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## Entomocidal effect of a local spicy and fruit peel powders as rice grain protectant against *Sitophilus oryzae* (L.) Coleoptera: Curculionidae

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### Abstract

Entomocidal potentials of plant powders prepared from a local spicy and fruit peel were evaluated under ambient laboratory conditions of  $27\pm 2$  °C and  $75\pm 2\%$  (temperature and relative humidity respectively) against adult rice weevil, *Sitophilus oryzae* on rice grains. Doses at 2.0/20g, 6.0/20g, 10.0/20g and control were applied for assessments of adult mortality. The Mortality of adult *S. oryzae* at 24, 48 and 72hrs after treatment were recorded. All concentrations of *P. guineense* and *C. sinensis* recorded higher mortality than the control. However, there was significance difference only in the highest concentration (10g) of *P. guineense* seed powder and the control ( $P < 0.05$ ) in mortality of adult *S. oryzae*. Also, *P. guineensis* seed caused significantly higher adult mortality of *S. oryzae* in rice grains than *C. sinensis* peel powders. These powders are recommended for the preservation of rice grains.

**Keywords:** Entomocidal, Spicy, Peel, *Sitophilus oryzae*

### 1. Introduction

Food security is a pressing concern; the agricultural sector of the world economy is therefore faced with the task of achieving a production level that ensures adequate food supply to feed the increasing population as well as provides raw materials for the industries. This is particularly so as the energy sector is vigorously pursuing research into the use of grains and root crops as sources of starch for conversion into bio-fuels. Coincidentally, these crops (maize, rice, millet, sorghum, soybeans, cowpeas, sugarcane, and groundnuts) are the staple foods in most parts of the developing countries of the world such as Africa, South America and Asia<sup>[1]</sup>. Insect pests cause heavy economic losses to these stored grains throughout the world and their impacts are more devastating in poor countries<sup>[2]</sup>. In Africa, the rice weevil, *S. oryzae* is a serious pest of stored rice. The efficient control of stored grain pests has long been the aim of entomologists throughout the world<sup>[3]</sup>.

Synthetic chemical pesticides have been used for many years to control stored grain pests<sup>[4, 5]</sup>. However, the potential hazards on mammals from it increased concern by consumers over insecticide residues in processed cereal products, the ecological consequences, increasing cost of application and the precautions necessary to work with traditional chemical insecticides all call for new approaches to control stored-product insect pests<sup>[6, 7, 8, 4, 9]</sup>. In Nigeria, chemical pesticides has been misused leading to several repercussions including acute and chronic poisoning in man, sudden deaths<sup>[10]</sup> and pest resurgence in the ecosystem<sup>[5, 11]</sup>. Furthermore, the development of resistant strains, killing of non target species, pollution of part of the ecosystem, worker's unsafety and increasing costs are recorded as environmental repercussion of abuse and misuse of pesticides<sup>[10, 12]</sup>.

It is therefore imperative to look for alternative organic sources that are readily available, affordable, relatively less poisonous and less detrimental to the environments<sup>[9]</sup>. Plant materials are safe to the environment, users and consumers' alike, inexpensive, repellents and antifeedants<sup>[13, 14]</sup>. Currently, attention is being given to the use of edible plant materials as grain protectants<sup>[15, 16, 17]</sup> and the tropics are well endowed with these plant species, some of which are also used for medicinal purposes<sup>[18]</sup>. The incorporation of plant parts in pest management of stored products has been recommended as it will guarantee user safety and reduce environmental pollution<sup>[19]</sup>. The objective of this study was to assess the efficacy of powders prepared from a local spicy and fruit peel as protectants of rice grains against infestation by *S. oryzae*.

## 2. Materials and Methods

### 2.1 Experimental Site

The present study was carried out in the Department of Botany laboratory of Nnamdi Azikiwe University, Awka during July to August, 2014. Awka is the capital of Anambra State with an estimated population of 301,657 inhabitants as of 2006 Nigeria census. Awka lies within coordinates 6°12'\_N and 7°04'\_E in the tropical zone of Nigeria [20].

