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ASSESSMENT OF NEEM (*AZADIRACHTA INDICA*) AND MORINGA (*MORINGA OLEIFERA*) BIO-PESTICIDES IN THE CONTROL OF FIELD INSECT PESTS OF OKRA (*ABELMOSCHUS ESCULENTUS*) IN ILORIN, NIGERIA

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ABSTRACT

A field experiment evaluated the effectiveness of aqueous leaf extracts of neem and moringa against insect pests affecting okra. The study included five treatments: aqueous leaf extracts of neem, moringa, a 1:1 mixture of both, cypermethrin, and a control group. A Randomized Complete Block Design was employed, consisting of three blocks and three replicates. In total, fifteen plots were established, each containing twelve plants, using the okra variety NH47-4. The plots were treated with various extracts to assess their efficacy against field insect pests. The initial spraying took place two weeks after germination, followed by additional applications at ten-day intervals. Insects on the tag plant were sampled, counted, and recorded starting from the seedling stage (four weeks after planting) until harvest. The findings revealed that all aqueous extracts demonstrated a significant reduction in insect pest infestation on okra compared to the control group; however, the aqueous leaf extract of neem exhibited the highest efficacy among the treatments. Farmers are advised to use neem aqueous extract as an eco-friendly and affordable alternative to chemical pesticides for sustainable okra production.

Keywords: Aqueous extracts, Bio-pesticides, Okra, pests, Neem, moringa

INTRODUCTION

Okra (*Abelmoschus esculentus* L.) is a commercially important vegetable crop widely cultivated in Africa and Asia, with major production in India (3.5 million tons), Nigeria (0.73 million tons), Ghana (0.10 million tons), and Egypt (0.08 million tons) (FAOSTAT, 2004; Nwangburuka, 2010; Badaru, 2011). In Nigeria, okra is valued as a nutrient-rich, economically important crop grown across tropical and sub-tropical regions (Ibitoye and Kolawole, 2022). However, its production is constrained by high insect pest infestation, which significantly reduces yield and quality (Echezona et al., 2010). Key pests include Podagrica spp., *Lagria villosa*, *Bemisa tabaci*, *Sylepta derogata*, *Aphis gossypii*, *Anoplocnemis curvipes*, and *Maylabris spp.*, which attack both leaves and fruits (Ofuya et al., 2023, Aderolu et al., 2023 and Ounis et al., 2024). In West Africa, *Podagrica uniforma* and *Podagrica sjostedti* are particularly destructive, causing defoliation and transmitting Okra mosaic virus (Uddin II and Odebiyi, 2011). Sucking insects viz., aphids, whiteflies, leafhoppers, planthoppers and mealybugs, are major sap-feeding insects that cause considerable damage to crop plants (Manobala et al., 2025).

To manage these pests, plant-based insecticides (PBIs) or botanicals pesticidal compounds have been discovered from many plants, including wild plants and herbal medicines Erenso, and Berhe 2016 and Jawalkar, et al., 2016). Botanicals are gaining renewed attention as safer and environmentally friendly alternatives to synthetic chemical insecticides due to their repellency, antifeedant activity, biodegradability, broad-spectrum efficacy, and reduced risk of insect resistance (Echereobia et al., 2010). Among these, Neem (*Azadirachta indica*) is well-documented for its insecticidal properties, including antifeedant, growth-inhibiting, and repellent effects on a wide range of pests. Moringa (*Moringa oleifera*), besides being a nutritious crop, has also been reported to contain bioactive compounds with pesticidal and growth-promoting potential. Considering the need for safer pest management strategies in okra production, this study evaluates the efficacy of aqueous extracts of Neem and Moringa leaves in controlling field insect pests of okra, aiming to identify sustainable alternatives to synthetic insecticides.

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm of the University of Ilorin. Okra variety NH47-4 purchased from the National Institute for Horticultural Research (NIHORT) was used for the study. Mature leaves of *Moringa oleifera* were sourced from a moringa plantation at Tanke, while leaves of *Azadirachta indica* (neem) were obtained from the Teaching and Research Farm and used as botanicals in the study. Mature leaves were specifically selected due to their higher concentrations of bioactive compounds, such as alkaloids, flavonoids, tannins, and phenolics, which are known to confer pesticidal properties. Additionally, mature leaves provide a more consistent chemical composition, ensuring reproducibility of results, and are readily available in sufficient quantities for laboratory processing. In the laboratory, 450 g of fresh mature neem and moringa leaves were ground using a mortar and pestle to prepare extracts for experimental application. The resultant slurry was then soaked in 1 litre of distilled water for 24 hours. After 24 hours, the aqueous mixture was stirred vigorously before it was sieved using a muslin cloth as a sieve using (Nneji et al 2020) method. The resulting aqueous extracts were stored in plastic bottles until use. For the combined treatment, equal volumes of neem and moringa extracts (225 mL each) were mixed to prepare a total of 450 mL of a 1:1 neem–moringa aqueous extract. The single and mixed aqueous extracts derived were then used as insecticides for spraying the okra crop on the field. Spraying start at 2 weeks after germination. It was repeated at a 10-day interval after the first spray for the duration the crop was on the field.

