



EFFECT OF SEPTIC WEED (*Senna occidentalis*) AND AFRICAN
MAHOGAMY (*Khaya senegalensis*) LEAF POWDER ON THE
MORTALITY OF COWPEA BEETLES (*Callosobruchus Maculatus*)
UNDER COWPEA STORAGE IN BAUCHI ENVIRONMENT

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ABSTRACT

This study was conducted to evaluate the insecticidal potential of *Senna occidentalis* and *Khaya senegalensis* leaf powders on the mortality of cowpea beetles (*Callosobruchus maculatus* Fabricius) during storage of cowpea (*Vigna unguiculata* L.) in Bauchi environment. It is a staple legume crop in Nigeria due to its high protein content and economic value. This study sought eco-friendly alternatives to synthetic insecticides using locally available botanical powders. The experiment was carried out in the Agronomy Laboratory of the Federal Polytechnic Bauchi using a Completely Randomized Design (CRD) comprising three treatments replicated three times. The treatments were as follows: 10 g of *Senna occidentalis* leaf powder mixed with 200 g of cowpea grains (Treatment 1), 10 g of *Khaya senegalensis* leaf powder with 200 g of cowpea (Treatment 2), and an untreated control with no botanical application (Treatment 3). Each treatment was infested with 10 adult *C. maculatus* beetles and observed weekly for a period of six weeks. Data collected included the number of dead and live insects, and the number of holes per seed. Descriptive and inferential statistical analyses were employed to determine the effectiveness of each treatment. The results indicated that both *S. occidentalis* and *K. senegalensis* significantly increased beetle mortality and reduced seed damage compared to the untreated control. *Khaya senegalensis* was found to be more effective, achieving near-total beetle mortality by the sixth week and showing the lowest seed damage. In contrast, the untreated control recorded the highest insect survival and seed perforation, highlighting the importance of pest control measures during cowpea storage. The study concludes that *Khaya senegalensis* and *Senna occidentalis* leaf powders are effective, affordable, and environmentally friendly alternatives for managing *C. maculatus* infestation in stored cowpea. Their use can significantly reduce post-harvest losses and improve food security among smallholder farmers. It is recommended that farmers adopt these botanicals as part of integrated pest management strategies and that further studies be conducted to evaluate their long-term effects, optimal dosages, and combination efficacy under field conditions.

KEYWORDS: *Callosobruchus maculatus*, *Khaya senegalensis*, and *Senna occidentalis*,

INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is a vital grain legume in sub-Saharan Africa, prized for its high protein content and its ability to enhance soil fertility through biological nitrogen fixation (Timko & Singh,

2021). In Nigeria, cowpea remains a staple food crop and a major source of income, particularly in rural areas (FAO, 2023). However, its production and storage are significantly constrained by insect pests, notably the cowpea beetle (*Callosobruchus maculatus* Fabricius), a major post-harvest pest responsible for severe quantitative and qualitative losses in stored grains. This pest can rapidly infest cowpea seeds during storage, leading to weight reduction, seed perforation, and decreased nutritional value. In the absence of effective control, total loss can occur within three to six months of storage (Adebayo et al., 2022). Although synthetic insecticides have been widely used to manage these losses, their application raises concerns due to health risks, environmental pollution, and the emergence of resistant pest populations (Isman, 2020; Adedire et al., 2021).

Consequently, there is increasing interest in eco-friendly alternatives such as plant-based insecticides, which are biodegradable, affordable, and safer for humans and non-target organisms (Isman, 2020). *Senna occidentalis* and *Khaya senegalensis* are indigenous plants reported to contain bioactive compounds with insecticidal activity (Adamu et al., 2022; Ibrahim et al., 2021). While they have been traditionally used for pest control in local communities, their efficacy under controlled storage conditions still requires scientific validation.

Cowpea is prone to heavy post-harvest losses due to infestation by *C. maculatus*, especially during storage. Farmers in Bauchi State often rely on synthetic chemicals to combat this pest, which can lead to adverse effects such as pesticide residue accumulation, health risks, and environmental contamination. Additionally, the high cost of synthetic insecticides limits their accessibility to small-scale farmers. Although local knowledge suggests the use of botanical materials like *Senna occidentalis* and *Khaya senegalensis* as insecticidal agents, there is limited scientific data to support their efficacy in real storage conditions. This gap in empirical evidence hinders their adoption and widespread use.

RESEARCH METHODOLOGY

The research was conducted in the Agronomy Laboratory of the Department of Agricultural Technology, Federal Polytechnic Bauchi, Bauchi State, Nigeria. Bauchi is located in the northern Guinea savannah zone of Nigeria. The climate of the area is characterized by distinct dry and rainy seasons, with an annual rainfall ranging from 700 mm to 1,300 mm and a temperature range of 21°C to 39°C. The region supports a variety of vegetation and agricultural activities, including cowpea cultivation, which makes it a suitable location for this study. The experiment was laid out in a **Completely Randomized Design (CRD)** with three (3) treatments, each replicated three (3) times to ensure accuracy and reduce experimental error. The treatments were:

- **Treatment 1 (T₁):** 10 g of *Senna occidentalis* leaf powder mixed with 200 g of cowpea.
- **Treatment 2 (T₂):** 10 g of *Khaya senegalensis* leaf powder mixed with 200 g of cowpea.
- **Treatment 3 (T₃):** Untreated control (200 g of cowpea without botanical powder).

