



PHYTOTOXICITY OF NEEM SEED KERNEL EXTRACT AND ITS EFFECTS FOR THE CONTROL OF COWPEA FIELD PESTS IN BAUCHI STATE, NIGERIA

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ABSTRACT

Field trial was conducted during the rainy season of 2024 at Abubakar Tafawa Balewa University, Teaching and Research Farm Bauchi, Gubi campus to investigate the effect of neem seed kernel extract for the control of cowpea insect pests. The treatments consisted of neem seed kernel oil (0.5L/ha, 1L/ha and 1.5L/ha), one cowpea variety obtained from Institute for Agricultural Research, Samaru (Sampea-13), 2%Acetamiprid+1.5%Lamdacyhalothrine EC (1L/ha) and zero application (control). These were combined to give 5 treatments. The result revealed there were significant differences ($p \leq 0.01$) between the insecticides on number of aphids per plant, proportion (%) of plants infested by aphids, number of maruca larva per flower, proportion of flowers infested by the larva, number of damaged pods, number of clavigralla per plants, number and percentage of shriveled pods. cowpea treated with either neem seed kernel (1.5L/ha) or 2.5%Acetamiprid+1.5%Lamdacyhalothrine had the lowest number of aphids per plant, while untreated cowpea plants had the highest proportion of plants infested by aphids as well as number of aphid per plant, followed by neem seed kernel (0.5L/ha). cowpea plants treated with 2.5%Acetamiprid+1.5%Lamdacyhalothrine had the lowest percentage of plants infested by aphids, flowers infested by maruca larva, shriveled pods and number of damaged pods followed by neem seed kernel (1.5L/ha). In yield and yield components of cowpea, plants treated with either neem seed kernel (1.5L/ha) or 2.5%Acetamiprid+1.5%Lamdacyhalothrine had the highest number of seeds per pod and highest grain yield (8933.33kg/ha and 909.17kg/ha). Neem seed kernel extract had significantly impacted cowpea yield and insect pest infestation; therefore, it is recommended to treat cowpea with 1.5L/ha of neem seed kernel for the control of cowpea insect pests and higher yield.

Keywords: Cowpea, Neem, Seed Kernel, Field, Pest

INTRODUCTION

Cowpea (*Vigna unguiculata*) is a leguminous crop that plays a vital role in food security and income generation for millions of people in Africa (Fatokun *et al.*, 2019). It is a rich source of protein, fiber, and other essential nutrients, making it an ideal crop for improving nutrition and health (Singh *et al.*, 2017). Cowpea is also an important crop for sustainable agriculture due to its ability to fix nitrogen, tolerate drought, and resist pests and diseases (Ehlers *et al.*, 2017). Cowpea is native to Africa, where it has been cultivated for over 10,000 years (Singh *et al.*, 2017). It is widely grown in West Africa, particularly in Nigeria, Ghana, and Senegal (Fatokun *et al.*, 2019). Cowpea is a nutrient-rich crop, providing: - High-quality protein (20-25% of dry matter) Fiber (5-7% of dry matter) Minerals (potassium, phosphorus, magnesium) and Vitamins (folate, thiamin, niacin) Cowpea is an important crop for smallholder farmers in Africa, providing income generation through sale of grains and leaves, employment opportunities for rural communities, food security through provision of nutritious grains and leaves.

Neem seed is a natural pesticide that has been used for centuries to control insect pests (Schmutterer, 2018). The seeds contain a compound called azadirachtin, which has insecticidal, repellent, and growth-regulating properties (Kumar *et al.*, 2019). Neem is native to India and Southeast Asia, where it has been used for centuries in traditional medicine and agriculture (Schmutterer, 2018). Neem seed extracts have been shown to be effective against a wide range of insect pests. Azadirachtin, the active compound in neem seed, works by: Disrupting insect hormone systems, inhibiting insect growth and development and repelling insects from treated areas. Cowpea is



susceptible to various insect pests, including: Aphids (*Aphis craccivora*): These small, soft-bodied insects feed on plant sap, causing curled or distorted leaves (Omoigui *et al.*, 2019). Thrips (*Megalurothrips sjostedti*): Thrips are tiny, insects that feed on plant sap, causing stunted growth and distorted leaves (CABI, 2020). Pod borers (*Maruca vitrata*): These caterpillars feed on cowpea pods, causing significant yield losses (Oghiakhe *et al.*, 2019). Flower thrips (*Frankliniella occidentalis*): These thrips feed on cowpea flowers, reducing seed set and yield (Annan *et al.*, 2019).

