient conditions of 30±0.5°C and 70±5 r.h using silica gel and ensuring adequate ventilation.

Mortality assessments were recorded on 2, 3, 5, 7, 10, 14, 17 and 21 days after treatment (DAT). Dead adult weevils being those that showed no visible movement after 20 seconds were recorded. After 211 days assessments, all adult weevils were removed from the plastic dishes in anticipation of emerging F_1 progeny. At the end of 21 days period, cumulative data on percentage adult weevil mortality were corrected using Abbott's (1925) formula;

$$P_T = \frac{P_O - P_C}{100 - P_C} \times 100$$

Where P_T = corrected mortality (%), P_O = observed mortality (%). At the end of 21 days, the effect of leaf powders on reproductive capacity was determined by the use of egg plug staining techniques (Ivbijaro, 1984). The F_1 progeny population was assessed on daily basics and removed up to a period of four after the initial 21 days period. After the four weeks, no emerging F_1 weevil was observed. Two weeks after that period, the contents of each dish were sieved to remove the dusts, frass and any insect present in the grains. The grains were re-weighed and the percentage losses in weight of the grains were computed thus:

$$\%\text{Wt loss} = (W_f - W_i)100 / W_i$$

Here, W_i = initial weight, W_f = final weight

After re-weighing, the grains were sorted into wholesome and punctured grains and the percentage of punctured grain was computed as:

$$(W/Y)100$$

Where X = number of punctured grain per treatment, Y = total number of grain per treatment.

Table 1: Mortality of *S. oryzae* exposed to leaf powder treatments in stored rice grain (FARO)

Leaf powder	Dosage (g/20 g grain)	Mean % adult mortality (n = 4; p<0.05*)
Ocimum gratissimum	0.0	0.00^{a}
	1.0	80.00^{b}
	2.0	88.00^{b}
	3.0	94.00^{ab}
	4.0	100.00^{a}
	5.0	100.00^{a}
Vernonia amygdalina	0.0	0.00^{c}
	1.0	73.00^{b}
	2.0	79.00^{b}
	3.0	90.00^{ab}
	4.0	96.00^{ab}
	5.0	100.00^{a}

*Means followed by common letter(s) are not significantly different at 5% probability level comparison made only vertically

Table 2: Effects of leaf powders of *Ocimum gratissimum* and *Vernonia amygdalina* on the indices of *S. oryzae* infestation

Leaf powder	Dosage (g/20 g grain)	Mean % No. of egg laid (n = 4; p<0.05*)	Mean % adult emergence (n = 4; p<0.05*)	Mean % weight loss (n = 4; p<0.05*)	Mean % punctured grain (n = 4; p<0.05*)
Ocimum gratissimum	0.00	93.10^{a}	86.10^{a}	48.90^{a}	92.20^{a}
	1.00	20.10^{b}	9.20^{b}	2.00^{b}	19.20^{b}
	2.00	9.30^{bc}	3.60^{c}	1.20^{b}	6.20^{c}
	3.00	7.10^{bc}	2.40^{c}	0.40^{b}	2.30^{c}
	4.00	2.10^{b}	0.40^{d}	0.10^{b}	2.00^{c}
	5.00	0.00^{c}	0.00^{d}	0.00^{b}	0.00^{c}
Vernonia amygdalina	0.00	93.30^{b}	86.30^{a}	48.10^{a}	93.4^{a}
	1.00	24.30^{b}	11.30^{b}	2.50^{b}	20.00^{b}
	2.00	13.60^{b}	5.20^{c}	1.40^{b}	8.20^{c}
	3.00	10.10^{bc}	3.20^{c}	0.70^{b}	4.20^{c}
	4.00	3.20^{c}	1.80^{cd}	0.30^{b}	2.20^{c}
	5.00	1.60^{c}	0.30^{d}	0.01^{b}	1.50^{c}

*Mean followed by common letter(s) are not significantly different at 5% probability level comparison made only vertically

Data collected on % mortality, % weight loss and % punctured grain were transformed using Arc sinc while data collected on number of egg laid and emerging F_1 progeny were transformed using $\log_{10}$ transformation. After transformation, the data obtained were anlysed using anlysis of variance and means were separated using Tukey's procedure. The data were however transformed back to the original state before presentation in Table 1 and 2.

