Full Length Research Paper

Evaluation of toxicity of *dennitia tripetala* baker f. and *curcuma longa* l. rhizomes against cowpea seed bruchid, *callosobruchus maculatus* (f.) coleoptera: bruchidae

*E. F. Asawalam*¹ and *U. J. Dioka*²

¹,²Plant Health Management Department, Michael Okpara University of Agriculture Umudike, P.M.B.7267 Umuahia, Abia State, Nigeria.

*Corresponding Author's Email: elechiasw@yahoo.com

ABSTRACT

A laboratory study was conducted at Crop Science Laboratory of Michael Okpara University of Agriculture Umudike, Nigeria to determine the toxicity of powders of *Curcuma longa* rhizomes and *Dennitia tripetala* leaf, fruit and bark against the Cowpea seed bruchid, *Callosobruchus maculatus* F. (Coleoptera: Bruchidae) on stored cowpea (*Vigna unguiculata*) seeds. The experimental design was a completely randomized design with four replications. 1g of the different powders was admixed with 50g of IAR 48 Cowpea seeds placed in plastic vials. The effects of the treatments on insect mortality were assessed at 7, 14, 21 and 28 days after treatment. The results showed that plant powders were effective in checking insect infestation by recording significantly higher mortality when compared with the control. *D. tripetala* fruit provided the best protection for stored cowpea by exhibiting a significantly increased mortality (74%) when compared with the other treatments. The result obtained suggest that powders of *C. longa* rhizomes and *D. tripetala* leaf, fruit and bark can be utilized in protecting stored cowpea from *C. maculatus* infestation since they are cheaper than synthetic insecticides and safe for humans.

Keywords: Cowpea, *Callosobruchus maculatus*, *Dennitia tripetala*, *Curcuma longa*, Toxicity

INTRODUCTION

Cowpea, *V. unguiculata* (L) (Walp) is an important leguminous crop, providing plant protein for human and animals (Okosun and Adedire, 2010). It also serves as a basic raw material for the production of cookies, bread, ground beef patties and many other delicacies (Singh, 2001). Its flour is used for making bread and cookies instead of baking flour (Onwueme and Sinha, 1991). In Nigeria, cowpea can be consumed boiled (as porridge) or boiled and eaten with stew. Locally, it can also be ground and processed into flour and used to make many traditional foods: for example, “Akara” (bean balls), “moi-moi” (bean cake) etc (FAO, 2000). When the pods are still green but mature, they are cut and used in cooking delicacies like fried rice or in the making of salad as green vegetable. In Sudan and Ethiopia, its roots are eaten as vegetable. Cowpea is also used in the feeding of livestock as fodder and formulation of feed for livestock. It also serves as cover crop (Onwueme and Sinha, 1991).

Cowpea (*Vigna unguiculata*) is susceptible to attack by *Callosobruchus maculatus* in storage. *C. maculatus* belong to the family Bruchidae. They cause heavy losses in quality and quantity of stored cowpea (Okonkwo and Okoye, 1996). According to Oparaekw et al., (2000) yield losses in cowpea due to insect pests in Nigeria was estimated to be above 80%. *C. maculatus* infestation causes direct damage to cowpea grains causing loss of grains. The larvae bore into the seed and feed on the stored product. Infestation may start in the field and eggs can be laid on maturing pods in the field but as the pods
dry they are likely to be attacked.
Chemical control using fumigants and synthetic insecticides has dominated control strategy against insect pests. The synthetic insecticides are also associated with various ecological problems such as environmental hazards, lethal effect on non target organisms, pest resurgence, pest resistance and mammalian toxicity due to residue persistence (Lajide et al., 2003; Asawalam and Adesiyani, 2001; Epidi et al., 2008; Ewete and Alamu, 1999).