Experimental Design and Plot Layout

The study was carried out using a randomized complete block design. The total land area used measured 16 m x 7.3 m. The land was ploughed and harrowed and then divided into 3 blocks. The blocks were divided into 15 plots with each plot measuring 2 m x 1.1 m separated by a 1 m alleyway. Planting was done on flat beds at 60 cm intra and 30 cm inter-row spacing respectively. 4 seeds were sown per stand and it was later thinned to 2 plants per stand after germination. There were 12 stands per plot. There were five treatments with each treatment replicated thrice. The five treatments used were aqueous neem leaf extract, aqueous moringa leaf extract, mixture of aqueous of neem and moringa leaf in a 1:1 ratio, control and cypermethrin as the standard check.

All stands per plot were sampled for insects and the insects found on the plants were counted and recorded. Counting of the insects was done twice a week from the seedling stage until the crop was harvested from the field. The following data were collected and used to evaluate the efficacy of the treatments; number of insect pests per plant, number of leaves per plant, number of leaves per plant without holes, number of leaves per plant with holes, weight of fresh fruit per plant, number of damaged pods per plant and the number of marketable fresh undamaged pods per plant.

Here's the table with brief descriptions for each formula added below, in a polished manuscript style:

Table 1: Description of Data Collection Parameters

Parameter	Symbol	Formula	Units
Number of insect pests per plant	IP	Count of all insects on a plant	No. of insects/plant
Number of leaves per plant	NL	Count of all leaves on a plant	No. of leaves/plant
Number of leaves without holes	LWH	Count of leaves without damage	No. of leaves/plant
Number of leaves with holes	LWHo	Count of leaves showing pest damage	No. of leaves/plant
Weight of fresh fruit per plant	FW	Sum of fresh fruit weight per plant	g/plant
Number of damaged pods per plant	DP	Count of pods showing visible damage	No. of pods/plant
Number of marketable undamaged pods per plant	MP	Total harvested pods − DP	No. of pods/plant

Descriptions of Formulas

i. ***IP:*** The total insects counted on each plant were recorded to assess pest infestation.
ii. ***NL:*** All leaves per plant were counted to evaluate vegetative growth.
iii. ***LWH:*** The number of leaves without holes was calculated by subtracting the damaged leaves (LWHo) from the total leaves (NL).
iv. ***LWHo:*** Leaves showing visible pest damage (holes) were counted to determine leaf injury.
v. ***FW:*** The fresh weight of all harvested fruits per plant was measured using a digital balance.
vi. ***DP:*** Pods showing visible damage from pests were counted to evaluate fruit injury.
vii. ***MP:*** Marketable undamaged pods were calculated by subtracting damaged pods (DP) from the total harvested pods, indicating the yield suitable for sale.

The data were transformed using square root transformation and then analyzed using Analysis of Variance (ANOVA) and were there were significant differences the means were separated using the Least Significant Difference (LSD). This was done using SPSS (IBM statistic version 21).

RESULTS AND DISCUSSION

The study indicated that aqueous extracts of *Moringa oleifera* (moringa) and *Azadirachta indica* (neem), as well as their combination, were effective control agents against field insect pests affecting okra. All treatments led to a notable reduction in insect pest populations. Among these treatments, the standard check emerged as the most effective, exhibiting the fewest insects, while the control group recorded the highest insect numbers (Table 1). The aqueous neem leaf extract proved to be the most potent botanical treatment, with a statistically significant difference ($P<0.05$) when compared to the aqueous moringa leaf extract (Table 1). Although the mixed application of both extracts was the least effective of the botanical treatments, it still demonstrated significantly better results than the control group (see Table 1).

