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Evaluation of some plant materials on management of Apids (*Apids craccivora*) on cowpea (*Vigna unguiculata (L.) Walp)* plant in Maiduguri Borno State, Nigeria

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Abstract: *The experiment was conducted at the Teaching & Research Farm of Department of Agricultural Technology, Ramat Polytechnic Maiduguri Teaching and Research farm Maiduguri, Borno State, during the dry season of 2023. The main objective of the study is to control Aphid using Neem leaf powder and oil in Cowpea. The experimental was laid out in a Randomized Complete Block Design (RCBD). There are five (5) treatments and replicated three times, which consisting of 15 plots and the experimental unit was 2 x 2m, 0.5m in between and are left as alley. The treatments were different level of Neem leaf powder and neem oil, they are as follows: Neem leaf powder (NLP) – 20g/L of water, Neem leaf powder (NLP) – 30g/IL of water, Neem oil (NO) – 10m/L of water, Neem oil (NO) – 20m/L of water, and Control – 0.0ml. The parameters measured are: Plant height at 2, 4 and 6weeks after sowing (WAS), Number of leaves damage at 2.4 and 6 (WAS), Number of insect pest per plot ware also count & recorded and total yield weight / plot. All data were subjected to analysis of variance using the ANOVA and difference between treatments means identified using least significant difference test (LSD). The study revealed that all the treatments (neem leaf powder 20g and 30g and neem oil 10ml and 20ml) gave positive result in suppressing the insect population. However neem oil 20ml had highest yield weight with 846.67g, followed by the neem oil 10ml with 716.67g, neem leaf powder 30g with 653.33g and neem leaf powder 20g with 406.67g. While the least yield weight was registered under control (0.0ml).*

Keyword: Apids (*Apids craccivora*), Cowpea (*Vigna unguiculata),* Neem Leaf Powder (NLP) and Neem oil (NO).

INTRODUCTION

Cowpea (*Vigna unguiculata (L.) Walp)* is one of the most important leguminous crops grown extensively in the tropics, particularly the savannah zone of West Africa. It is nutritious, highly palatable, providing plant protein for humans and animals alike, and relatively free of anti-metabolites. In West Africa, where cowpea are consumed in different forms, it is a major source of protein, carbohydrate-based die. Cowpea are prone to field and storage pests. These insect

pests infest cowpea and severely reduce the quantity and quality of both the grains and fodder yields; implying losses in both grain and fodder. It is reported that the major insect pests which severely damage cowpea during all growth stages are the cowpea aphids (Aphis craccivora Koch), foliage beetles (Ootheca spp, Medythia spp), the flower bud thrips (Megalurothrips sjostedti Trybom) the legume pod borer (Maruca vitrata Fabricius) and the sucking bug complex, of which Clavigralla spp, Anoplocnemis spp, Riptortus spp, Mirperus spp, Nezara viridula Fab and Aspavia armigera L are most important and are prevalent. Without adequate control, reasonable grain yield cannot be obtained Jackai, (2019). Several control measures are, however available, but chemicals are most effective, giving several fold increase in grain yield as Jackai, (2019) observed. Other measures used to reduce insect damage to cowpea are bio-intensive approaches that rely more on manipulating the plant or its environment. These include the use of resistant varieties, habitat modification, cultural and biological control. In spite of the use of these methods, Jackai,(2019) observes that control may not be optimal because of great diversity of pests involved. In the West African sub region, low levels of cowpea yield (200 - 350 kg/ha) obtained by some farmers are directly attributed to insect pest damage in the field. Grain yield, however varies with variety and the method of field insect pests' control. Botanical insecticides are naturally occurring chemicals, extracted from plants which break down readily in the soil and are not stored in plant or animal tissue. Often their effect are not long lasting as those of synthetic pesticides. Botanical insecticides are generally pest–specific and are relatively harmless to non-target organisms. These natural insecticides especially those of plant origin have proved to be effective, bio-degradable, low cost, low technological base, selective and environmentally friendly. Also, the possibility of insect developing resistance to botanical insecticide is less. Furthermore, plant extracts act as mortality agents, repellents, anti-feedants, attractants, oviposition deterrents and sterility agents Abdalla, A.S *et al* (2018)

Synthetic insecticides are expensive for small farmers and require equipment and training for their use. The massive use of these products in recent years has driven to many problems, such as the emergence of resistant populations and high amount of insecticides residues in foodstuffs, which harm consumers' health and the environment Alamri S.A *et al* (2019). Among the promising vegetable species for the control of cowpea weevil, products derived from neem (Azadirachta indica A. Juss) stand out because they contain substances, especially Azadirachtin, that act as an insecticide. Neem leaf powder caused increased adult mortality of weevil in cowpea seeds, without causing changes in the viability characteristics of the seeds. However, there are still few studies evaluating the effect of powders made from different parts of the neem tree on the mortality of cowpea insectAscher *et al* (2017).

