The Use of Powder from the Stem Bark of *Scorodophloeus zenkeri* Harms for the Prevention of Damage to Stored Beans by *Acanthoscelides obtectus* Say. (Coleoptera: Bruchidae)

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**Abstract:** Infested and uninfested bean grains were kept in small jute bags (infestation rate 1% and 2%), then mixed with the powder from the stem bark of *Scorodophloeus zenkeri* at the 2, 4 and 6% doses (w/w) and stored for 6 months in order to evaluate the protectant effect of this plant substance against damage to grains by the bean beetle *Acanthoscelides obtectus*. There was a significant treatment effect, the percentage of grain damage increasing with the infestation level. There was a significant negative relationship between the level of grain damage and the treatment dose. The potential for using this tropical plant at the farmer level in long-term storage of bean grain is discussed.

**Key words:** Plant powder, grain damage, bean protection, storage bruchid.

**INTRODUCTION**

The use of synthetic insecticides remains marginal under subsistence farming conditions in Africa, most probably because of the complexity of the technology involved and the wider awareness of their hazardous nature. Medicinal and/or insecticidal plants have since served as alternatives in grain stores at the farmer level\(^1\,^2\,^3\,^4\,^5\), but the heavy toll that insects continue to reap in postharvest storage suggests either that the plant substances are used inappropriately, or that they lack residual effect. In this study, we tested the powder from the stem bark of *Scorodophloeus zenkeri* Harms (Caesalpiniaceae) on bean to determine its most effective use in grain protection against damage by *Acanthoscelides obtectus*, the major storage beetle in Africa\(^6\). Damage is manifested by characteristic circular exit holes chewed out of the grain kernel by emerging adults, a cycle which starts with female beetles laying eggs on grain; the eggs later hatch and the newly eclosed larvae bore into the grains and complete development within by chewing the grain kernel.

**MATERIALS AND METHODS**

This study was conducted in the Haut-Plateau Division (1200-1400 m altitude), Western Province of Cameroon, at the farm site. The test plant, *Scorodophloeus zenkeri*, is a small tree widespread in the dense and humid tropical forest of Central Africa, commonly used in traditional medicine for the treatment of headache, cough, rheumatism and constipation\(^7\). It was selected based primarily on assumption of absence of mammalian toxicity owing to its use as a popular spice in several diets. Its bark was cut into pieces, dried at 40°C for 7 days in an oven (Model Heraeus, type 5060), then ground to powder for mixture with bean grains. The bean grains used in the tests (variety GLP 190, 9-11 % r.h) were supplied by farmers at the experimental site. They were untreated, with no holes and were heated in the oven at 50°C for 10 minutes to insure that no insects lived within.

Experimental procedure: Infested bean grains (collected from *Acanthoscelides obtectus* rearing cages in the laboratory) were added in small jute bags to healthy heat-treated grains to obtain two distinct infestation rates, 1% and 2%. This was achieved by adding 5 and 10 infested grains to 500 heat-treated grains, respectively. Powder of *S. zenkeri* was poured in the bags and mixed with grains at three treatment doses, 2, 4, or 6% (w/w). Lower doses using plant powders had been reported to have no insecticidal activity\(^8\). There were three controls: untreated grains, grains treated with *Capsicum frutescens* at the dose of 2% w/w (natural control) and those treated with

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Poudrox® (malathion 5%, chemical control). There were four replicates per treatment and all bags were tied randomly to the roof inside the stores with a string to prevent rodent attacks. The experiment was repeated once. Bags were opened six months later to assess grain damage. Grains were considered damaged if they had one or more holes. Grains were separated into three categories, namely: A, number of grains with no hole; B, number of grains with one hole; and C, number of grains with more than one hole. Total grain damage was calculated as B + C. In order to assess the severity of the damage, a grain damage index (DI) was computed to give weight to these different damage categories such that: DI = (0.5 X %B) + %C.

**Data analysis:** Data for each treatment were pooled and evaluated with general linear model procedures using SAS Statistical Software Package, after appropriate transformations were carried out on percentage of grain damage to stabilize variances. Mean separation was performed using the SNK test. A regression analysis was performed for the relationship between the level of grain damage and the treatment dose.

