Toxicity Effect of *Xylopiaaethiopica* Seed Powder in the Control of Insect Pest of Maize

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**Abstract:** *Xylopiaaethiopica* is a slim, tall, aromatic and evergreen tree belonging to the family Annonaceae. The efficacy of its seed powder in the control of *Sitophiluszeamais* (Maize weevil) was investigated in the Science Laboratory Department of Federal Polytechnic Auchi, Edo State, Nigeria. The seed powder was applied at the rates of 0 (control), 10, 25, 50 and 100 (gkg⁻¹). The results obtained showed that *Xylopiaaethiopica* seed powder at 25gkg⁻¹ - 100gkg⁻¹ were effective in the control of *Sitophiluszeamais* at 0.01% level of significance. The trial revealed very strong insecticidal action of *X. aethiopica* on maize weevil. Furthermore, the efficacy of this insecticidal action on *S. zeamais* increased with increasing concentration of the *X. aethiopica* seed powder with 100gkg⁻¹ giving the highest mortality rate, residual action and egg hatchability of 87.15%, 78% and 0% respectively. This finding is critical to resource poor farmers in developing countries who will find this trial practicable and affordable.

**Keywords:** *Xylopiaaethiopica* seed powder, aromatic, maize weevils (*Sitophiluszeamais*)

1. Introduction

Maize (*Zea mays*) is a staple and most popular food crops of high nutritional value grown and consumed in the entire ecological zone in Nigeria [1] and globally. Presently, maize constitutes a critical component in the food basket of over 60% in the population in West Africa [2].

Insect pest damage to stored grains results in major economic losses in Nigeria and Africa in general where subsistence grain production supports the livelihood of majority of the population. This grain loss caused by storage pest such as maize weevils [3] is a serious issue. Insect pest on stored products reduce the quality, quantity, nutritive value and viability of stored crops, like maize, sorghum, wheat, and rice [4]. [5] reported that these pests and many others, threaten food security. Insect pest especially grain weevil such as *Sitophilus* species causes 25-100% post harvest losses in storage in cereal crops [6]. [7] reported that *Sitophiluszeamais* and *Sitophilusorzea* are the two main species known to attack maize and rice production in Nigeria. Also, their insidious feeding habits are often undetected until damage has occurred. Many farmers in Nigeria record losses resulting from the feeding activities and damage of the maize grain pests; it is essential that necessary control measures are put in place [8, 7].

Insect pest control in stored food product has relied heavily on the use of gaseous fumigants and residual contact insecticides. The implication is a serious problem to health, toxic residues, and environmental hazards. Similarly, this control measure adopted in storage has of recent been criticized because of the difficulties associated with its hazards, procurement, development of pest resistance and pest resurgence problem [9]. Thus, these problems have created the need to find materials that will effectively protect stored grain that are readily available, affordable, relatively less poisonous and less detrimental to the environment. This has stimulated interest by finding alternative control strategies using re-evaluation of traditional botanical pest control agent [10]. Poor farmers in developing countries use different plant materials to protect stored grains against pest infestation by mixing grains with protectants made up of plant products. This idea is supported with the fact that the use of natural plant materials to protect agricultural products against many varieties of insect pests is an old-age practice in some part of the world and Nigeria in general [11].

*Xylopiaaethiopica* is an important plant species which is much in abundance in the rainforest and moist fringe forest vegetation belt of Africa, but largely found in the West, Central and Eastern parts of Africa [12] and have some potential in grain preservation which can be harnessed in the form of powder for use in storage entomology [13, 8]. This achievement will help to increase the scope of maize production and utilization, as well as to meet up with the ever increasing demand for maize products. This trial however aims to determine the efficacy of *Xylopiaaethiopica* seed powder in the control of *Sitophiluszeamais* at varied treatment level and to also determine the residual effect of *Xylopiaaethiopica* seed power in the control of *Sitophiluszeamais* at varied treatment level.

2. Materials and Methods

The experiment was carried out at the Science Laboratory Department of Federal Polytechnic Auchi, Edo State, Nigeria which is located between Latitude 6° 45’ North and longitude 6° 8’ East with a hot humid tropical climate.

