UKR Journal of Agriculture and Veterinary Sciences (UKRJAVS)
Homepage: https://ukrpublisher.com/ukrjavs/
Email: submit.ukrpublisher@gmail.com
Volume 1, Issue 3 (Sept-Oct) 2025
ISSN: 3107-6173 (Online)

Comparative Study of Neem and Eucalyptus Leaf Powders for Protecting Stored Cowpea Against Callosobruchus maculatus

Okeke MaryGeraldine Ebele[1]*, Esieneze Faith Uchechi[2], Ejete Maryrose Ngozi[3]

[1,2,3] Department of Crop Science and Horticulture, Nnamdi Azikiwe University Awka, Anambra State Nigeria

***Corresponding Author**: Okeke MaryGeraldine Ebele

DOI: *https://doi.org/10.5281/zenodo.18616747*

Article History

Original Research Article

Received: 15-01-2026

Accepted: 02-02-2026

Published: 12-02-2026

Citation: Okeke MaryGeraldine Ebele, Esieneze Faith Uchechi, & Ejete Maryrose Ngozi. (2026). Comparative study of neem and eucalyptus leaf powders for protecting stored cowpea against *Callosobruchus maculatus*. *UKR Journal of Agriculture and Veterinary Sciences (UKRJAVS), 1*(3), 37–43.

Abstract

The cowpea weevil, Callosobruchus maculatus (F.) (Coleoptera: Bruchidae), is a major pest of stored cowpea (Vigna unguiculata (L.) Walp.) causing significant quantitative and qualitative losses. Synthetic chemical insecticides are highly effective but raise concerns regarding mammalian toxicity, environmental pollution, and the development of pest resistance. This study evaluated the efficacy of neem leaf powder, eucalyptus leaf powder, and their combination against Callosobruchus maculatus infestation in stored cowpea over a 28-day period, measuring adult mortality and subsequent damage caused by the weevils at four concentration levels (5g, 10g, 15g, and 20g) and a 7-day interval (7, 14, 21, and 28 days after treatment). Analysis of the results revealed that the botanical treatments generally increased weevil mortality and reduced damage compared to the untreated control. At 7 days, the combined Neem + Eucalyptus treatment at 5g achieved the highest mortality (14.33), while Neem at 10g showed the highest overall mortality (14.00) among single treatments. By 28 days, the Neem + Eucalyptus combination consistently showed higher mortality rates (ranging from 0.33 to 2.33) than the single treatments. Conversely, the Neem + Eucalyptus combination was the most effective in reducing damage at 28 days, achieving 0.00 damage at 5g and 15g. Overall, while the individual plant powders, particularly Neem, demonstrated high early mortality, the combination of Neem + Eucalyptus proved superior in minimizing subsequent damage to the stored cowpea, indicating its potential as a highly effective and sustainable integrated pest management strategy against C. maculatus.

Keywords: *Cowpea, Callosobruchus maculatus, Neem leaf powder, Eucalyptus leaf powder, Post-harvest pest management.*

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is a vital grain legume belonging to the Fabaceae family, widely cultivated in tropical and subtropical regions, particularly in sub-Saharan Africa. It serves as a key source of protein for humans and fodder for livestock, contributing to food security and household income (Boukar et al., 2015; Alemu et al., 2016). The crop is well adapted to drought-prone environments, tolerates poor soils, and improves soil fertility through biological nitrogen fixation, making it crucial for smallholder farming systems (Belay et al., 2017). Nutritionally, cowpea seeds are rich in protein (23–32%) and essential amino acids, while other plant parts such as leaves and pods are also consumed in various forms (Pioltelli et al., 2023; Abebe & Alemayehu, 2022).

Despite its importance, cowpea production faces significant challenges, particularly post-harvest losses caused by insect pests. Among these, the cowpea weevil (*Callosobruchus maculatus*) is the most destructive, capable of infesting stored grains and causing losses exceeding 50% if unmanaged (Kedia et al., 2015; Affognon et al., 2015). The larvae burrow into seeds, reducing seed viability, nutritional quality, and market value, thereby threatening household food security.

