Toxicity of Root Powder of *Derris elliptica* for the Control of Kola Weevil, *Balanogastris kolae* in the Stored Kolanut

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Abstract:
The root powder of *Derris elliptica* was used against *Balanogastris kolae* on kola nut. The root powder of *Derris elliptica* was applied at various concentrations of 5g, 10g and 15g. The mortality of adult *B. kolae* at 24, 48, 72, 96 and 120hrs after treatment were recorded and compared with the control. All concentrations recorded higher mortality than the control. The root powder application at the 10g and 15g of the concentrations gave the highest mortality of *Balanogastris kolae* during the exposure period. However, no significant difference exists between the mortality counts of *Balanogastris kolae* in various concentrations of the powder and the control.

**Key words:** Toxicity; Kolanut; *Balanogastris kolae*; *Derris elliptica*. 
INTRODUCTION

The word ‘kola’ is a collective name for the seed of four caffeine-containing evergreen tree species belonging to Sterculiaceae family and the genus Cola. The two species that are of commercial importance include Cola nitida and Cola acuminata which are majorly grown in the forest of Africa particularly in Nigeria and Ghana (Daramola, 1981; Burdock, 2009). The cultivation of kola in Nigeria is ecologically limited to the rain forest zones of the southern part of Nigeria and riverine areas of the savannah region (Adebayo and Oladele, 2012). Kola nut is an important economic cash crop to a significant proportion of Nigerian population who are involved in kola farming, trading and industrial utilization especially in the South eastern region of Nigeria (Asogwa et al., 2012). It is referred to as an orphan crop as most countries outside Africa and even Africans to an extent shy away from its production and improvement (Asogwa et al., 2008).

Kola nut occupies a unique place amongst West Africans where it is widely consumed. In all types of traditional gatherings in these parts, kola nuts are highly esteemed channels of blessings (Adebayo and Oladele, 2012). Kola nut are used in the tropics of West Africa as a religious object and sacred offering during prayers, ancestors’ veneration and significant life events such as naming ceremonies weddings and funerals (Asogwa, 2012, Adebayo and Oladele, 2012). It is highly valued for its perceived medicinal attributes which make it a highly desired product (Adebisi 2004) and are often eaten as snacks especially among the elderly in Nigeria (Odebunmi et al., 2008). The kola nut is valued in many cultures as a sign of friendship and peace and is consumed (“broken”) at reunions, during meetings, ceremonies and festivals. It is also the only stimulant allowed to Muslims (Asogwa, 2012). Its pod husk, which is a by-product from processing the nut, is widely used for animal feeding because of its high nutritive quality (Asogwa et al., 2012).
Economic production of kola nuts had been seriously hampered both in the field and in storage by kola nut weevils the most destructive of all kola pests (Mokwunye et al., 2013, Gabriel and Adedire, 2011). In order to prevent stored kola nuts from the attack of store pests, (weevils), kola nuts farmers and traders use various types of pesticides including banned ones (Asogwa et al., 2008). The applied pesticides in their characteristic nature have the ability to permeate plant cells and remain as residues. Several authors have reported the presence of pesticide residues in various foods, vegetables, soils, sediments and diverse environmental matrices. Kola nuts obtained from the selected markets in the south western Nigeria contained some levels of chlordane and endosulfan as residues while few samples among kola nuts from Ogun and Osun States had herbicide (alachlor) residues in them (Aikpokpodion et al., 2013). 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). 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 repercussions of abuse and misuse of pesticides (Akunne and Okonkwo, 2006; Ofuya et al., 2008).

These side effects of synthetic insecticides have all necessitated the search for alternative control measures against the kola weevils (Anikwe and Ojelade, 2005, Elhag, 2000 and Anikwe et al., 2009). Aikpokpodion et al., (2013) recommended that, alternative insecticides which are safe, biodegradable and environmental friendly should be sought for the purpose of kola preservation. Plant based protectants such as *D. elliptica* has been used in the control of pests and the rotenone isolated from it was introduced in 1850 as a plant insecticide (Weinzierl, 2000; Grdiša and Gršić, 2013). The aim of this research was to evaluate the efficacy of the root powder of *Derris elliptica* in the control of Kola weevil, *Balanogastria kolae*. 

MATERIALS AND METHODS

Study Area
This work was carried out at the Department of Botany Laboratory, Nnamdi Azikiwe University, Awka, Anambra State. 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 (Onyido et al., 2011).