**RESULTS AND DISCUSSIONS**

For the two infestation rates (1% and 2%), all treatment doses (2, 4 and 6%) of *S. zenkeri* powder showed a grain protectant effect which was manifested by significantly lower (P<0.05) percentages of damage compared with the damage in untreated (control) bean grains (Table 1). Grain damage at the 4% and 6% treatment doses was comparable (P>0.05), but at a significantly lower level compared with the minimum treatment dose of 2%. Damage at this 2% dose was at a par (P>0.05) with the level of damage recorded with *Capsicum frutescens* (natural control). The lowest percentages of grain damage were recorded with Poudrox®, the chemical control. There was a negative relationship between the level of grain damage and the treatment dose, the treatment dose accounting for 85.95% and 93.24% of the variation in the level of grain damage at the 1% and 2% grain infestation levels (Figure 1). Damage across treatment doses significantly increased with the infestation rate (Figure 2).

The highest treatment dose (6%) had a damage index value which was significantly lower (P<0.05) than the damage index values recorded for the two lower treatment doses (2% and 4%) (Figure 3).

**Table 1:** Grain damage (%) by *Acanthoscelides obtectus* in initially infested beans mixed with powder from the stem bark of *Scorodophloeus zenkeri* after 6 months of storage.

<table>
<thead>
<tr>
<th>Treatment dose (%)</th>
<th>Level of bean infestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>with powder of <em>S. zenkeri</em></td>
<td>1%</td>
</tr>
<tr>
<td>2</td>
<td>19.6±2.7 b</td>
</tr>
<tr>
<td>4</td>
<td>9.3±1.5 c</td>
</tr>
<tr>
<td>6</td>
<td>7.7±1.9 c</td>
</tr>
<tr>
<td>0 (untreated control)</td>
<td>41.5±6.2 a</td>
</tr>
<tr>
<td><em>Capsicum frutescens</em> (natural control)</td>
<td></td>
</tr>
<tr>
<td>Poudrox® (malathion 5%, chemical control)</td>
<td>12.4±2.1 bc</td>
</tr>
</tbody>
</table>

Means (± S.E) in each column followed by the same letters are not significantly different at 5% level (SNK test). Means separation based on arcsine-transformed data.

**Discussion:** Storage of beans is often necessary at the farmer level because production and consumption do not necessarily occur simultaneously. It is our experience that there is always some level of grain infestation by the beetle *Acanthoscelides obtectus* at the time the bean is being stored, which is responsible for the substantial grain losses in case of extended storage[10,11,12]. Therefore, findings in the present study are of paramount importance to the resource-poor farmer since they clearly indicate that lightly infested bean grain (1% and 2%) mixed with powder of *S. zenkeri* in small jute bags at doses greater than 2% (w/w) can be stored without significant damage by
The effectiveness of *S. zenkeri* powder seemed to depend primarily on the treatment dose, although other variables, such as the active compounds of this plant, may be potentially important. Its chemical analysis by Ngono\cite{7} revealed the presence of saponins and tannins; these are antinutritional factors exerting a deterrent activity on insects and disturbing their feeding\cite{13}, which may explain the low grain damage levels recorded in this study with treated grains. The presence also in this plant of phenols which are known to impart negatively on the biological processes of insect pests\cite{16,17,18} gives further credence to the hypothesis of chemical implication in the observed plant powder effectiveness.

A vital consideration in resorting to natural rather than chemical control is the presumably relatively harmless nature of the natural substances used. *S. zenkeri* conforms to this projection as it is a popular spice in many African diets. Based therefore upon this consideration and on the results of this study, we may recommend powder of *S. zenkeri* as a safe, effective and affordable method of bean preservation among low-resource farmers who store small amounts of grains for consumption and planting. A number of grains will inevitably appear with adult emergence holes at the end of the storage period due to initial infestation prior to grain treatment with the powder, but it is our experience that the presence of these holes does not alter the acceptability of grain for food or seed among this category of farmers.

**Acknowledgements:** Funding of this study was by the Pan-Africa Bean Research Alliance (PABRA/CIAT) project.

**REFERENCES**