Conventional management of stored-product pests has relied on synthetic insecticides such as fumigants. While effective, these chemicals pose serious concerns including human health risks, environmental hazards, and the development of pest resistance (Ileke et al., 2020;

Mandudzi & Edziwa, 2016). In response, attention has shifted toward eco-friendly alternatives, particularly botanical insecticides. Plant-based products are biodegradable, less toxic to humans and non-target organisms, often locally available, and culturally acceptable for smallholder farmers (Stevenson et al., 2017; Akinneye & Ogungbite, 2013).

Botanical extracts and powders from plants such as neem (*Azadirachta indica*) and eucalyptus (*Eucalyptus* spp.) have shown potential for controlling stored-product insects due to their insecticidal and repellent properties (Ileke & Adesina, 2018; Musundire et al., 2015). Neem products, for instance, affect insect growth, longevity, and fecundity and have been effective against a wide range of insect pests globally (Dhaliwal et al., 2013). Eucalyptus leaves, rich in essential oils and volatile compounds, have also demonstrated repellent and insecticidal activity (Ojuu et al., 2023). Despite this promise, comparative studies evaluating the efficacy of these botanical powders, individually and in combination, against *C. maculatus* under realistic storage conditions are limited.

Therefore, this study aims to evaluate the insecticidal and grain-protectant effects of neem leaf powder, eucalyptus leaf powder, and their combined mixture against *Callosobruchus maculatus* in stored cowpea seeds. Specifically, the work seeks to identify which botanical treatment offers the most effective protection against seed damage and pest proliferation, providing smallholder farmers with safer, affordable, and environmentally friendly alternatives to synthetic insecticides. The findings are expected to contribute to the development of sustainable post-harvest pest management strategies that enhance food security, maintain grain quality, and reduce reliance on chemical pesticides

Materials and Methods

Experimental Site

The study was conducted in the Teaching and Research Laboratory, Department of Crop Science and Horticulture, Nnamdi Azikiwe University, Ifite Ogwari, Ayamelum LGA, Anambra State, Nigeria (6.6041°N, 6.9057°E; altitude 91 m). The area has an annual rainfall of 1,500–2,000 mm and average temperatures of 25.4–30.6°C during the planting season.

Experimental Design

A 3 × 4 factorial experiment plus control was arranged in a completely randomized design with three replicates, totaling 39 experimental units. Treatments included three botanical types (Neem leaf powder, Eucalyptus leaf powder, and a 1:1 mixture of both) applied at four concentrations (5%, 10%, 15% and 20% of seed weight) to a single cowpea variety, with untreated seeds serving as the control.

Experimental Materials

Cowpea Seeds: Wholesome and infested cowpea seeds were obtained from Eke Awka Market, Anambra State. Infested seeds containing *Callosobruchus maculatus* were stored at room temperature, while undamaged seeds were refrigerated at 4–9°C until use.

Botanical Powders: Fresh leaves of Neem (*Azadirachta indica*) and Eucalyptus (*Eucalyptus globulus*) were collected, air-dried for 10 days, ground to fine powder, and stored in clean, airtight containers. Powder concentrations were prepared based on the weight of cowpea seeds (100 g per treatment) using the formula as adopted from Liamngee et al. (2020)

Powder concentration (g)= (Percentage level ÷ 100) × Weight of grains (g)

Where: Percentage level = 5%,10%,15%, 20%

Weight of cowpea grains = 100g

Using this formula, the following quantities of leaf powder was obtained for each concentration: 5% = 5g

10% = 10g

15% = 15g

20% = 20g

Callosobruchus maculatus Cultures

Laboratory cultures were established by introducing five pairs of adult weevils into containers with 250 g of wholesome cowpea seeds. After 5–7 days, adults were removed, and emerging progeny were collected and held for 24 h to ensure maturity before use in the experiments.

Treatment Application and Storage Assessment

For each treatment, 100 g of wholesome cowpea seeds were mixed with the appropriate amount of botanical powder and placed in separate containers. Five pairs of one-day-old *C. maculatus* adults were introduced per container, which was covered with muslin cloth to prevent insect escape while allowing air circulation. Observations of seed damage and insect development were recorded at 7-day intervals for 28 days.

Data Analysis

Data were subjected to analysis of variance (ANOVA), and means were separated using Fisher's Least Significant Difference (LSD) at 5% probability level.