Source and Preparation of the Plant Powder
The roots of *D. elliptica* were harvested from a farm at Ugbene, a town in Awka North Local Government Area of Anambra State. The harvested roots were washed with water to remove sand, chopped into small pieces to allow proper drying. They were dried at room temperature for 7 days to retain the active ingredient. The dried materials were ground into powder in an electric hammer mill. The powder was kept in air tight container to retain the active ingredients and as well to avoid absorbing moisture. The powders were stored in a cool dry place until when needed.

Experimental Set up
The infested kola nuts were heated in the oven at 50°C for 4 hours to rid them of insidious infestation and afterwards left to cool after which dead insects were discarded. 10g of kola nuts 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 root powder in the proportions of 5g, 10g and 15g were added separately into the containers holding 10g of Kolanut and shaken vigorously to admix thoroughly. 10g of Kolanut not treated with plant material were also measured into the same type of container and used as control. Each of the treatments was replicated thrice. Five newly emerged adult kolanut 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 daily mortality count of adult *B. kolae* at 5days, were recorded and used to determine the most effective concentration of the powders. Dead weevils were removed and discarded after every count. Data generated on mortality of the weevils due to efficacy of root 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 10g and 15g of the concentrations of the powder gave the highest mortality of *B. kolae*. The 5g powder concentration and control however gave the lowest mortality count of *B. kolae*. Table 2 below shows that the F-ratio value of 0.285 has a P-value of 0.836 which is greater than 5% level of significance (P>0.05). This indicates that there is no significant difference between the mortality counts of *B. kolae* in various concentrations of the powder. The figure 1 reveals that 10g and 15g of the concentrations of the root powder gave the highest mortality of *B. kolae*. The 5g powder concentration and control however gave the lowest mortality count of *B. kolae* after 5 days of post treatment.
Table 1: Mortality Count of *Balanogastris kolae* treated with *Derris elliptica* root Powder at Various Concentrations

<table>
<thead>
<tr>
<th>Concentrations</th>
<th>Total Mortality</th>
<th>Mean Mortality ± SD*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5g</td>
<td>4.00</td>
<td>0.27±0.46</td>
</tr>
<tr>
<td>10g</td>
<td>5.00</td>
<td>0.33±0.49</td>
</tr>
<tr>
<td>15g</td>
<td>5.00</td>
<td>0.33±0.49</td>
</tr>
<tr>
<td>Control (0g)</td>
<td>3.00</td>
<td>0.20±0.41</td>
</tr>
</tbody>
</table>

*Mean ± SD

**DISCUSSION**

The result of the present study reveals that the root powder of *Derris elliptica* possesses insecticidal properties as the various powder concentrations caused mortality of *B. kolae*. This supports the fact that insecticides of natural origin could serve as an alternative to synthetic insecticides in the control of the kola weevil. Spindor dust (Spinosad 0.125%) a natural origin insecticide obtained from the fermentation of a soil bacterium, *Saccharopolyspora spinosa* has also been reported to cause adult mortality of *B. kolae* and as a potential insecticide that could be used to protect kola nuts in storage (Anikwe *et al.*, 2009). However, the kolanuts treated with 15g and 10g concentrations of the root powder of *Derris elliptica* recorded the highest mortality (0.33) of adult *B. kolae* followed by those of 5g concentration but lowest in the control. Therefore, increase in the concentration of the root powder of *Derris elliptica* in the control of adult kola weevil increases the mortality. Similar results were obtained by (Anikwe *et al.*, 2009) who reported that the efficacy of the dust of Spindor increased with increase in concentration of the powder and incubation period. The morality recorded may be attributed to the contact toxicity of the root powders of *Derris elliptica*. The results also showed that no significant difference
exists between the various powder concentrations and the control. This could be attributed to the low concentrations (15g, 10g and 5g) used. It is evident that kolanut weevil’s especially *B. kolae* are widely distributed across the kola growing belt of Nigeria at varying degree and such infestation normally starts from the filed to store. More so, kola nut is one of the most important cash crops grown in Nigeria for economic, social and traditional uses. It is necessary to protect them from the weevil preferably by the use of botanicals such as *Derris elliptica* which showed insecticidal potentials against *B. kolae*. Taking into consideration the environmental friendliness of *Derris elliptica*, the farmers as well as traders are advised to apply its root powder in admixture with kola nuts in order to prevent them against *B. kolae* attack especially at higher concentrations.
REFERENCES