A number of management techniques are available to control cowpea insect pests. Integrated pest management (IPM) strategies are recommended for managing cowpea insect pests, including: Use of resistant varieties, crop rotation and sanitation, biological control using natural enemies and chemical control using insecticides. Chemical control methods involve using insecticides to control pest populations. However, the use of synthetic insecticides can have negative impacts on human health and the environment. Health problems: Exposure to synthetic insecticides has been linked to various health problems, including cancer, neurological disorders, and reproductive issues (Aktar *et al.*, 2018). Environmental problems: Synthetic insecticides can contaminate soil, water, and air, and can harm non-target organisms, such as bees and butterflies (Potts *et al.*, 2019). Poor resource 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 naturally occurring plant materials to protect agricultural produce against a variety of insect pests is an old-age practice in some parts of the world (Onolemhemen *et al.*, 2011).

MATERIALS AND METHODS

Study Area

The Field experiment was conducted at the Abubakar Tafawa Balewa University Teaching and Research Farm Bauchi. The experiments were carried during the rainy season of 2024

Collection and Preparation of Neem Seed Kernel Extract (*Azadirachta indica*)

Ripened neem fruits were collected and the seeds were separated from the pulp and dried under shade. The kernels were ground into a fine powder.

Extraction Method

The powdered kernels of about 5kg were mixed with about 10L water, and the mixture was stirred and left to steep overnight. The mixture was then filtered, and the resulting liquid was collected as the aqueous neem seed kernel extract.

Treatments and Experimental Design

The treatment consisted of neem seed kernel oil (0.5L/ha, 1L/ha and 1.5L/ha), cowpea variety obtained from Institute for Agricultural Research, Samaru (Sampea-13), 2%Acetamiprid+1.5%Lamdacyhalothrine EC (1L/ha) and zero application (control). These were combined to give 5 treatments, randomized and replicated three times. The experiment was laid out in Randomized Complete Block Design (RCBD).

Land Preparation and Field Layout

The land was cleared, ploughed and then harrowed into fine tilt soil and levelled flat. It was then marked into three blocks each containing ten plots. Each plot measured 9m². A path of 0.5m and 1m was allowed within and between blocks respectively, the boundary of each plot was demarcated by ropes and sticks, tagged with its treatment number. The total area of the land used was 392m². Seeds were sown as per treatment at 25x75cm spacing, two seeds were sown per hole and later thinned to one plant per stand, the land was kept weed free by manual weeding.

Application of Treatments

The neem seed kernel extracts were applied at the rate of 0.5L/ha, 1.0L/ha and 1.5L/ha weekly. The Acetamiprid2%+Lamdacyhalothrine1.5% was applied biweekly according to the manufacturer's instruction at the rate of 1.0L/ha.

Data Collection

Data were collected from 10 randomly picked plants at various stages of the plant growth on the following parameters;



Aphis craccivora

Infestation was assessed in the morning weekly for six weeks for aphid colony. Aphid on each stand was counted visually. Mean for the six weeks was taken and recorded.

Maruca vitrata

Infestation of cowpea flowers by *Maruca* was assessed by counting in the field in the evening. The presence of holes and larva on the flowers were the *Maruca* damage index. Ten flowers from the tagged plants of each plot were chosen randomly, carefully opened and examined on the spot. There were five observations at 5 days' intervals and the mean was taken and recorded.

Clavigralla tomentosicollis

Number of clavigralla were counted weekly, in the morning, at six weeks after sowing. Four observations were made. Number of damaged pods: These were visually scored in the field when the pods were filled, matured but still green. Pod damaged was visually rated. The presence of holes and frass on pods and sticking together of pods were used as *Maruca* damage.