RESULTS

Table 1: Effect of different concentrations of the plant extracts on Mortality and Damage Caused by C. maculatus 7 days after treatment.

		Mortality		
Treatments	**5g**	**10g**	**15g**	**20g**
Neem	10.00	14.00	11.33	11.33
Eucalyptus	7.00	7.00	9.00	9.67
Neem + Eucalyptus	14.33	8.67	14.33	10.33
Control	5.33	5.33	5.33	5.33
LSD (0.05)	**6.12**	**6.12**	**6.12**	**6.12**
		Damage		
Neem	5.00	5.00	4.67	6.67
Eucalyptus	3.67	4.33	3.33	6.33
Neem + Eucalyptus	5.67	4.67	4.67	6.67
Control	4.00	4.00	4.00	4.00
LSD (0.05)	**2.54**	**2.54**	**2.54**	**2.54**

Table 1 presents the effect of different concentrations (5 g, 10 g, 15 g, and 20 g) of *Azadirachta indica* (Neem), *Eucalyptus globulus* (Eucalyptus), and their combination on the mortality of *Callosobruchus maculatus* and the damage to stored cowpea seeds after 7 days of treatment.

Analysis of variance revealed that the treatments had a **significant effect ($P < 0.05$)** on adult mortality. The mortality observed in all botanical treatments was significantly higher than that of the control (5.33), which reflects natural mortality. Neem powder at 10 g recorded the highest mortality of 14.00, while its 15 g and 20 g concentrations maintained relatively high mortalities (11.33 each), significantly different ($P < 0.05$) from the control. Eucalyptus treatment produced lower mortality, with its peak at 9.67 (20 g), which was statistically lower than neem or the combination at the same concentration. The combined treatment of neem and eucalyptus was most effective overall, producing the highest mortality values of 14.33 at both 5 g and 15 g concentrations. Since these values exceed the LSD (6.12), they are significantly different from the control and from some individual treatments, indicating an additive or possibly synergistic effect of the two botanicals.

With respect to seed damage, the treatments did not show any **statistically significant differences ($P > 0.05$)** compared to the control group. All the observed mean differences in seed damage were below the LSD value of 2.54, indicating non-significance. Neem treatment recorded moderate seed protection, with damage values of 5.00 at both 5 g and 10 g, while eucalyptus treatments consistently produced the lowest mean seed damage, with the least value of 3.33 at 15 g. However, these reductions were not statistically significant at P(0.05). The combination treatment did not perform better than neem alone, as higher damage values were observed (5.67 at 5 g and 6.67 at 20 g). The control group maintained a uniform damage value of 4.00, serving as the baseline.

The results suggest that while the botanical powders, particularly neem and the neem–eucalyptus combination, significantly increased mortality of *C. maculatus* ($P < 0.05$), their effects on seed damage were not statistically significant ($P > 0.05$) within the 7-day evaluation period.

Table 2: Effect of different concentrations of the plant extracts on Mortality and Damage Caused by C.maculatus 14 days after treatment.

		Mortality		
Treatments	**5g**	**10g**	**15g**	**20g**
Neem	7.00	9.00	5.00	5.67
Eucalyptus	7.67	4.33	7.00	8.67
Neem + Eucalyptus	5.33	6.67	8.67	6.00
Control	7.00	7.00	7.00	7.00
LSD (0.05)	**3.77**	**3.77**	**3.77**	**3.77**

		Damage		
Neem	3.00	4.33	2.33	2.33
Eucalyptus	4.67	5.33	4.67	6.33
Neem + Eucalyptus	2.00	3.33	4.33	3.33
Control	5.00	5.00	5.00	5.00
LSD (0.05)	**2.79**	**2.79**	**2.79**	**2.79**

Table 2 shows the effect of different concentrations (5 g, 10 g, 15 g, and 20 g) of *Azadirachta indica* (Neem), *Eucalyptus globulus* (Eucalyptus), and their combination on the mortality of *C. maculatus* and seed damage 14 days after treatment.

Statistical analysis indicated that mortality values across treatments were **not significantly different (P > 0.05)** from the control (7.00), as most observed differences fell below the LSD value of 3.77. Neem treatment recorded its highest mortality at 10 g (9.00), while Eucalyptus reached its peak at 20 g (8.67). The combination treatment produced relatively higher mortality at 15 g (8.67), comparable to the best results of the individual botanicals. Despite these apparent numerical differences, the mortality values did not differ significantly (P > 0.05), suggesting that by Day 14, the insecticidal effects of the treatments were less distinct compared to Day 7.

