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**Ogbinaka EJA**
Department of Agronomy, Delta State University, Abraka, Nigeria

**Edema IO**
Department of Agronomy, Delta State University, Abraka, Nigeria

**Ehijie OH**
Department of Agronomy, Delta State University of Science and Technology, Ozoro, Nigeria

**Onakpoma SO**
Department of Agronomy, Delta State University, Abraka, Nigeria

**Corresponding Author:**
**Ogbinaka EJA**
Department of Agronomy, Delta State University, Abraka, Nigeria

# Evaluation of neem products for their efficacy in the management of some major insect pests associated with cowpea in Asaba Delta State, Nigeria

**Ogbinaka EJA, Edema IO, Ehijie OH and Onakpoma SO**

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**Abstract**
The effects of Neem extracts; Neem seed kernel extract (NSKE), Neem leaf extract (NLE), Neem stem bark extract (NSBE) at 0, 5, 10 and 15% concentrations were investigated on *Ootheca mutabilis, Aspervia armigera, Clavigralla tomentosicollis and Coptosoma stali,* all cowpea insect pests in Asaba area Delta State. The specific objective of the study was to evaluate the efficacy of selected neem extracts for insect pest management in cowpea production in the area. The treatments; NSKE, NLE, NSBE and untreated check were replicated three times using a randomized complete block design (RCBD). The results obtained indicated that neem extract had some insecticidal properties which showed positive control on some major insect pests and significantly influenced pest population associated with the crop. The study showed that 10% NSBE concentration was more effective for the management of *Ootheca mutabilis, Aspervia armigera* and *Clavigralla tomentosicollis* amongst the various levels of neem extracts tested in two years cropping seasons (2021 and 2022). Based on the findings from the study, 10% concentration of NSBE is recommended to farmers for mitigating insect pest damage on cowpea in the study area.

**Keywords:** Neem extracts, insect pests, cowpea, damage, pest management

## Introduction
Cowpea (*Vigna unguiculata* (L) Walp.) is a common legume of the family Fabaceae. Its subfamily is Faboideae. It plays a key role in Nigeria because it constitutes a significant proportion of the total dietary proteining and energy intake of Nigerians [1]. In some parts of the world legumes serve as alternates to animal proteins especially where there is paucity of animal proteins due to socioeconomic constraints [2].

Cowpea is commonly called 'Beans' [3] and it is the largest sole contributor of protein intake of many rural and urban families in Nigeria [1]. In Nigeria, it is consumed in many forms; cooked as porridge in some Nigerian foods [4], as well as fried bean cake called *akara* and as powder form it is used for *moin-moin* [5, 6].

The crop is mostly grown in the sudan zone in the extreme northern parts of Nigeria, but with recent high level of insecurity in the Northern parts of Nigeria, farmers in the south are beginning to develop interest in large scale production of most crops produced mainly by northern farmers over the past years. Soils in the southern parts are rich in nutrients and also good to sustain production of the crop [7].

Cowpea requires predominantly sandy to predominantly clay acidic to base (pH 4.5 -8.0) soils [8]. It can also be cultivated all year round [9].

This valuable crop is plagued by many insect pests which are known for drastically reducing crop yield [10, 11]. The volume of insect pests associated with the crop can cause total yield loss [9, 12]. Farmer's dependence on conventional insecticides over the years to ensure sustained production and good yield has become a concern due to the continuous findings on the impact of these insecticides to the environment and man. The use of such insecticides is being discourages because of their rapidity in decimating pest species in high population (both beneficial and non beneficial) and they are also becoming more expensive to extent most farmers can no longer afford them [13].

Beyond the use of these conventional insecticides there is an increasing world-wide outcry against the heavy usage of synthetic agro chemicals and a new order is focused on the use of botanicals to reduce cost of production, safeguard production and to protect animals and humans lives. The use of neem products in controlling many insect pests of cowpea and other crops has been effective in current researches carried in some localities in Nigeria [12, 14].

It is against this background that this research was conducted to explore effective, affordable ways of controlling insect pests of cowpea with little or no side effects and environmentally capable means to boost cowpea production in the southern parts of Nigeria. The objective of this study was aimed at evaluating the efficacy of selected neem extracts namely; Neem seed kernel extract (NSKE), Neem leaf extract (NLE), Neem stem bark extract (NSBE) for insect pest management of cowpea in Asaba, Delta State.