**Rearing of Maize weevil**

Adult *Sitophiluszeamais* were obtained from naturally infested maize grains from Auchi market. These were raised in two Kilner jars containing 200g of maize grains capped with muslin cloth and kept at an ambient temperature of 27°C and relative humidity of 75-80%. The muslin cloth allowed for ventilation but precluded entry or exit of bronchids and other insects.

**Plant material**

The fruits of *Xylopiaaethiopica* were collected from Iruekpen, Edo State. The fruits were dried to a constant weight at 60°C...

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**Volume 6 Issue 8, August 2017**

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Paper ID: 21071702

DOI: 10.21275/21071702

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in an oven. The dry material was ground to a very fine powder.

The maize (DMR-yellow) grains obtained from the ADP office at Auchi was used. The maize grains were fumigated for 48 hours and aerated for 7 days, this was to ensure that any developing larva/pupa within the grains was killed, as suggested by [14].

The test material (powder) from the fruit of *Xylopia aethiopica* was admixed with the maize grain at different rates (0, 10, 25, 50 and 100gkg⁻¹). Similarly, twenty maize weevils made up of 10 female and 10 males was introduced into the treated grains and mortality counts taken. Three replicates for each experiment was set up. All treatments were arranged using the completely randomized design. The following parameters were taken:

**Mortality**

For mortality studies, the maize grains were treated with the seed powder at different rates (0, 10, 25, 50 and 100gkg⁻¹) before the introduction of *Sitophilus zeamais*. The jar was covered with a muslin cloth, held in place with a rubber band. Mortality of *Sitophilus zeamais* was determined from daily counts for dead adults for 15 days after which all surviving adults were removed as suggested by [14, 11].

**Reproductive capacity**

Effect of *Xylopia aethiopica* seed powder on the reproductive capacity of adult maize weevil was also investigated 20 days after infestation by treating jars set aside with gentian violet as suggested by [11] to reveal egg plugs of the weevils. Progeny emergence was recorded from 25 days after infestation till 60 days after infestation.

**Residual effect of the test material**

Powder of *Xylopia aethiopica* treated jars was infested with the test weevils 10, 20, 40, 60, 80 and 100 days after application. The 20 weevils made up of 10 males and 10 females used mortality of the test weevils was determined by daily mortality counts. The reproduction of the test weevils was also studied using the methods adopted by [14].

Data collected were subjected to Analysis of Variance (ANOVA) using the GenStat Release 8.1 statistical software and the means separated using Turkey’s Test at 1% level of significance.

### 3. Results

The effect of *Xylopia aethiopica* seed powder on the mortality of *Sitophilus zeamais* is presented in Table 1 below. The result shows that barely 24 hours after infestation, the jar treated with 100gkg⁻¹ recorded the highest mortality value. At 48, 72, 96 and 120 hours after infestation, the trend remained the same with more significant (p<0.01) efficacy recorded with increasing concentration of the seed powder. 25gkg⁻¹-100gkg⁻¹ recorded values were significantly (p<0.01) higher than 0gkg⁻¹-10gmgkg⁻¹ treated seed powder.

<table>
<thead>
<tr>
<th>X. aethiopica powder (gkg⁻¹)</th>
<th>24hrs</th>
<th>48hrs</th>
<th>72hrs</th>
<th>96hrs</th>
<th>120hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>10</td>
<td>4.52a</td>
<td>3.68b</td>
<td>2.10a</td>
<td>1.65a</td>
<td>0.00</td>
</tr>
<tr>
<td>25</td>
<td>6.30a</td>
<td>5.26a</td>
<td>3.00a</td>
<td>1.00a</td>
<td>0.31a</td>
</tr>
<tr>
<td>50</td>
<td>7.12a</td>
<td>6.35a</td>
<td>3.00a</td>
<td>2.52a</td>
<td>1.32b</td>
</tr>
<tr>
<td>100</td>
<td>15.60a</td>
<td>10.30a</td>
<td>9.01a</td>
<td>6.70a</td>
<td>3.10a</td>
</tr>
<tr>
<td>Mean</td>
<td>6.12</td>
<td>4.50</td>
<td>2.67</td>
<td>1.82</td>
<td>0.94</td>
</tr>
<tr>
<td>LSD</td>
<td>1.07</td>
<td>0.87</td>
<td>0.37</td>
<td>0.57</td>
<td>1.12</td>
</tr>
<tr>
<td>CV (%)</td>
<td>9.10</td>
<td>9.01</td>
<td>7.00</td>
<td>2.40</td>
<td>6.34</td>
</tr>
</tbody>
</table>