In terms of seed damage, the treatments demonstrated **statistically significant reductions (P < 0.05)** compared to the control (5.00). Neem reduced seed damage most effectively at 15 g and 20 g (2.33 each), which were significantly lower than the control. Eucalyptus treatment showed less consistency, with damage values ranging from 4.67 at 5 g to as high as 6.33 at 20 g, the latter exceeding the control. The combination treatment was the most effective overall, with damage values consistently below the control across all concentrations, and the lowest recorded at 5 g (2.00). Since these values are lower than the LSD (2.79), they are statistically significant (P < 0.05).

Overall, results at 14 days post-treatment indicate that while differences in mortality among treatments and control were **not statistically significant (P > 0.05)**, the botanical powders—particularly neem and the neem–eucalyptus combination—**significantly reduced seed damage (P < 0.05)**. This suggests that the protective effect of these plant materials is more evident in reducing oviposition and larval penetration into seeds rather than in sustaining adult mortality at later storage periods.

Table 3: Effect of different concentrations of the plant extracts on Mortality and Damage Caused by C.maculatus 21 days after treatment.

		Mortality		
Treatments	**5g**	**10g**	**15g**	**20g**
Neem	4.00	6.00	3.00	5.00
Eucalyptus	4.00	5.67	3.33	3.67
Neem + Eucalyptus	1.33	2.67	3.00	3.00
Control	3.00	3.00	3.00	3.00
LSD(0.05)	**3.58**	**3.58**	**3.58**	**3.58**
		Damage		
Neem	2.00	2.33	2.33	3.00
Eucalyptus	2.33	2.00	2.33	1.00
Neem + Eucalyptus	1.00	1.67	1.00	1.67
Control	1.00	1.00	1.00	1.00
LSD(0.05)	**2.86**	**2.86**	**2.86**	**2.86**

Table 3 presents the effect of different concentrations (5 g, 10 g, 15 g, and 20 g) of *Azadirachta indica* (Neem), *Eucalyptus globulus* (Eucalyptus), and their combination on the mortality of *C. maculatus* and seed damage 21 days after treatment.

Statistical analysis revealed that there were no significant differences ($P > 0.05$) among treatments and the control with respect to adult mortality, since all observed differences were below the LSD value of 3.58. Neem treatment produced the highest numerical mortality of 6.00 at 10 g, followed closely by eucalyptus with 5.67 at 10 g. However, the neem–eucalyptus combination consistently showed the lowest mortality across all concentrations, with a peak of only 2.67 at 10 g, which was not statistically higher than the control (3.00). These findings indicate that by 21 days, the insecticidal effect of the botanicals had declined considerably compared to earlier observation periods.

In contrast, seed damage showed clearer trends. Neem treatments reduced damage to values between 2.00 and 3.00, with the least at 5 g. Eucalyptus treatments also lowered damage effectively, particularly at 20 g (1.00), compared to the control (1.00). The neem–eucalyptus combination demonstrated the best protective effect overall, recording the lowest seed damage values of 1.00 at 5 g and 15 g, and only slightly higher values of 1.67 at 10 g and 20 g. However, statistical comparison showed that none of these reductions were significantly different ($P > 0.05$) from the control, since all observed differences were below the LSD value of 2.86.

Overall, results at 21 days indicate that the plant powders lost much of their insecticidal potency against adult *C. maculatus*, as mortality values were not significantly different from the control ($P > 0.05$). While neem, eucalyptus, and their combination reduced seed damage numerically, these reductions were also not statistically significant ($P > 0.05$), suggesting that the effectiveness of the treatments diminishes with prolonged storage.

Table 4: Effect of different concentrations of the plant extracts on Mortality and Damage Caused by C.maculatus 28 days after treatment.