### 2.2 Culture of *S. oryzae*

The adult *S. oryzae* used for the experiment were cultured in a plastic vial under ambient laboratory temperature of 27±2°C and 75±2% relative humidity. The infested rice grains were purchased from a local market (Eke Awka) in Awka, Anambra State. The infested rice grains were left in the culture vial measuring 19cm in diameter and were kept in the laboratory cupboard to allow mating by the old insects and subsequent oviposition. The culture vial was left undisturbed till the emergence of adults. The newly emerged adults were used for the experiment.

### 2.3 Preparation of Plant Materials

The fresh orange peels were sourced from Ifite market in Awka while the matured fresh West African black pepper seeds were obtained from Relieve market Onitsha both in Anambra State. The orange peels were air dried while the West African black pepper seeds were sun dried for 7days. The two plant materials were both blended into a powdery form using electric blender. The powder was kept in an air tight container so as to retain the active ingredients and as well to avoid trapping moisture. The powders were kept in a cool dry place until when needed.

### 2.4 Experimental Protocol

The uninfested rice grains were heated in the oven at 100°C for 60 minutes to ward off any stage of insect infestation and dead insects were discarded. 20g of rice grains were measured into each of white transparent plastic containers measuring 12cm in diameter with perforated lids to allow ventilation and prevent entry or escape of insects. The experimental plant powders in the doses of 2g, 6g and 10g were added separately into the containers holding 20g of rice and vigorously shaken to admix thoroughly. The control, where neither of the materials was added was also replicated as in the treatments. Each of the treatments was replicated thrice.

Twenty newly emerged adult *S. oryzae* unsexed were introduced into each of the experimental containers including the control. The experimental set-ups were kept in the laboratory cupboards. The time for the infestation was noted and recorded properly. All treatments were arranged in completely randomized design (C.R.D).

### 2.5 Data Collection and Statistical Analysis

Data generated and recorded from mortality count of adult *S. oryzae* at various exposure periods (24, 48 and 72hrs) and concentrations (2g, 6g, 10g and control) were used to determine the most efficient time and concentrations of the powders. Dead weevils were removed and discarded after every count. Data generated on mortality of the weevils due to efficacy of plant powders were subjected to analysis of variance (ANOVA) using SPSS computer Software package (version 20) at 0.05 significant levels.

## 3. Results

The result shown in Table 1 indicate that the mean mortality of adult *S. oryzae* (2.56±2.74) was recorded higher in the rice

grains treated with the highest concentration (10g) of *P. guineense* seed powder followed by those of 6g concentration (2.00±2.50). However the mean mortality was lowest (0.11±0.33) in the control. This indicates that the mortality of *S. oryzae* varied in a dose dependent manner. The effect of the *P. guineense* powders on adult mortality was significantly ( $P < 0.05$ ) different between the treatments and the control.

Table 1 also indicates that the mean mortality of adult *S. oryzae* was higher in the rice grains treated with 2g and 10g concentration (0.33±0.71) of *C. sinensis* peel powder followed by those of 6g concentration (0.22±0.44). However the mean mortality was lowest (0.11±0.33) in the control. This indicates that the mortality of adult *S. oryzae* does not vary in a dose dependent manner. The effect of the *C. sinensis* powders on adult mortality was not significantly ( $P > 0.05$ ) different between the treatments and the control.

The result presented in Table 2 reveal that the mean mortality of adult *S. oryzae* in rice grains treated with *P. guineense* seed was higher at 72hrs of post treatment (2.92±2.937) followed by 48hrs (0.75±0.754) and lowest at 24hrs after treatment (0.08±0.289), indicating that adult mortality varied in a time dependent manner. The effect of *P. guineense* on mortality of adult *S. oryzae* with time showed significant difference ( $P < 0.05$ ). The result further indicated that the use of *P. guineense* seed powder increased the mortality in adult *S. oryzae* especially at higher exposure period. In contrast, the mean mortality of adult *S. oryzae* in rice grains treated with *C. sinensis* peel powder was higher at 48hrs after treatment (0.50±0.522) followed by 72hrs (0.25±0.622) and lowest at 24hrs after treatment (0.00±0.00). Also, the effect of *C. sinensis* powders on mortality of adult *S. oryzae* with time showed no significant difference at 5% level of significance.