## Materials and Methods

The experiment was conducted at the teaching and research farm of the Department of Agronomy, Faculty of Agriculture, Delta State University, Asaba Campus, Abraka. The location lies within latitude $06^0 14^{'}$N and Longitude $06^0$ $49^{'}$E of the equator. A tropical zone characterized by 7-8 months of rains between April and November, punctuated by a short dry spell in August. The mean annual rainfall in the area is 1900mm (Ministry of Aviation, Asaba).

### Experiment site and Design

A total land area measuring 31.6m X 14m was used for the experiment. A fallowed land that has been left uncultivated for over five years was cleared and thrashes removed before tilling. A randomized complete block design (RCBD) layout was used for the study. The land was divided into three replicates, each replicates contained 10 plots measured 2.4m X 2.4m and there were 30 sub plots in all. The plots were separated from each other by 1m strip of land. Two factors were measured, three neem extracts Neem seed kernel extract (NSKE), Neem leaf extract (NLE), Neem stem bark extract (NSBE) and four concentration levels 0%, 5%, 10% and 15%.

### Sources of Materials

Cowpea variety, IT84S-2246-4 whose growth is determinate (erect) and matures within 60 days was sourced from IITA Ibadan for the experiment. The neem materials (Neem seed leaf and bark) used for preparing neem extracts (Neem seed kernel extract (NSKE), Neem leaf extract (NLE), Neem stem bark extract (NSBE) were collected from neem trees at the Delta State Secretariat premises in Asaba. A Knapsack Sprayer, measuring tape, cutlasses, spade and other needed materials were purchased from local shops and used for the experiment.

### Preparation of Neem Extracts

Neem seed kernel extracts (NSKE)

NSKE was prepared using methods reported by [15]. Ripe seeds from neem tree, *Azadirachta indica* (A) Juss, (family *Meliaceae*) were collected, washed with water and sun dried. The dried fruits were cracked to obtain the seed and were ground into powder.

### Five percent (5%) NSKE was prepared as follows

Half kilogram (1/2kg) of ground neem seed was soaked in 10 litres of cold water. The solution was stirred and filtered thoroughly through a clean muslin cloth after 24 hours. 20g cold water starch and 0.5 ml liquid soap were later added as sticker and emulsifier respectively.

### Ten percent (10%) NSKE was prepared as follows

One kilogram (1kg) of ground neem seed powder was soaked in 10 litres of cold water solution of 10% litres of cold water solution of 10% NSKE was prepared as explained in (1) above.

### Fifteen percent (15%) NSKE was prepared as follows

One and half kilogram (11/2kg) of ground neem seed powder was soaked in 10 litres of cold water. Solution of 15% NSKE was also prepared as explained in (1) above.

Neem leaf extract (NLE) and Neem stem bark extract (NSBE);

A good quantity of neem leaves and neem stem bank were harvested and dried at room temperature in the laboratory. They were ground into powder form by a mechanical grader, measures of 1/2kg, 1kg and 11/2kg which gave concentrations of 5%, 10%, and 15% aqueous solution of NLE and NSBE were prepared as described in (1) above for NSKE.

### Planting procedure

A sub-plot was marked out into 4 rows and each row contains 6 stands. Each stand was planted with 3 seeds of cowpea at a spacing of 60cm between rows and 30cm along row. Supply of failed stands was done 7 days after sowing (DAS). While thinning of seedling to the one plant per stand was done at 10days after plant emergence (DAE) to give a plant population of 55,556 plants per hectare. A sub plot had 32 plants out of which 8 stands in the middle were selected as sampled stands for data collection.

### Application of treatments

Treatment application commenced 23 days after sowing. Cowpea plants were sprayed to run-off with treatments using a knapsack sprayer and the application was done at weekly intervals for four weeks until pods were matured for picking.