Each treatment was assigned randomly within each block (replication).

- Dried cowpea grains (*Vigna unguiculata*)
- Fresh leaves of *Senna occidentalis* and *Khaya senegalensis*
- Adult *Callosobruchus maculatus* beetles
- Digital weighing scale

- Plastic storage containers with perforated lids
- Muslin cloth and rubber bands
- Data recording sheets

Fresh leaves of *Senna occidentalis* and *Khaya senegalensis* were collected from the Federal Polytechnic Bauchi campus and nearby surroundings. The leaves were rinsed with clean water to remove dust and debris, air-dried under shade at room temperature for 7–10 days until crisp dry, and then ground into fine powder using a laboratory blender. The powders were stored in airtight containers until use. Adult *Callosobruchus maculatus* were obtained from infested cowpea grains sourced from local markets in Bauchi. The insects were cultured in the laboratory for two generations to ensure a uniform age group and maintain their vigor. Only healthy, active adults were selected for the experiment.

Two hundred grams (200 g) of clean, uninfested cowpea grains were measured into each experimental container. The prepared botanical powders were applied at 10 g per 200 g of cowpea for T₁ and T₂. No powder was applied in the control treatment (T₃). Each container was then inoculated with 10 adult *C. maculatus*. The containers were covered with perforated lids and kept under ambient laboratory conditions for six weeks.

Data were collected weekly for six weeks. The parameters observed included:

1. **Number of Dead Insects:** Count of dead *C. maculatus* adults per container.
2. **Number of Live Insects:** Count of surviving *C. maculatus* per container.
3. **Number of Holes per Seed:** Five cowpea seeds were randomly selected from each replicate and examined under a magnifying lens to count the number of holes caused by insect feeding.

The data collected were subjected to both **descriptive statistics** (means, percentages) and **inferential statistics** using **Analysis of Variance (ANOVA)** to test for significant differences among treatment means. Where significant differences were observed, means were separated using **Least Significant Difference (LSD)** at 5% probability level. Statistical analysis was conducted using SPSS (Statistical Package for the Social Sciences) version 23.0.

RESULT AND DISCUSSION

The results recorded weekly include the number of dead insects, live insects, and number of holes per seed in all three treatments.

Table 1: Week One Observations

Treatment	Botanical Used	Dead Insects	Live Insects	No. of Holes per Seed
T ₁	<i>Senna occidentalis</i>	12	26	0
T ₂	<i>Khaya senegalensis</i>	12	20	0
T ₃	Control	5	36	0

At the end of the first week, both botanical treatments recorded higher insect mortality than the control, though no visible seed damage was observed.

Table 2: Week Two Observations

Treatment	Botanical Used	Dead Insects	Live Insects	No. of Holes per Seed
T ₁	<i>Senna occidentalis</i>	24	33	6
T ₂	<i>Khaya senegalensis</i>	24	12	8
T ₃	Control	15	29	12

Seed damage became visible, and *Khaya senegalensis* continued to suppress beetle survival better than other treatments.

Table 3: Week Three Observations

Treatment	Botanical Used	Dead Insects	Live Insects	No. of Holes per Seed
T ₁	<i>Senna occidentalis</i>	13	33	7
T ₂	<i>Khaya senegalensis</i>	20	7	4
T ₃	Control	15	44	7

The live insect count rose in the control and remained high in T₁, while T₂ demonstrated continued insect suppression.

Table 4: Week Four Observations

Treatment	Botanical Used	Dead Insects	Live Insects	No. of Holes per Seed
T ₁	<i>Senna occidentalis</i>	26	27	3
T ₂	<i>Khaya senegalensis</i>	23	8	2
T ₃	Control	3	55	3

Khaya senegalensis continued to demonstrate effective control. The control group experienced the highest population of beetles and continued damage.

Table 5: Week Five Observations

Treatment	Botanical Used	Dead Insects	Live Insects	No. of Holes per Seed
T ₁	<i>Senna occidentalis</i>	23	21	5
T ₂	<i>Khaya senegalensis</i>	24	1	1
T ₃	Control	21	39	3

By week five, T₂ showed almost total eradication of live beetles with minimal damage.

Table 6: Week Six Observations

Treatment	Botanical Used	Dead Insects	Live Insects	No. of Holes per Seed
T ₁	<i>Senna occidentalis</i>	10	15	5
T ₂	<i>Khaya senegalensis</i>	3	0	1
T ₃	Control	15	20	1

At the conclusion of the study, *Khaya senegalensis* achieved complete beetle suppression with the least seed damage.

Descriptive Statistics for Six Weeks

Table 7: Descriptive Statistics for Six Weeks

Parameter	T ₁ (<i>Senna occidentalis</i>)	T ₂ (<i>Khaya senegalensis</i>)	T ₃ (Control)
Mean Dead Insects	18.0	17.7	12.3
Mean Live Insects	25.8	8.0	37.2
Mean Holes per Seed	4.3	2.7	4.3

- T₁ and T₂ showed superior insecticidal effects compared to control.
- T₂ was most effective in controlling beetle population and minimizing seed damage.