RESULTS

At the end of the 21 DAT significantly range of 73-100% mortality was observed among treated grain as compared with the control of 0% ($p<0.05$). Generally, percentage mortality was dosage dependent as the curculionids mortality increased as dosage increased. The result further revealed 100% mortality of the weevil at 5 g application levels of both leaf powders (Table 1).

Table 2 showed the effect of leaf powders on the ovipositor, F_1 adult emergence, weight loss (%) and punctured grain (%). Staining technique revealed that *S. oryzae* deposited fewer eggs in all the treated than the untreated control, as the treated grain recorded a significantly range of 0-24.3 as against control mean of 93.2% ($p<0.05$). The number of egg laid and adult weevil emergence that developed into F_1 adult decreased with the admixed rate of leaf powders (Table 2). Both treated materials were statistically comparable at various dosage levels. Egg laid and progeny development on the untreated grain was almost without exception. This revealed that the leaf powder has a tremendous reduction effect on adult emergence.

Generally, % weight loss in the treated grain was progressively lower with higher dosage with a range of 0.0-2.5. This range was lower than that of the untreated control (48.5%) (Table 2). *O. gratissimum* appeared to be more effective than the *V. amygdalina* but they were statistically comparable at various dosage levels. Both tested materials were more effective at higher dosage than at lower dosage in terms of reducing weight loss.

The percentage punctured grain observed in the treated grain was in the range of 0-20% and it was more than that of the untreated control (92.8%) (Table 2). *O. gratissimum* at all dosage levels recorded lower weight loss than *V. amygdalina*. There was inverse relationship between dosage level and percentage punctured grain as the dosage level resulted in higher percentage punctured grain. *O. gratissimum* leaf powder applied at 5 g per 20 g grain had the least percentage punctured grain (%) and weight loss (0%).

DISCUSSION

The trial has showed that the leaf powder of *O. gratissimum* and *V. amygdalina* adequately protected rice grain from *S. oryzae*. This is consistent with the previous work of Enobakhare and Law-Ogbomo (2002b) using leaf powders of *O. gratissimum* and *V. amygdalina* to control *S. zeamais* in stored maize grains. The insecticidal effect of the leaf powders is attributed to one or more of the following: fumigation effect, repellency, stomach poison effecting case where the weevils feed on admixed grains, mechanical action, starvation or desiccation (Sharaby, 1988; Dales, 1996).

The leaf powders impaired oviposition as revealed through the number of egg laid observed in the treated grain as compared with the control. The effectiveness of the leaf powders as larvicides was revealed through lower number of F_1 emerging adult than the number of egg laid. The progeny development in the untreated control was without exception, higher than on the treated grains. This illustrates the magnitude of insect multiplication and damage that occur in unprotected seeds. The decrease in F_1 emergence in the treated grains could be resulted from increased adult mortality, ovicidal and larvicidal properties of the tested leaf powders. The ovicidal and larvicidal properties could have arisen from impairing respiration through blockage of spiracle thereby resulting in suffocation (Dales, 1996).

Both tested leaf powders had lower percentage weight loss and punctured grain than the untreated grains. The reduction could be attributed to high adult weevil mortality, reduction in F_1 adult emergence and certain nutritional inhibitors in the leaf powder (Dales, 1996) in the treated grains.

Efficacy of *O. gratissimum* and *V. amygdalina* against *S. zeamais* has been attributed to their toxicity on the adult weevil, oviciddal effects of the leaf powders, reduced oviposition and reduced F_1 progeny development. Observation revealed that weevils can readily be controlled by mixing leaf powder of *O. gratissimum* at 5 g with 20 g of rice grain, because at that dosage level there was complete mortality (100%), no laid, no F_1 adult emergence, no weight.

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