### Data collection and analysis

Four most prevalent insect pest species, *Ootheca mutabilis* ($P_1$), *Aspervia armigera* ($P_3$), *Clavigralla tomentosicollis* ($P_4$) and *Coptosoma stali* ($P_8$) from a list of over sixteen (16) insect pests species observed in the cowpea field were selected for data collection during the study. Insect pest were collected with the aid of a sweeping net between 8.00am - 9.00am (when they were less mobile) and counted. Insects collected were identified with the aid of reference collection done by [12] an entomologist in the Department of Agronomy, Delta State University, Abraka. Data were not subjected to any statistical analysis rather the results were discussed using simple percentages.

## Results and Discussion

### Insect pests collected from cowpea in 2021 and 2022 planting season in the experimental site Asaba

A list of insect pest complex of cowpea in the 2021 and 2022 cropping season as observed in the experimental site are presented in Table 1.0. The list showed that there were sixteen (16) insect species from eleven (11) insect families in the 2021 cropping season and fourteen (14) insect species from twelve (12) insect families in the 2022 cropping season. The identified insect species in the 2021 and 2022 cropping season

covered seven (7) insect orders.

**Insect pest orders, species and percentage relative abundance in the 2021 and 2022 cropping seasons**

The Heteropterans were the most dominant in both cropping years, with 43.6% and 42.9% relative abundance respectively. The Heteropterans were closely followed by the coleopterans in order of relative abundance of 25.0% and 21.4% for 2021 and 2022 cropping seasons respectively. The other insect orders were represented by specie each which constitutes the least dominant relative abundance of 6.3% and 7.1% for the 2021 and 2022 cropping season respectively as shown in Table 2.

**Effects of different concentrations of Neem extracts on the population of four major insect pest of cowpea in 2021 and 2022 cropping season in Asaba**

The results obtained from the application of 5%, 10%, and 15% concentrations of NSBE, NLE, and NSKE on cowpea commonest most prevalent insect pests (*Ootheca mutabilis*, *Aspervia armigera*, *Clavigralla tomentosicollis* and *Coptosoma stali*) during the 2021 cropping season in Asaba are presented in Table 3.

The commonest insect species studied responded differently to the various concentrations of the different neem extracts. For *O. mutabilis*, all concentrations of NLE were not significantly different in their effectiveness in the management of the insect pest. Similarly, the concentrations of NSKE did not differ in their effectiveness against *O. mutabilis.* However, the 5%, 10%, and 15% concentrations of neem stem bark extract (NSBE) were significantly more effective (P≤ 0.05) in managing *O. mutabilis* when compared with the results from the control plots.

As for *A. armigera* and *C. tomentosicollis*, there was no significant difference in the effectiveness of the various neem extracts and the different concentrations used.

All the concentrations of NLE significantly (P≤ 0.05) controlled *C.stali*, when compared with the control, while there were no significant difference in the performance of all the concentrations of NBSE and NSKE, on *A. armigera* and *C. tomentosicollis* when compared with the control during the 2021 cropping season.

The results from the field trials of different neem extracts at different concentrations (5%, 10%, and 15%) of NSBE, NLE, and NSKE on cowpea commonest most prevalent insect pests (*Ootheca mutabilis*, *Aspervia armigera*, *Clavigralla tomentosicollis* and *Coptosoma stali*) during the 2022 cropping season in Asaba are presented in Table 4. Similar to 2021 cropping season, the insect pests studied responded differently to the various concentrations of different neem extracts. For *O. mutabilis*, all the concentrations of NLE were significantly different in their effectiveness in the management of the insect pest species. Similarly, the various concentrations of NSKE were not significantly different in their effectiveness against *O. mutabilis.* However, the 10% concentration of neem stem bark extract (NSBE) drastically reduced the population of

*O. mutabilis* when compared with other extracts used and the control. As for *A. armigera*, of all the concentrations of neem extracts used, only 10% concentration of NSBE showed significant (P≤ 0.05) control on the pest. While all the concentrations of neem extracts used were significantly effective against *C. stali*, all concentrations of NSBE as well as 10 and 15% concentrations of NSKE were significantly more effective against *C. tomentosicollis* when compared with the control.

The 2021 cropping season result indicated that 5% concentration of NSBE was the most effective bio-pesticide for the management of *Ootheca mutabilis*, *Clavigralla tomentosicollis*, and *Coptosoma stali* while 10% concentration NSBE proved a better bio pesticide for managing *Aspervia armigera.* The 2022 cropping season results however showed that 10% concentration of NSBE was the most effective bio-pesticide in managing *Aspervia armigera* and was most effective for managing *Ootheca mutabilis* and *Clavigralla tomentosicollis*. The 10% concentration of NSBE drastically reduced the population of most of the selected pests in both seasons.