Insect pest issues are closely tied to population dynamics; a larger number of pests on crops typically results in greater damage. The treatments were successful in reducing insect infestations, leading to a decrease in the number of damaged pods when compared to untreated crops. Overall, the aqueous leaf extract of moringa was more effective than the control in managing field insect pests on okra, though it was not as efficient as the aqueous neem leaf extract. The aqueous extract of neem leaves was the most effective in suppressing insect pests on okra, a result likely due to the bioactive compounds inherent in neem. Kofi, H.W.H., (2024). Neem leaves mainly contain azadirachtin A and B, salannin, and meliantriol, which have insect-repellent properties, as well as nimbin and nimbolide, known for their antiviral activity (Tufail et al., 2025). The pesticidal characteristics of the neem plant, combined with its action as both a systemic and stomach poison, may explain its efficacy in diminishing insect pest populations (Ndor et al., 2012). Furthermore, the chemical properties of neem appear to be more potent than those of the phytochemicals present in moringa leaves, as moringa did not perform as effectively as the aqueous extract of neem. This greater efficacy may be attributed to the higher concentrations of bioactive compounds in neem, such as azadirachtin, nimbin, and salannin, which are water-soluble and known to exhibit strong insecticidal and deterrent effects.

Table 2: Effect of the Botanicals on Insect Population per Plant on Okra

Treatment/Week	4WAP	5WAP	6WAP	7WAP	8WAP
Control	4.4[a]	4.9[a]	5.7[a]	4.8[a]	4.6[a]
ANLE	1.9[d]	1.9[d]	2.2[c]	1.9[c]	1.9[d]
AMLE	2.5[c]	3.1[c]	3.7[b]	3.6[b]	3.3[c]
AN+MLE	3.7[b]	3.8[b]	3.9[b]	3.9[b]	3.8[b]
Cypermethrin	1.6[d]	1.0[e]	1.5[d]	1.2[d]	1.8[d]
S.E	0.2	0.2	0.3	0.1	0.2

Figures followed by the same letter in a column are not significantly different at P<0.05

Key
WAP-Weeks after planting
ANLE-Aqueous neem leaf extract
AMLE-Aqueous moringa leaf extract
AN+MLE-Aqueous neem + moringa leaf extract

This observation was also reflected in the number of leaves per plant that remained free of holes. Cypermethrin achieved the highest count of hole-free leaves per plant from the 4th to the 8th week after planting, showing a significant difference (P<0.05) compared to the aqueous neem leaf extract (see Table 2). Conversely, the control group exhibited the lowest number of hole-free leaves per plant. Notably, the impact of the aqueous neem leaf extract on the number of hole-free leaves was comparable to that of cypermethrin during the 6th to 8th weeks after planting, with no significant difference (P>0.05) observed between the two (see Table 2).

Table 3: Effect of the Botanicals on the Number of Leaves per Plant without Holes

Treatment/Week	4WAP	5WAP	6WAP	7WAP	8WAP
Control	0.5[d]	0.8[c]	0.6[d]	0.5[c]	0.5[d]
ANLE	3.1[b]	2.7[b]	3.3[b]	3.9[ab]	3.9[b]
AMLE	1.9[c]	1.7[bc]	2.1[c]	1.7[bc]	2.1[c]
AN+MLE	1.4[cd]	0.9[c]	0.9[cd]	1.2[c]	1.2[cd]
Cypermethrin	4.4[a]	5.7[a]	6.9[a]	5.7[a]	8.3[a]
S.E.	0.4	0.5	0.5	0.9	0.5

Figures followed by the same letter in a column are not significantly different at P<0.05

Key
WAP-Weeks after planting
ANLE-Aqueous neem leaf extract
AMLE-Aqueous moringa leaf extract
AN+MLE-Aqueous neem + moringa leaf extract

Table 3 shows the effect of different treatments on the number of leaves per plant with holes. Leaf damage increased over time in all treatments, with the control showing the highest number of damaged leaves. Aqueous neem leaf extract (ANLE) and the neem–moringa mixture (AN+MLE) effectively reduced leaf damage, performing similarly to the chemical check (cypermethrin), while moringa leaf extract (AMLE) had a moderate effect. These results indicate that neem-based treatments significantly limited insect feeding compared to the untreated control.

Table 4: Effect of the Botanicals on the Number of Leaves per Plant with Holes

Treatment/Week	4WAP	5WAP	6WAP	7WAP	8WAP
Control	0.8[b]	2.3[bc]	5.3[a]	7.9[a]	10.2[a]
ANLE	0.8[b]	3.5[ab]	3.3[b]	5.0[b]	8.2[b]
AMLE	0.9[b]	3.1[ab]	4.6[ab]	7.2[ab]	9.5[a]
AN+MLE	1.8[a]	2.9[ab]	5.1[a]	7.8[a]	9.8[a]
Cypermethrin	1.7[a]	1.5[c]	3.2[b]	6.7[ab]	7.9[b]
S.E.	0.2	0.4	0.7	1.1	0.4

Figures followed by the same letter in a column are not significantly different at P<0.05

