Evaluation of the Efficacy of Mixed Leaf Powders of *Vernonia amygdalina* (L.) and *Azadirachta indica* (A. Juss) Against *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae)

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**Abstract.** Plant leaf powders prepared from two plant species, *Vernonia amygdalina* (bitter leaf) and *Azadirachta indica* (neem) were used against adult cowpea weevil, *Callosobruchus maculatus* (Fab.) on cowpea grains. The leaf powders of *Vernonia amygdalina* L. (Va) and *Azadirachta indica* A. Juss (Az) were applied separately and in mixtures in the ratios of Va100%, Az100%, Va50%:Az50%, Va20%:Az80% and Va80%:Az20% respectively. They were evaluated under ambient laboratory conditions (30±3°C and 75±3%). Mortality of adult *C. maculatus* at 24, 48 and 72hrs after treatment were recorded and compared with the control. All concentrations recorded higher mortality than the control except the mixture with the ratio Va20%:Az80%. The powder application at Az100% proportion caused the highest mortality, during the exposure period. It was also significantly (P<0.05) different from the control in adult mortality.

**Key words:** Evaluation, *Vigna unguiculata*, *Vernonia amygdalina*, *Azadirachta indica*, *Callosobruchus maculatus*. 
INTRODUCTION
Cowpea [\textit{Vigna unguiculata} (L.) Walp. (Fab.)], a dietary protein, is a staple food crop of significant economic importance in Nigeria and worldwide (Emeasor \textit{et al.}, 2007; Magloire, 2005). People like vegetable dishes of young cowpea leaves, immature pods, or immature seeds (Emeasor \textit{et al.}, 2007). Cowpea seed pods and leaves are consumed in fresh form as green vegetables in some African countries (Ghaly and Alkoak, 2010), while the rest of the cowpea plant after the pods have been harvested serves as a nutritious fodder for livestock (Abebe \textit{et al.}, 2005) and also a source of cash income (Dugje \textit{et al.}, 2009). The nutritive value of cowpea makes it an extremely important protein source to vegetarian and people who cannot afford animal protein (Adiyemi \textit{et al.}, 2012). It can be referred to “protein source for all” because it is affordable for both the rich and poor citizens.

The production and storage of cowpea have faced so many constraints, throughout West Africa such as diseases and the limited use of fertilizers and irrigation inputs (Brisibe \textit{et al.}, 2011; Raguraman and Singh, 2000) but the major constraints is the insect pest known as \textit{Callosobruchus maculatus} (Musa \textit{et al.}, 2009), which infests it before and after harvest consequently leading to loss of economic value (Baidoo \textit{et al.}, 2005). Infestations on stored grains may reach 50\% within 3-4 months of storage (Oparaek and Dike, (2005). In the bid to control the storage insects of cowpea, chemical insecticides are widely used (Lowenberg-Deboer \textit{et al.}, 2008). In Nigeria, the abuse and misuse of these chemical pesticides have several repercussions one of which is acute and chronic poisoning in man (Akunne and Okonkwo, 2006; others include sudden deaths, blindness, skin irritation and pest resurgence in the ecosystem (Lowenberg-Deboer \textit{et al.}, 2008; Omoloye, 2008). Furthermore, the development of resistant strains, killing of non target species, pollution of part of the ecosystem, toxic residue, worker’s unsafety and increasing costs are recorded as environmental repercussion of abuse and misuse of pesticides (Akunne and Okonkwo, 2006; Ofuya \textit{et al.}, 2008)
Plant materials that are safe, to the environment, users and consumers’ alike, inexpensive, repellents and antifeedants need to be exploited as suitable alternatives to the expensive, toxic and environmentally unsafe synthetic insecticides (Magloire 2005, and Isman, 2006). Mixing of different plant materials with grains for the protection of insect pests is an old practice adopted by farmers, particularly in developing and under developed countries (Yadu et al., 2000). Moreso, researches have shown that botanicals have been extensively used on agricultural pests and to very limited extent on insect pests of stored products (Berger, 2005; Ijeh and Ejike, 2011; Ufele et al., 2013). There have also been some degrees of success and achievements in the use of leaf powders of neem and bitter leaf against insect pests of stored products (Moses and Dorathy; Brisibe et al., 2011). In Nigeria, information about the effects of mixed application of leaf powders against adult *C. maculatus* has been recorded. This work is aimed at determining the efficacy of mixed application of leaf powders of *Vernonia amygdalina* and *Azadirachta indica* against adult *Callosobruchus maculatus*.