Means followed by the same letters within a column are not significantly different at 1% level

The data shown in Table 3 below indicates that there is a significant (P<0.01) difference in the treatment means as it affects the life cycle of the maize weevil. The *Xylopia aethiopica* seed powder proved very effective in the control of the eggs plug of the weevils. The number of emergent adults and egg plugs was high in the control (0gkg⁻¹) while 100gkg⁻¹ recorded no progeny. The result shows that *Xylopia aethiopica* powder impaired not only oviposition but also affected the length of the life cycle of the weevils.

<table>
<thead>
<tr>
<th>X. aethiopica powder gkg⁻¹</th>
<th>No of egg plugs</th>
<th>No of emergent adults</th>
<th>Length of the cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>27</td>
<td>24</td>
<td>30.00</td>
</tr>
<tr>
<td>10</td>
<td>18</td>
<td>10</td>
<td>33.20</td>
</tr>
<tr>
<td>25</td>
<td>10</td>
<td>7</td>
<td>34.30</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>1</td>
<td>40.50</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Mean</td>
<td>27.51</td>
<td>3.30</td>
<td></td>
</tr>
</tbody>
</table>

Means followed by the same letters within a column are not significant different at 1% level
4. Discussion

Insecticidal properties of a number of plant extracts have been evaluated against stored product insects [15]. Essential oils from some medicinal and aromatic plants are known to possess bioactive compounds that are either toxic to a number of insects at various stages of growth or elicit antifeedant properties [16]. Xylopiaaethiopica seed powder exhibited insecticidal properties that had a great effect on Sitophiluszeamais. This insecticidal feature from the plant extracts are as a result of the aromatic component or essential oils present in the fruit and seeds. This assertion has been validated by scientist [12]. This aromatic or essential oil is responsible for the insecticidal properties exhibited by the X. aethiopica seed powder against the maize weevil. The insecticidal function of the Xylopiaaethiopica powder are supported by the previous reports that extracts from plant have shown to possess insecticidal properties against insect pest [8, 17, 4]. The powder from the Xylopiaaethiopica showed a significant (P<0.01) effect in the control of the reproductive capacity of Sitophiluszeamais as shown in Table 3. Furthermore, the efficacy of this insecticidal action on S. zeamais increased with increasing concentration of the X. aethiopica seed powder with 100gkg-1 giving the highest mortality rate, residual action and egg hatchability of 87.15%, 78% and 0% respectively. This is in agreement with [5] who noted that five species, Xylopia, aethiopica, Terapleuratetraptera, Alluimsativum, Afromomummeleguata and Piper guineense were significant to maize weevil control. It exhibited an aromatic smell enough to suffocate the maize weevils resulting in residual killing of the weevils over a period of time thus indicating the very strong insecticidal properties of the test specie.

5. Conclusion and Recommendation

The results obtained from this study indicates that using natural plant extract as grain protectants in storage pest management system is very important. The use of this plant extract to control pest are readily available, safe to apply, affordable by our resource poor farmers and not harmful to health. It is however suggested that further trial should be directed towards discovering the active constituent in the test material Xylopiaaethiopica. Its use as an ornamental tree also deserves more attention.

References

[10] T.B. Niber,“The ability of powders and shurries from ten plant species to protect stored grain from attack by Prostephanus truncatus Horn (Colepeterasobruchididae) and Sitophilusoryzea L. (Coleopteracurculionidae)”,Journal Stored Products Resources 30 (4) 297-301, 1994.