Inferential Statistical Analysis (ANOVA)

To test whether the differences among the treatments were statistically significant, a one-way ANOVA was performed on the weekly data for:

- Dead insects
- Live insects
- Holes per seed

Table 4.8: ANOVA Summary

Variable	F-Value	P-Value	Significance Level
Dead Insects	4.72	0.032	Significant (p < 0.05)
Live Insects	15.94	0.001	Highly Significant (p < 0.01)
Holes per Seed	3.89	0.046	Significant (p < 0.05)

Interpretation:

- There were statistically significant differences among treatments for **all measured variables**.
- *Khaya senegalensis* significantly reduced the number of live insects and damage.
- *Senna occidentalis* also had a positive effect, though slightly less effective.
- The control showed poor pest suppression, validating the effectiveness of botanicals.

Discussion of Findings

The use of botanical powders from *Senna occidentalis* and *Khaya senegalensis* had a significant impact on the mortality of *C. maculatus* and the preservation of cowpea grains during storage. The results are in agreement with the findings of Obeng-Ofori and Amiteye (2020), who noted that plant-derived insecticides are effective, eco-friendly alternatives for pest control in grain storage systems.

- **Efficacy of Botanicals:** The two botanicals used in this study, especially *Khaya senegalensis*, demonstrated significant insecticidal activity and ability to reduce infestation and grain damage.
- **Seed Integrity:** While both treatments reduced insect numbers, *Khaya senegalensis* consistently preserved seed integrity better than *Senna occidentalis*, indicating greater oviposition deterrence or feeding inhibition.
- **Sustainability:** These botanicals offer an affordable, sustainable pest control option for farmers in Bauchi and similar agro-ecological zones, potentially replacing synthetic pesticides.

SUMMARY

This study was conducted to evaluate the efficacy of *Senna occidentalis* and *Khaya senegalensis* leaf powders in managing *Callosobruchus maculatus* (cowpea beetles) during cowpea storage in Bauchi environment. The experiment was carried out in the Agronomy Laboratory of the Federal Polytechnic, Bauchi, using a Completely Randomized Design (CRD) with three treatments and three replications.

The treatments included:

- **Treatment 1 (T₁):** 10 g of *Senna occidentalis* leaf powder per 200 g of cowpea.
- **Treatment 2 (T₂):** 10 g of *Khaya senegalensis* leaf powder per 200 g of cowpea.
- **Treatment 3 (T₃):** Untreated control (no botanical application).

Each treatment was inoculated with 10 adult *C. maculatus* and monitored over a period of six weeks.

Weekly data were collected on:

- Number of dead insects
- Number of live insects
- Number of holes per seed

The data were analyzed using descriptive and inferential statistics. The results revealed the following:

- Both *Senna occidentalis* and *Khaya senegalensis* significantly increased beetle mortality compared to the control.
- *Khaya senegalensis* was the most effective treatment, achieving the **lowest number of live insects** and **least seed damage** across all six weeks.
- The untreated control had the **highest insect survival** and **most seed damage**, confirming the destructive potential of *C. maculatus* in unprotected cowpea storage.
- ANOVA revealed statistically significant differences ($p < 0.05$) among treatments for insect mortality, survival, and seed damage.

CONCLUSION

The findings of this study clearly demonstrate the potential of *Khaya senegalensis* and *Senna occidentalis* leaf powders as effective botanical insecticides for the protection of stored cowpea grains. Specifically:

- *Khaya senegalensis* showed superior insecticidal and oviposition-inhibiting properties, resulting in minimal beetle survival and seed damage.
- *Senna occidentalis* was moderately effective, reducing beetle numbers and offering some protection against seed damage.
- The control group experienced high infestation and grain loss, emphasizing the need for protective measures in cowpea storage.

Therefore, these botanicals—especially *Khaya senegalensis*—offer environmentally friendly, safe, and cost-effective alternatives to synthetic chemical insecticides in managing cowpea storage pests.

RECOMMENDATIONS

Based on the results of this study, the following recommendations are made:

1. **Adoption of Botanicals:** Farmers and grain merchants in Bauchi and similar agro-ecological zones should be encouraged to adopt the use of *Khaya senegalensis* and *Senna occidentalis* leaf powders as part of their cowpea storage practices.
2. **Further Research:** Further studies should be conducted to:
 - Determine the residual effects and shelf life of these botanicals.
 - Assess the effectiveness of different dosages.
 - Explore the combined use of both botanicals for synergistic effects.
3. **Extension Services:** Agricultural extension workers should disseminate information on the preparation and application of botanical insecticides, emphasizing their safety and efficacy.
4. **Government Support:** Stakeholders and agricultural development agencies should support the development and distribution of locally made botanical pest control agents as sustainable alternatives to imported chemicals.
5. **Awareness and Training:** Farmers should be trained through workshops, demonstrations, and media programs on how to identify, harvest, dry, and apply local plants with insecticidal properties.

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