**MATERIALS AND METHODS**

**Culture of the Experimental Insect**

The adult *C. maculatus* used for the experiment were cultured in a plastic container under ambient laboratory temperature of 30±3°C and 75±3%. The infested cowpea grains were purchased from Eke Awka market Awka, Anambra State. The infested cowpea grains were left in the culture vial (19cm in diameter) and were kept in the laboratory cupboard so that the old insects will mate and oviposit. This was left undisturbed for two months and the newly emerged adults were used for the experiment.

**Sources and Preparation of Plant Materials**

The matured fresh leaves of *Vernonia amygdalina* were obtained from a farm beside the Zoology laboratory and *Azadirachta indica* from Science village both in Nnamdi Azikiwe University, Awka. The two plant leaves were oven dried under the
temperature of 60°C overnight (Aliero and Abdullahi, 2009). The dried leaves were ground into powder using electric blender (Binatone model) and sieved to obtain fine powders. The plant powders were put in air tight containers separately to ensure that the active ingredients are not lost. The powders were stored in a cool dry place until when needed.

**Experimental Set up**

The infested cowpea grains were heated in the oven at 125°C for 60 minutes to ward off any stage of insect infestation and dead insects were discarded. 30g of cowpea 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. 5g of the experimental leaf powders in the proportions of Va100%, Az100%, Va20%:Az80%, Va80%:Az20% and Va50%:Az50% were added separately into the containers holding 30g of cowpea and vigorously shaken to mix thoroughly. 30g of cowpea grains not treated with plant material were also measured into the same type of container and used as control. Each of the treatments had three replicates.

Twenty newly emerged adult cowpea weevils unsexed were introduced into each of the experimental containers including the control. The 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).

**Data Collection and Statistical Analysis**

Data were generated and recorded from mortality count of adult *C. maculatus* at 24, 48 and 72hrs and were used to determine the most efficient proportions of the powders. Dead weevils were removed and discarded after every count. Data generated on mortality of the weevils due to efficacy of leaf powders were subjected to analysis of variance (ANOVA) using SPSS computer Software package (version 20) at 0.05 significant levels.
RESULTS

The result shown in Table 1 indicates that the mean mortality count of adult *C. maculatus* (4.00±1.41) is higher in the cowpea seeds treated with *A. indica* powder than those of *V. amygdalina* powder (2.67±1.41). However the mean mortality count is lowest (1.89±1.17) in the control. The Analysis of Variance (ANOVA) for the mean mortality count of adult *C. maculatus* on cowpea seeds treated with the two leaf powders used in the experiment and the control indicates that there is significant difference (P-value = 0.04) in the mortality count of adult *C. maculatus* between *A. indica* powder application and the control at 5% level of significance. However no significant difference in the mortality count of adult *C. maculatus* occurred between *A. indica* leaf powder and *V. amygdalina* leaf powder and between *V. amygdalina* leaf powder and the control at 5% level of significance.

The result shown in Table 1 also indicates that the mean mortality count of adult *C. maculatus* is slightly higher in cowpea seeds treated with powder mixture of Va50%:Az50% (2.33±1.12) followed by Va80%:Az20% (1.89±1.45) and Control (1.89±1.17). However it is lower in treatment with Va20%:Az80% mixture (1.78±1.30). Also, no significant difference exists between the mortality count of adult *C. maculatus* in the various powder mixtures at 5% level of significance (P>0.05). This result indicates that the use of *V. amygdalina* and *A. indica* leaf powder mixtures in any proportion does not significantly increase the mortality counts in adult *C. maculatus*. 
Table 1: Mean Mortality Count of C. maculatus on Cowpea Seeds Treated with Leaf Powders of A. indica and V. amygdalina