Number of shriveled pods

These were also visually scored in the field when the pods were filled, matured but still green. Pods that were deformed, discoloured and or dried prematurely were counted and were used as *Clavigralla* damage.

Number of pod/plants

Number of pods per plant were counted from the tagged plants and the mean number of pod/plants was recorded.

Number of seed/pods

Number of seeds in each pod of the tagged plants were counted and the mean number of seeds/pods was recorded.

Grain yield(kg/ha)

The data was collected by weighing the grains in each plot after threshing using measuring scale and was calculated in kg and then projected per hectare. Data Analysis: All the data collected were subjected to analysis of variance (ANOVA) to test the level of significant of all the treatment. Duncan's Multiple Range Test (DMRT) was adopted to separate significantly different treatment means

RESULTS AND DISCUSSION

Effect of Neem Seed Kernel Extract on Aphid (*Aphis craccivora*) Infestation

Result on the impact of insecticidal treatments on *Aphis craccivora* infestation in cowpea indicated significant differences ($p \leq 0.01$) in aphid infestation levels across insecticide treatments. Cowpea plots sprayed with 1.5 L/ha neem seed kernel extract or 2.5% Acetamiprid + 1.5% Lambda-cyhalothrin recorded the lowest number of aphids per plant and lowest proportion of plants infested. In contrast, untreated plots had the highest aphid population, followed by those treated with the lowest neem concentration (0.5 L/ha). The efficacy of neem seed kernel extract at 1.5 L/ha against aphids is consistent with studies by Mohammed and Salisu (2020), who reported significant aphid suppression using neem extracts in Bauchi State. Azadirachtin's antifeedant and growth-disrupting properties are known to reduce aphid survival and reproduction (Buba *et al.*, 2022). Although chemical insecticides showed superior control, neem extract remains a viable eco-friendly option, especially at higher doses.



Table 1: Effect of Neem Seed Kernel Extract on Aphid Infestation

TREATMENTS	No. of Aphids/plant	%(proportion) of plants infested by Aphids
INSECTICIDE(L/HA)		
Control	4.92 ^a	34.50 ^a
NSK-0.5	4.50 ^b	18.33 ^b
NSK-1.0	3.33 ^c	6.83 ^{cd}
NSK-1.5	1.75 ^d	3.33 ^d
Chemical-1.0	0.92 ^d	1.42 ^d
LS	**	**
SE±	0.171	1.616

Means followed by different letter within the same column are significantly different using DMRT. LS: Level of Significance, NSK: Neem Seed Kernel Extract, Chemical: 2.5%Acetamiprid+1.5%Lamdacyhalothrine EC, **: Significant at 0.01%

Effect of Neem Seed Kernel Extract on Pod Borer (*Maruca vitrata*) Infestation

Significant differences ($p \leq 0.01$) were observed between insecticide treatments. Pod borer infestation was higher in untreated cowpea, with a greater number of larvae per flower, higher flower damage, and more pod damage. The chemical insecticide (1 L/ha) provided the best control, followed by 1.5 L/ha neem extract. Untreated plants recorded the highest infestation levels. Neem's efficacy in reducing larval numbers corroborates the findings of Ibrahim *et al.* (2023), who reported significant reductions in *Maruca* larval density using neem oil formulations in North-central Nigeria.

Table 2: Effect of Neem Seed Kernel Extract on *M.vitrata* Infestation

TREATMENTS	No. of <i>M.Vitrata</i> larvae per Flower	%(proportion) of flowers infested by larva	No.of damaged pods
INSECTICIDE(L/HA)			
Control	23.92 ^a	68 ^a	4.01 ^a
NSK-0.5	13.75 ^b	42.90 ^b	3.27 ^b
NSK-1.0	4.60 ^c	31.70 ^c	2.83 ^c
NSK-1.5	2.00 ^d	15.00 ^d	2.03 ^d
Chemical-1.0	1.00 ^c	8.70 ^c	1.29 ^c
LS	**	**	**
SE±	0.139	0.737	0.042

Means followed by different letter within the same column are significantly different using DMRT. LS: Level of Significance, NSK: Neem Seed Kernel Extract, Chemical: 2.5%Acetamiprid+1.5%Lamdacyhalothrine EC, **: Significant at 0.01%