Plant products from species such as Dennitria tripetala, Cucurma longa, Piper guineensis and Azadirachta indica, Ocimum gratissimum, Monodora myristica, Momordica charantia, etc have been reported as alternatives to synthetic insecticides (Adesina et al., 2012; Emeasor et al., 2005; Oparaiche et al., 2002; Ivbijaro, 1990; Olafa and Erhun, 1988; Tripathi et al., 2002; Iloha and Ekrakene, 2006). In recent years, increasing attention has been focused on evaluating their efficacies and identifying the active constituents of these plant materials used in grain protection (Jembere et al., 2000). Ogunwolu et al. (1994) demonstrated the insecticidal activity of powders made from root, bark, fruit, leaf and stem bark of Zanthoxylum zanthoxyloides against C. maculatus. The development of C. maculatus and its damage on cowpea was found to be suppressed by root bark powder of Z. zanthoxyloides.
Neem kernel powder at 5-10g per/100g seed and Eucalyptus leaf powder at 10-20g per 100g seed were effective in the control of C. maculatus on stored cowpea (Lajide et al., 2003). They reported that Uvaria afzelii, Eugenia aromatic and Aframomum melegueta were toxic to C. maculatus at all level of treatment within 24 hours of application. Olaifa and Erhun (1988) reported that 0.02% of Piper guineense oil applied to stored cowpea completely prevented oviposition by adult C. maculatus. The work of Ivbijaro (1990) showed that 2ml/kg cowpea seed caused 100% mortality in adult C. maculatus within 24 hours and prevented the emergence of F1 adults. Oparaiche et al., 2002 reported that Ocimum gratissimum L. at 2.5g, 5.0g and 10.0g/100g cowpea grains effected 46.7%, 46.7% and 65.0% adult bruchid mortality respectively within 24 hours while Hyptis suaveolens Poit at the same dosage rate effected 73.3%, 75.0% and 80% adult bruchid mortality respectively within 48 hours post treatment. Okosun and Adedire (2010) reported that significantly lower number of adults emerged from seeds treated with extracts of African nutmeg seed [Monodora myristica (Gaertn.) Dunal]. Asawalam and Adesiyani (2001) reported the insecticidal potentials of Ocimum basilicum against the maize weevil. Their study revealed that this powder has bioactive components which protected the grain against maize weevil infestation. C. longa and D. tripetala are safe for humans and cheaper than synthetic insecticides.

The objective of this research work was to evaluate the toxicity of powders of C.longa rhizomes and D. tripetala leaf, fruit and bark against the bruchid beetle, C. maculatus.

**MATERIALS AND METHODS**

**Insect Culture**
The insects used to establish a laboratory colony of C. maculatus came from a batch of infested cowpea purchased at Umuahia main market, Nigeria. Beetles were reared subsequently by replacement of devoured and infested cowpea seeds with fresh uninfected cowpea seeds in 3-Litre Plastic vials covered with muslin cloth to allow air circulation and held tightly with rubber band. Insect rearing and the experiment were carried out at ambient temperature of 28 ± 2 °C and relative humidity of 75± 5 %. One-day-old general adult bruchids were obtained by sifting the stock culture a day before the experiment.

**Collections of uninfected cowpea grains and plant materials**
Clean infected IAR 48 cowpea seeds were obtained from Michael Okpara University of Agriculture Umudike Teaching and Research Farm. The leaves, fruits and bark of Dennitria tripetela were locally sourced from Umuahia main market and C. longa rhizomes were obtained from National Root Crop Research, Institute Umudike. These two plant materials were evaluated for insecticidal activity against C. maculatus.

The list of plant materials and parts used are given in Table 1.

**Preparation and application of plant materials**
The plant materials were air-dried for two weeks in a well ventilated place. The powders were prepared by grinding the plant materials using Thomas (model ED-5) milling machine at National Root Crops Research Institute, Umudike. The powders were kept in air-tight jars prior to use (Okonkwo and Okoye, 1996). 1gram of each powder was measured into plastic vials containing 50g of uninfected cowpea seeds and thoroughly mixed by manual agitation of the vial. A control experiment containing no plant powder was also set up. Each treatment was replicated four times in a Completely Randomized Design.