		Mortality		
Treatments	**5g**	**10g**	**15g**	**20g**
Neem	8.00	7.33	9.00	6.00
Eucalyptus	9.00	8.67	8.00	6.67
Neem + Eucalyptus	0.33	2.33	0.67	1.00
Control	2.00	2.00	2.00	2.00
LSD(0.05)	**3.84**	**3.84**	**3.84**	**3.84**
		Damage		
Neem	8.33	5.67	7.33	6.33
Eucalyptus	7.00	5.67	5.00	5.00
Neem + Eucalyptus	0.00	1.67	0.00	0.00
Control	1.67	1.67	1.67	1.67
LSD(0.05)	**2.81**	**2.81**	**2.81**	**2.81**

Table 4 presents the effect of different concentrations (5 g, 10 g, 15 g, and 20 g) of *Azadirachta indica* (Neem), *Eucalyptus globulus* (Eucalyptus), and their combination on the mortality of *C. maculatus* and seed damage after 28 days of storage.

Analysis of variance showed that treatments had a significant effect ($P < 0.05$) on adult mortality, as differences between treated samples and the control (2.00) exceeded the LSD value of 3.84 in most cases. Neem treatment recorded its highest mortality at 15 g (9.00), followed by 5 g (8.00) and 10 g (7.33), all of which were significantly higher ($P < 0.05$) than the control. Similarly, eucalyptus was highly effective, producing mortality of 9.00 at 5 g and 8.67 at 10 g, also significantly greater than the control. In contrast, the neem–eucalyptus combination consistently recorded the lowest mortality values across concentrations, ranging from 0.33 to 2.33, none of which differed significantly ($P > 0.05$) from the control. These findings indicate that, unlike at earlier storage periods, the combination treatment lost its insecticidal effectiveness by Day 28, while neem and eucalyptus alone maintained significant adulticidal effects.

For seed damage, neem treatments recorded moderate values ranging from 5.67 to 8.33, with the highest damage at 5 g (8.33). Eucalyptus treatments produced comparatively lower damage, ranging from 5.00 to 7.00, with the lowest recorded at 15 g and 20 g (5.00 each). However, the neem–eucalyptus combination provided the strongest protection against seed damage, with extremely low values at all concentrations. Notably, complete suppression of seed damage (0.00) was observed at 5 g, 15 g, and 20 g, while only 1.67 damage was recorded at 10 g. Since these values were consistently lower than both the control (1.67) and the LSD value of 2.81, the reductions are statistically significant ($P < 0.05$).

Overall, results at 28 days post-treatment indicate that neem and eucalyptus individually maintained their insecticidal activity against adult *C. maculatus* ($P < 0.05$), while the combination treatment, though ineffective in causing adult mortality, provided the most significant protection against seed damage ($P < 0.05$). This suggests that the combination may act more as a deterrent or oviposition inhibitor rather than a direct insecticide at later storage periods.

Discussion

The results demonstrate that neem (*Azadirachta indica*) and eucalyptus (*Eucalyptus* spp.) leaf powders have potential as eco-friendly alternatives to synthetic insecticides for managing *Callosobruchus maculatus* in stored cowpea. Mortality and seed damage varied across the storage period, reflecting differences in short-term adulticidal activity and long-term protective effects.

Neem and the neem–eucalyptus combination induced the highest adult mortality in the early storage period, likely due to bioactive compounds such as azadirachtin, which disrupt feeding, growth, and reproduction (Islam, 2009). Although direct mortality declined over time, the powders continued to reduce seed damage, suggesting additional effects through oviposition deterrence or repellency. By 28 days, individual powders regained some adulticidal activity, while the combination was particularly effective in preventing seed damage, achieving complete suppression at several concentrations.

These findings are consistent with previous studies highlighting neem's role in inhibiting oviposition and progeny development, and eucalyptus's insecticidal effects through volatile terpenoids such as 1,8-cineole (Akbar et al., 2024; Ogunmefun et al., 2023; Sanon et al., 2018). Overall, neem provides strong short-term adulticidal effects, eucalyptus maintains longer-term activity, and their combination offers superior protection against seed damage. However, the decline in residual efficacy over time underscores the need for re-application or integration with other storage strategies for sustained control.

Conclusion and Recommendations

This study confirms that neem and eucalyptus leaf powders, particularly when combined, are effective, environmentally friendly alternatives for controlling *C. maculatus* in stored cowpea. The combination treatment consistently reduced seed damage and maintained moderate adult mortality over the storage period, highlighting its potential for sustainable pest management.