Effect of Neem Seed Kernel Extract on Pod Sucking Bug (*Clavigralla tomentosicollis*) Infestation

Result on the effect insecticidal treatment on *Clavigralla tomentosicollis* infestation showed there was significant differences ($p \leq 0.01$) between the treatments. The chemical insecticide (1 L/ha) was most effective in reducing bug infestation, followed by 1.5 L/ha neem extract. The performance of neem at 1.5 L/ha further validates its potential as a botanical insecticide, in line with the results reported by Okonkwo and Umeh (2019), where neem seed oil extract reduced pod damage without harming pollinators. Although chemical insecticides remain the most effective option, the use of high-concentration neem seed kernel extract offers an effective and environmentally sustainable alternative for managing pod bugs, especially for resource-limited farmers.

Table 3: Effect of Neem Seed Kernel Extract on Clavigralla Infestation

TREATMENTS	No. of C. Tomentosicollis per plant	No. of shriveled pods	% proportion of shriveled pods
INSECTICIDE(L/HA)			
Control	4.21 ^a	1.86 ^a	19.86 ^a
NSK-0.5	3.73 ^b	1.43 ^b	11.33 ^b
NSK-1.0	3.35 ^c	1.23 ^c	8.60 ^c
NSK-1.5	2.10 ^d	0.94 ^d	4.92 ^d
Chemical-1.0	1.19 ^e	0.75 ^e	3.60 ^e
LS	**	**	**
SE±	0.033	0.017	0.251

Means followed by different letter within the same column are significantly different using DMRT. LS: Level of Significance, NSK: Neem Seed Kernel Extract, Chemical: 2.5%Acetamiprid+1.5%Lamdacyhalothrine EC, **: Significant at 0.01%

Phytotoxicity of Neem Seed Kernel Extract on Yield and Yield Components of Cowpea

The results revealed that number of pods per plant, number of seeds per pod, grain yield, and pod length were all significantly ($p \leq 0.01$) higher in cowpea treated with 1.5 L/ha neem seed kernel extract or 2.5% Acetamiprid + 1.5% Lambda-cyhalothrin. The observed yield improvement in plots treated with neem seed kernel extract at 1.5 L/ha aligns with the findings of Mohammed *et al.* (2020), who reported that neem extract application significantly enhanced cowpea yield parameters in Bauchi State by minimizing pest damage during critical growth stages.

Table 4: Phytotoxicity of Neem Seed Kernel Extract on Yield and Yield Components of Cowpea

TREATMENTS	No. of pods Per Plant	No. of seeds Per Pod	Pod length(cm)	Grain Yield(kg/ha)
INSECTICIDE(L/HA)				
Control	9.42 ^e	8.83 ^d	13.00 ^d	384.50 ^d
NSK-0.5	12.67 ^d	11.92 ^c	13.75 ^c	533.75 ^c
NSK-1.0	14.92 ^c	12.92 ^b	15.10 ^b	616.67 ^b
NSK-1.5	19.25 ^b	14.67 ^a	16.42 ^a	893.33 ^a
Chemical-1.0	20.75 ^a	15.17 ^a	16.83 ^a	909.17 ^a
LS	**	**	**	**
SE±	0.194	0.236	0.190	10.790

Means followed by different letter within the same column are significantly different using DMRT. LS: Level of Significance, NSK: Neem Seed Kernel Extract, Chemical: 2.5%Acetamiprid+1.5%Lamdacyhalothrine EC, **: Significant at 0.01%

CONCLUSION AND RECOMMENDATION

The findings from this study confirm that Neem seed kernel extract at 1.5 L/ha effectively suppressed major insect pests of cowpea, particularly aphids, *Maruca vitrata*, and *Clavigralla tomentosicollis*, and improved plant performance and yield. Its efficacy was comparable to that of the synthetic insecticide, indicating its potential as a sustainable and eco-friendly alternative for insect pest management in cowpea farming systems. Neem seed kernel extract at 1.5 L/ha is recommended for effective control of key insect pests of cowpea. It provides a viable, environmentally friendly, and cost-effective alternative to synthetic insecticides.

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