The result of the T-test of significant for the mean mortality of *S. oryzae* in rice grains treated with the two plant powders showed that the t-static value of 2.806 has a P-value of 0.01 which is lower than 5% level of significance ( $P < 0.05$ ). This indicates that *P. guineensis* seed caused significantly higher adult mortality of *S. oryzae* in rice grains than *C. sinensis* peel powders at 72hrs of post treatment.

**Table 1:** Mean Mortality ± SD of Adult *S. oryzae* in Rice Grains Treated with a Local Spicy and Fruit Peel Powders at Various Concentrations

Concentrations	Mean Mortality ± SD of Adult <i>S. oryzae</i> in Rice Grains Treated with Plant Powders	
	<i>Piper guineense</i>	<i>Citrus sinensis</i>
Control	0.11±0.33	0.11±0.33
2.0g	0.33±0.71	0.33±0.71
6.0g	2.00±2.50	0.22±0.44
10.0g	2.56±2.74	0.33±0.50

Significantly different at  $P < 0.05$

**Table 2:** Mean Mortality ± SD of Adult *S. oryzae* in Rice Grains Treated with a Local Spicy and Fruit Peel Powders at Various Time of Exposure

Test powders	Mean Mortality ± SD of Adult <i>S. oryzae</i> in Rice Grains Treated with Plant Powders		
	24hrs	48hrs	72hrs
<i>P. guineense</i>	0.08±0.289	0.75±0.754	2.92±2.937
<i>C. sinensis</i>	0.00±0.000	0.50±0.522	0.25±0.622

Significantly different at  $P < 0.05$

## 4. Discussion

The result of the present study revealed that both powders of *P. guineense* seed and *C. sinensis* peel possess insecticidal

properties as they caused the mortality of adult *S. oryzae* higher than the control at all doses used. This current study supports the findings of Rajapakse, RHS, Parugrug ML, Asawalam, E.F.<sup>[21, 22, 23]</sup> who reported that plant powders of *P. guineense* can be used in suppressing the population of storage pests. Arong GA<sup>[24]</sup>, also reported that *P. guineense* has shown to possess phytochemicals that confer on it significant insect repellent and insecticidal value. Also, Abdullahi YM<sup>[25]</sup> showed that powders of *P. guineense* had pronounced effects on the egg laying capacity and survival of *C. maculatus*, comparable to treatment with Actellic dust. Researchers have reported the use of *C. sinensis* peel powder in the control of stored product insects Dawit KZ, Akunne CE,<sup>[26, 19]</sup> Suleiman M<sup>[27]</sup> reported that peel powder of *C. sinensis* recorded 47.50 - 82.50% adult mortality of *S. zeamais* in treated guinea corn. Akunne CE<sup>[19]</sup> have also reported that orange peel powder caused significant mortality of adult rice weevil. Orange peels contain secondary metabolites that show insecticidal activity against several coleopteran and dipteran Belmain S, Salvatore, A, Shrivastava G<sup>[28, 29, 30]</sup>.

The significantly highest mean mortality of adult *S. oryzae* recorded in the rice grains treated with *P. guineense* seed at the various exposure periods showed that they were more effective in controlling rice weevils than *C. sinensis* peel powder. Similar reports have been given by Akunne CE, Akunne CE *et al.*<sup>[19, 31]</sup>. The variations in the adult mortality in rice grains treated with both test powders at the various times of exposure suggests that time should be considered in pest management. Akunne CE *et al.*<sup>[31]</sup> stated that time is a factor to be considered in the use of plant powders as rice grain protectants.

This study has revealed the use of *P. guineense* seed and *C. sinensis* peel powder as botanical pesticides. The efficacy of the powders was dependent on the concentration and period of exposure. These powders are recommended for the preservation of rice grains by farmers for both planting and consumption. The powders are not detrimental to human health hence are preferable to synthetic pesticides which are toxic to human. Further researches should be carried out on the mixed application of these two plant powders against stored insect pests. The planting of these plants are strongly recommended.

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