Ten freshly emerged adults of C. maculatus were introduced into the vials and covered with muslin cloth held tightly by the perforated cover of the vial and rubber bands. Mortality counts of the cowpea bruchids were carried out at 7, 14, 21, and 28 days after treatment. Insects were prodded using a blunt dissecting probe as stated by Obeng-ofori et al. (1997) and insects were considered as dead, on failure to respond to three probing.
Table 1. List of plant materials used for the study

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Family</th>
<th>Parts used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dennitria tripetela</td>
<td>fruits and bark</td>
<td>Annonaceae</td>
<td>Leaves, fruits and bark</td>
</tr>
<tr>
<td>Curcuma longa</td>
<td>Turmeric</td>
<td>Zingiberaceae</td>
<td>Rhizome</td>
</tr>
</tbody>
</table>

Figure 1. Mean percentage mortality of *C. maculatus* treated with powders of *C. longa* rhizomes and *D. tripetala* leaf, fruit and bark on stored cowpea seeds

Percentage mortality was assessed using the formula:

\[
\text{Percentage mortality} = \frac{\text{No of dead insects} \times 100}{\text{Total no of insects}}\]

Data on percentage adult weevil mortality were corrected using Abbott's (1925) formula thus:

\[
P_T = \frac{P_o - P_c}{100 - P_c}
\]

Where 
\(P_T\) = Corrected mortality (%) 
\(P_o\) = Observed mortality (%) 
\(P_c\) = Control mortality (%)

Statistical analysis: Data obtained were subjected to analysis of variance procedure and significant means were separated using Fishers' Protected Least Significant Difference at 5% level of probability.

RESULTS AND DISCUSSION

The mean percentage mortality of *C. maculatus* treated with powders of *C. longa* rhizomes and *D. tripetala* leaf, fruit and bark on stored cowpea seeds is presented in Figure 1. The result indicated increase in mortality as the number of days after infestation increased, in all the treatments. The results showed that the plant powders were effective in reducing insect infestation by recording significantly higher mortality when compared with the control. *D. tripetala* fruit provided the best protection for stored cowpea by exhibiting a significantly increased mortality (74%) when compared with the other treatments at 28 days after infestation. *D. tripetala* leaf powder ranked second with mean mortality of 61% followed by *D. tripetala* bark powder (55.25%) while mean mortality of *C. longa* rhizome powder was 52% (at 28 days after treatment). The result obtained revealed that there was no significant difference in the percentage mortality of the *D. tripetala* bark and *C. longa* rhizome powder. The result of this investigation is in agreement with the findings by Okonkwo and Okoye (2002) who reported that *D. tripetala* and *P. guineense* Schum and Thonn essential oil extracts at 5ml/5kg seeds effectively reduced seed damage to 10% and 12.5% compared to 43% and 90% seed damage on cowpea treated with Permethrin dust (2.5 ppm) and untreated control respectively. This result corroborates earlier work by Oparaeke and Dike (1996). Mahdi and Rahman (2008) also found that admixture of 3% of turmeric and cinnamon powder (w/w) with black gram seeds, caused 100% mortality and reduced F1 progeny of *C. maculatus* (F.). The resultant high mortalities of adults *C. maculatus* observed on cowpea seeds treated with the powders could be due to high toxic effect of the product on adult *C. maculatus*. The high mortality rates obtained from the plant materials may be attributed to the bioactive constituents contained
in the utilized powders. This toxicity has been attributed by various authors to the presence of many active ingredients such as Curcumin which is an active constituent in the rhizome of C. longa (Bhardwaj et al., 2011). However, there is need to formulate the essential oil of the powdered turmeric in order to reduce the staining effect on stored cowpea. The result obtained suggest that powders of C. longa rhizomes and D. tripetala leaf, fruit and bark can be utilized in protecting stored cowpea from C. maculatus infestation since they are cheaper and safe for humans.

**REFERENCES**


Adesina JM, Ofolabi LA, Ofuya TI (2012). Evaluation of insecticidal properties of Monodora myristica in reducing oviposition and seed damage by Callosobruchus maculatus (Fab.) Walp J. Agric. Technol. 8(2): 493-499


Okonkwo EU, Okoye WI (1996). The efficacy of four seed powders and the essential oils as protectants of cowpea and maize grains against infestation by Callosobruchus maculatus (Fabricius) (Coleoptera: Bruchidae) and Sitophilus zeamais (Motschulsky) (Coleoptera: Curculionidae) in Nigeria. Int. J. Pest Manage., 42 (3): 143-146.