Key
WAP-Weeks after planting
ANLE-Aqueous neem leaf extract
AMLE-Aqueous moringa leaf extract
AN+MLE-Aqueous neem + moringa leaf extract

The yield of a crop is dependent on the abiotic and biotic factors of which insect pests infestation is an important factor which influence the yield negatively. This study showed that the treatments had a positive effect on the yield parameters of okra. Aqueous neem leaf extract had the highest weight (112g) of fruit per plant for the botanicals evaluated, while the mixture was the least effective (47.6g) (Table 4.) The aqueous neem leaf extract was significantly different (P<0.05) from the other botanicals while the control had the least fruit weight (21.8g) amongst the treatments. The control had the highest number of damaged pods per plant (42.2) and this was significantly different (P<0.05) from aqueous neem leaf extract, which had the least number of damaged pods (18) amongst the botanicals evaluated. There was a significant difference (P<0.05) between te treatments (Table 4).

Table 5: Effect of the Botanicals on the Total Number of Damaged Pods Per Plant

Treatment	Total number of damaged pods/plant (g)
Control	42.2[a]
ANLE	18.0[d]
AMLE	27.4[c]
AN+MLE	35.9[b]
Cypermethrin	9.3[e]
S.E.	1.5

Figures followed by the same letter in a column are not significantly different at P<0.05

Key
WAP-Weeks after planting
ANLE-Aqueous neem leaf extract
AMLE-Aqueous moringa leaf extract
AN+MLE-Aqueous neem + moringa leaf extract

Table 6: Effect of the Botanicals on the Total Number of Marketable Fresh Pods Per Plant

Treatment	Total number of marketable fresh pods/plant (g)
Control	5.5[e]
ANLE	20.4[d]
AMLE	14.9[c]
AN+MLE	11.3[b]
Cypermethrin	31.0[a]
S.E.	0.5

Figures followed by the same letter in a column are not significantly different at P<0.05

Key
WAP-Weeks after planting
ANLE-Aqueous neem leaf extract
AMLE-Aqueous moringa leaf extract
AN+MLE-Aqueous neem + moringa leaf extract

Amongst the botanicals evaluated, aqueous neem leaf extract treated crops had the highest number of marketable fresh pods per plant (20.4) and this was significantly different (P<0.05) from the other botanicals while cypermethrin had the highest number of marketable pods per plant and it was significantly different (P<0.05) from aqueous neem leaf extract (Table 5). This is in line with the work of Mochiah et al. (2011), who observed that vegetables in which botanicals were sprayed as aqueous extracts produced the highest mean fruit weight and fruit numbers of okra and eggplant, supporting the results of this study. Eifedeyi and Remison (2010) suggested that this could be due to the high population of flea beetles in the untreated plots, which defoliated a large proportion of the leaf surface, thereby inhibiting cell multiplication, amino acid synthesis, and energy formation, ultimately reducing the photosynthetic capacity of the plants. This could be the reason why the yield obtained from treated crops were higher than that obtained from the untreated crops. This finding is in agreement with Aderolu et al (2012) and Babatunde et al, (2020), who observed that neem leaf extract, modified neem leaf extract and wood ash enhanced the yield of Amaranthus in comparison with the untreated control. All the botanicals were successfully used as protectants against insect pests of okra in the field with aqueous neem leaf extract being the most promising botanical, which resulted in reduced number of damaged pods and a reduction in the number of holes on the leaves which resulted in an increase in the weight of harvested pods. This aligns with the findings of Babatunde et al. (2021), who reported that ethanol extracts of *Sida acuta* and *Chromolaena odorata* performed comparably to the synthetic insecticide cypermethrin in controlling target insect pests. Their study further emphasized that such botanicals, being readily available, environmentally safe, and easy to prepare, can serve as effective alternatives to imported chemical insecticides and should be integrated into pest management programs

CONCLUSION

The findings of this study demonstrate that aqueous leaf extracts of neem (Azadirachta indica) and moringa (Moringa oleifera) can effectively reduce insect pest infestation and enhance the yield of okra (Abelmoschus esculentus L.). Among the botanicals tested, aqueous neem leaf extract (ANLE) showed the highest efficacy, producing a substantial increase in the total number of marketable pods per plant compared to the control, although slightly lower than the synthetic insecticide, cypermethrin. Given its effectiveness, environmental safety, and accessibility, ANLE presents a viable and sustainable alternative to synthetic insecticides for okra pest management. Therefore, farmers can adopt aqueous neem leaf extract as an eco-friendly substitute for chemical control, promoting safer food production while reducing reliance on synthetic pesticides.

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