Based on these findings, the combined use of neem and eucalyptus powders is recommended as a primary storage treatment for cowpea. This approach offers a low-cost, locally available, and safer alternative to synthetic insecticides, contributing to improved grain protection, food security, and sustainable agricultural practices.

Acknowledgments

The authors sincerely acknowledge the support of the staff of the Department of Crop Science and Horticulture, Nnamdi Azikiwe University, for providing laboratory facilities and technical assistance

References

1. Abebe, B. K., & Alemayehu, M. T. (2022). A review of the nutritional use of cowpea (Vigna unguiculata L. Walp) for human and animal diets. *Journal of Agriculture and Food Research, 10*, Article 100383. https://doi.org/10.1016/j.jafr.2022.100383

2. Affognon, H., Mutungi, C., Sanginga, P., & Borgemeister, C. (2015). Unpacking postharvest losses in sub-Saharan Africa: A meta-analysis. *World Development, 66*, 49–68. https://doi.org/10.1016/j.worlddev.2014.08.002

3. Akinneye, J. O., & Ogungbite, O. C. (2013). Insecticidal activities of some medicinal plants against Sitophilus zeamais (Motschulsky) (Coleoptera: Curculionidae) on stored maize. *Archives of Phytopathology and Plant Protection, 46*(10), 1206–1213. https://doi.org/10.1080/03235408.2013.763614

4. Alemu, M., Asfaw, Z., Woldu, Z., Fenta, B. A., & Medvecky, B. (2016). Cowpea (Vigna unguiculata (L.) Walp.) (Fabaceae) landrace diversity in northern Ethiopia. *International Journal of Biodiversity and Conservation, 8*(11), 297–309. https://doi.org/10.5897/IJBC2016.0946

5. Belay, F., Gebreslasie, A., & Meresa, H. (2017). Agronomic performance evaluation of cowpea (Vigna unguiculata (L.) Walp) varieties in Abergelle District, Northern Ethiopia. *Journal of Plant Breeding and Crop Science, 9*(8), 139–143. https://doi.org/10.5897/JPBCS2017.0640

6. Boukar, O., Fatokun, C. A., Roberts, P. A., Abberton, M., Huynh, B. L., Close, T. J., Ehlers, J. D., & Diop, N. N. (2015). Cowpea. In A. M. De Ron (Ed.), *Grain legumes* (pp. 219–250). Springer. https://doi.org/10.1007/978-1-4939-2797-5_7

7. Dhaliwal, G. S., & Koul, O. (2013). *Bio-pesticides and pest management: Conventional and biotechnological approaches.* Kalyani Publishers.

8. Ileke, K. D., & Adesina, J. M. (2018). Biochemical toxicity of two termicides, Xylopia aethiopica and Piper guineense seeds on termites, Macrotermes subhyalinus Smeathman (Isoptera: Termitidae) on albino rat. *Uttar Pradesh Journal of Zoology, 38*(3), 84–94.

9. Islam, M. (2009). Repellency of two monoterpenoids and neem oil against *Callosobruchus maculatus* (F.). *University Journal of Zoology, Rajshahi University, 28*, 41–44. https://doi.org/10.3329/ujzru.v28i0.5284

10. Kedia, A., Prakash, B., Mishra, P. K., Singh, P., & Dubey, N. K. (2015). Botanicals as eco-friendly biorational alternatives of synthetic pesticides against *Callosobruchus* spp. (Coleoptera: Bruchidae)—A review. *Journal of Food Science and Technology, 52*(3), 1239–1257. https://doi.org/10.1007/s13197-013-1167-8

11. Mandudzi, E., & Edziwa, X. (2016). Eucalyptus leaf powder is effective in maize weevil control. *International Journal of Agriculture and Forestry, 6*(2), 93–98. http://article.sapub.org/10.5923.j.ijaf.20160602.06.html

12. Musundire, R., Mazodze, F., Macheka, L., Mubaiwa, J., & Manditsera, F. (2015). *Eucalyptus grandis* and *Tagetes minuta* leaf powders effectively protect stored maize against *Sitophilus zeamais* without affecting grain organoleptic properties. *African Journal of Agricultural Research, 10*(2), 49–57. https://doi.org/10.5897/AJAR2015.9855