<table>
<thead>
<tr>
<th>Powder application</th>
<th>Mean mortality count*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Az100%</td>
<td>4.00±1.41</td>
</tr>
<tr>
<td>Va100%</td>
<td>2.67±1.41</td>
</tr>
<tr>
<td>Va20%: Az80%</td>
<td>1.78±1.30</td>
</tr>
<tr>
<td>Va80%: Az20%</td>
<td>1.89±1.45</td>
</tr>
<tr>
<td>Va50%: Az50%</td>
<td>2.33±1.12</td>
</tr>
<tr>
<td>Control</td>
<td>1.89±1.17</td>
</tr>
</tbody>
</table>

*mean ± SD

DISCUSSION

The result of the present study shows that leaf powders of A. indica and V. amygdalina when mixed separately with stored cowpea seeds as pest control agents caused the mortality of adult C. maculatus compared to the control (4.00±1.41; 2.67±1.41; 1.89±1.17). This result agrees with previous studies (Raguraman and Singh (2000); Musa et al. 2009; Moses and Dorathy, 2011) carried out on A. indica and V. amygdalina plants species as a potential botanical pesticides. Raguraman and Singh (2000) reported that neem tree has long been recognized for its pesticidal properties against insect pests. Moses and Dorathy (2011) reported that bitter leaf gave the best protection against cowpea weevil when compared with garlic and ginger. The significant difference (P < 0.05) obtained in the mortality of C. maculatus by comparing the efficacy of A. indica leaf powder with the control is an indication that A. indica leaf powder has some insecticide properties capable of controlling pests of stored cowpea. This study also supports Girish and Shankarah, (2008) who reported that neem tops the list of 2,400 plant species that are reported to have pesticide properties and is regarded as the most reliable source of eco-friendly biopesticide properties. However, no significant difference exists between V. amygdalina and A. indica leaf powder and between V. amygdalina leaf powder and the control. In contrast to the findings of Brisibe et al., (2011) who reported that, of
the three botanical pesticides \((A.\ annua; A.\ indica\ \text{and}\ \textit{O. gratissimum})\) tested, the highest adult insect mortality rate was recorded in the treatment with the highest concentration \((20g/250g\ \text{cowpea seeds})\) of dried and pulverized leaves respectively. They reported that at the concentration of \(5g\) of the tested botanicals, no significant difference existed among them but in the present study, the treatment with the highest concentration of \(5g\) of the leaf powders of \(A.\ indica\) on \(30g\) of cowpea seeds caused a significant difference in the mortality of \(C.\ maculatus\). The implication of this study is that the leaf powders of the two plant species can serve as botanical pesticides with \(A.\ indica\) leaf powder showing more efficacy than the \(V.\ amygdalina\) leaf powder.

This study further shows that moderate mean mortality count of adult \(C.\ maculatus\) was obtained from the cowpea seeds mixed with leaf powders of neem and bitter leaf at equal proportions \((Va50\%:Az50\%\)). However, no significant difference existed between the mortality rates of adult \(C.\ maculatus\) in the various powder mixtures at \(5\%\) probability level of significance. This may be an indication of the low percentage concentration \((Va20\%: Az80\%; Va80\%:Az20\%; Va50\%:Az50\%)\) of leaf powders and also the volume of the containers used during the treatments. This supports the findings of Mundi \textit{et al.}, (2012) who reported that adult mortality of \(C.\ maculatus\) was found to increase with increase in concentration levels of bioinsecticide leaf powders. The efficacy of leaf powders of neem and bitter leaf in the control of adult \textit{Callosobruchus maculatus} was also observed in this study. Cowpea seeds (the poor man’s meat) can be protected with bitter leaf powders and neem leaf powders. It is worthy to note that the concentration of bioinsecticides is a factor to be considered in the control of adult \(C.\ maculatus\). To solve the present food crisis, effort should be geared towards not only producing but saving yields from pest damage.

Since the plant species are cheap and readily available, it is recommended that the leaf powders of these two plants be used in the control of adult \(C.\ maculatus\).
Therefore, further researches are needed to determine the efficacy of the mixed leaf powders of neem and bitter leaf using higher concentrations and on a wide range of other common insect pests of stored products.

References