These findings are in line with earlier report by [16] that various concentrations of neem emulsions reduced incidence of *Selepa docilis* (Butlery), *Urentrus sp* and *Zonocerus variegates* (L) on eggplant while damaged caused by *Sylepta derogata* (F), a defoliator of okra was less on plots treated with 5%, 10% and 20% aqueous methanol extracts of defatted Neem cake. [14] also observed the efficacy of cold Neem leaf extract concentrations in controlling insect pests of soybean. [17] recommended the efficacy of 20% concentration of hot Neem leaf extract in controlling some major insect pest of soybean. The observations from this study are in line with so many earlier reports on the prospect of Neem extracts potentials as a reliable and dependable bio-pesticide for controlling a wide range of insect pests associated with many crops. In the findings of [18] [19] [20] *M. vitrata*, *A. curvipes*, *C. shadabi* and *C. maculatus* as insect pests associated with cowpea where managed by various Neem extracts and products.

The highest population of *Ootheca mutabilis* and *Coptosoma stali* in both cropping year were found in plots sprayed with 5% concentration of NSKE and the control plots respectively, while the highest population of *Aspervia armigera* and *Clavigralla tomentosicollis* were observed in plots sprayed with NSBE. NSBE may have had more phyto deterrence properties than the NLE and NSKE. This is in line with earlier reports by [21, 22, 23] that Neem has some phago deterrence effect on insect pests.

**Table 1:** Collected and identified insect pests of cowpea during 2021 and 2022 cropping seasons in Asaba

| Order | Family | Insect Species | Status | Order | Family | Insect Species | Status |
|---|---|---|---|---|---|---|---|
| Coleoptera | Chrysomelidae | *Ootheca mutabilis Sahlbery* | ** | Coleoptera | Chrysomelidae | *Ootheca mutabilis Sahlbery* | ** |
| Coleoptera | Chrysomelidae | *Ootheca bennigseni Weise* | ** | Heteroptera | Pentatomidae | *Aspervis armigera Fab* | |
| Heteroptera | Coreidae | *Clavigralla shadabi Dolling* | * | Coleoptera | Largridae | *Largria villosa Fab* | ** |
| Heteroptera | Pentatomidae | *Aspervis armigera Fab* | ** | Heteroptera | Coreidae | *Clavigralla tomentosicollis* | ** |
| Heteroptera | Coreidae | *Clavigralla tomentosicollis* | ** | Coleoptera | Coccinellidae | *Cheilomenes lunata Fab* | * |
| Coleoptera | Largrodae | *Largra villosa Fab* | ** | Homoptera | Aphidae | *Aphis craccivora Kosh* | * |
| Coleoptera | Coccinellidae | *Cheilomene lunata Fab* | * | Heteroptera | Plataspidae | *Coptosoma stali Mort* | ** |
| Homoptera | Aphidae | *Aphis craccivora Kosh* | * | Heteroptera | Plataspidae | *Coptosoma nubila Germ* | * |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Diptera | Muscidae | *Atherigona sp* | * | Diptera | Muscidae | *Atherigona sp* | * |
| Heteroptera | Plataspidae | *Coptosoma stali Mort* | ** | Orthoptera | Pyrgomorphidae | *Zonocerus variegates L* | ** |
| Heteroptera | Plataspidae | *Coptosoma nubila Germ* | * | Lepidoptera | Pyralidae | *Maruca vitrata Geyer* | ** |
| Orthoptera | Pyrgomorphidae | *Zonocerus variegates L* | ** | Heteroptera | Pentatomidae | *Anoplocnemis curvipes Fab* | * |
| Lepidoptera | Pyralidae | *Maruca vitrata Geyer* | ** | Heteroptera | Pentatomidae | *Dysdercus superstitiosus F* | * |
| Heteroptera | Pentatomidae | *Anoplocnemis curvipes Fab* | * | Thysanoptera | Thripidae | *Magalurothrips sjostedti Trb* | * |
| Heteroptera | Pentatomidae | *Dysdercus superstitiosus F* | * | | | | |
| Thysanoptera | Thripidae | *Magalurothrips sjostedti Trb* | * | | | | |

**Table 2:** Insect orders, number of species and relative abundance (%) during 2021 and 2022 cropping season in Asaba

| Insect Order | 2021 | | 2022 | |
|---|---|---|---|---|
| | Number of species | Relative abundance (%) | Number of species | Relative abundance (%) |
| Heteroptera | 7 | 43.6 | 6 | 42.9 |
| Coleoptera | 4 | 25.0 | 3 | 21.4 |
| Diptera | 1 | 6.3 | 1 | 7.1 |
| Orthoptera | 1 | 6.3 | 1 | 7.1 |
| Lepidoptera | 1 | 6.3 | 1 | 7.1 |
| Thysanoptera | 1 | 6.3 | 1 | 7.1 |
| Homoptera | 1 | 6.3 | 1 | 7.1 |

**Table 3:** Effects of different concentrations of Neem extracts on the population of four major insect pest during 2021 cropping season in Asaba

| Concentration of Neem extract | Insect pests population | | | |
|---|---|---|---|---|
| | ***O. mutabilis*** | ***A.armigera*** | ***C. tomentosicollis*** | ***C. stali*** |
| 0% | 1.75 | 1.00 | 0.61 | 1.67 |
| 5% NLE | 1.00 | 1.42 | 0.82 | 0.17 |
| 10% NLE | 1.08 | 0.67 | 0.50 | 0.50 |
| 15% NLE | 1.50 | 0.67 | 0.67 | 0.25 |
| | | | | |
| | | | | |
| 5% NSBE | 0.42 | 1.00 | 0.42 | 0.08 |
| 10% NSBE | 0.50 | 0.25 | 0.58 | 0.25 |
| 15% NSBE | 0.50 | 0.67 | 1.50 | 0.83 |
| | | | | |
| 5% NSKE | 1.42 | 1.00 | 0.83 | 1.00 |
| 10% NSKE | 0.58 | 0.58 | 0.58 | 0.25 |
| 15% NSKE | 0.83 | 0.92 | 0.92 | 0.42 |
| LSD (0.05) | 1.25 | 1.10 | 0.91 | 0.98 |

**Table 4:** Effects of different concentrations of neem extracts on the population of *Ootheca mutabilis*, *Aspervia armigera*, *Clavigralla tomentosicollis* and *Coptosoma stali* during 2022 cropping season in Asaba

| Concentration of Neem extract | Insect pests population | | | |
|---|---|---|---|---|
| | ***O. mutabilis*** | ***A.armigera*** | ***C. tomentosicollis*** | ***C. stali*** |
| 0% | 1.61 | 1.50 | 1.93 | 1.66 |
| 5% NLE | 1.17 | 1.25 | 1.00 | 0.33 |
| 10% NLE | 1.17 | 1.25 | 0.92 | 0.75 |
| 15% NLE | 1.75 | 1.67 | 1.25 | 0.98 |
| | | | | |
| | | | | |
| 5% NSBE | 1.75 | 1.00 | 0.58 | 0.48 |
| 10% NSBE | 0.25 | 0.08 | 0.42 | 0.40 |
| 15% NSBE | 1.67 | 0.92 | 0.67 | 0.60 |
| | | | | |
| 5% NSKE | 2.00 | 1.42 | 1.00 | 0.17 |
| 10% NSKE | 1.33 | 1.50 | 0.67 | 0.17 |
| 15% NSKE | 1.92 | 1.25 | 0.50 | 0.00 |
| LSD (0.05) | 1.62 | 1.40 | 1.04 | 0.50 |

## Conclusion

The findings from this study on the effects of 0%, 5%, 10% and 15% concentration of Neem seed kernel extract (NSKE), Neem leaf extract (NLE), Neem stem bark extract (NSBE) on *Ootheca mutabilis*, *Aspervia armigera*, *Clavigralla tomentosicollis* and *Coptosoma stali* in 2021 and 2022 cropping season established that neem extracts and concentrations had some properties which facilitated insect pest control and recommends 10% concentration of NSBE for controlling major insect pest of cowpea in Asaba.

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