The neem tree, Azadirachta indica A. Juss (Meliaceae), is a native of Southeast Asia and the Indian Subcontinent that has shown much promise in the arenas of crop protection and medicine (Schmutter 2018; Ascher 2019). Marco Polo remarked on the magnificent teeth of the East Indians who chewed on neem twigs (Cordier 1929). Various parts of the neem tree have been used to treat ailments of diverse origins for millennia and seem to be particularly effective against diseases of bacterial or fungal origin (National Research Council 2017). Even more fascinating is the novel chemistry that has been elucidated from the neem tree and its varied biological activities against phytophagous insects (Ara et al. 2019; Gaikwad *et al*.2020; Siddiqui *et al*. 2019; Ley *et al*. 2018). The compounds in neem have demonstrated powerful anti-feedant effects

against a very broad spectrum of phytophagous insects that compete with us for food and fibre (Kolb and Ley 2016; Mordue (Luntz) and Blackwell 2019; Ascher 2020; Verkerk and Wright 2017; Blaney *et al.* 2016; Lin-er *et al*. 2015). Neem has also shown a variety of other toxic manifestations, namely, inhibition of insect growth, deformations, inhibition of ecdysiast, outright mortality (Mordue (Luntz) and Blackwell 2019), and inhibition of protein synthesis (Timmins and Reynolds 2019) and inhibition of protein transfer (Moreira *et al*. 2019). This wide spectrum of toxic modes of action enhances neem's ability to slow down resistance development in phytophagous insects Bass *et al* (2018).

Although there have been very serious efforts to synthesize the active compounds for use in agriculture, the mixture of compounds occurring naturally in the neem tree has proved to be more effective than synthetics (Kolb and Ley 2019).

Interestingly enough, the anti-feedant fragments of azadirachtin A demonstrate significantly less anti-feedancy than the intact azadirachtin A molecule, demonstrating Nature's awesome powers of synthetic chemistry (Blaney *et al*. 2019). Furthermore, neem does not appear to be phytotoxic, nor does it appear to be toxic to vertebrates (although it has shown promise as a human spermicide) (National Research Council 2017) due to its specific modes of action (neem specifically, acts on insect chemoreceptors and their endocrine system) (Jacobson 2019; Lin-er *et al.* 2015). All of this, plus neem's widespread distribution in the subsaharan region of West Africa presents the neem tree as an ideal candidate for subsaharan pest management Bloomquist *et al* (2018).

Neem has already been in use in many countries to control field and storage pests, and farmers and scientists alike are demonstrating its effectiveness (Sowunmi and Akinnusi 2017; Makanjuola 2018; Echindu 2019; Tanzubil 2016). Applying the whole neem kernel extract, as opposed to selected compounds from neem, slows resistance development as there are many bioactive compounds in the neem kernel extract that display complimentary modes of action and may even potentiate or synergize each other, increasing neem's effectiveness (Kolb and Ley 2018; Blaney *et al.* 2019).

Not only may the numerous compounds in neem be effective, but the oil itself may be an important factor in toxicity to pest insects (Banken and Stark 2017). Many scientists have shown that various vegetable oils are effective at reducing infestations in stored products (Qi and Burkholder 2014), particularly against C. maculatus (DonPedro 2016; Ivbijaro 2015; Pacheco *et al.* 2015; Lowery and Isman 2016; Rajapakse and Van Emden 2018).

Cowpea is one of the most important legume crops, the main insect pest of cowpea in the field is aphids,although various insecticides are widely available in the market for controlling the insect pest (Aphids), but they require expensive equipments and training for their use. Consequently, some cowpea growers in Africa do not use insecticides because they cannot afford them; they do not have the necessary equipment or they are not taught how to apply them properly.They are expensive, polluting, and potentially dangerous to users. These lead to the search for the less or non toxic, available, affordable and environmental friendly means of control, which are the plant extracts.

3.1 Experimental Site

The experiment was conducted at the Teaching & Research Farm of Department of Agricultural Technology, Ramat Polytechnic Maiduguri Teaching and Research farm Maiduguri, Borno State,during the dry seasonof 2023. Maiduguri is located at latitude 11.4^0N and longitude 13.05^0E it has the attitude of 354m. Maiduguri is a semi arid zone, the average temperature in Maiduguri is 25.8 ^{0}C. The average annual rainfall is 613mm and the average annual percentage of humility is: 30:0% (Geaorge, 2002).

MATERIALS AND METHODS

Materials

The following materials were used in the experiment:
Ranging pole, Measuring tape, Rake, Hoe, Cutlass, Bucket, Cowpea seed, Card board paper, Peg, Marker, Rope, Weighing balance, Sprayer (1 liter capacity)**,** Neem leaf powder**,** Neem oil and Syringe (10ml).

Experimental Design and Treatments

The experimental was laid out in a Randomized Complete Block Design (RCBD). There are five (5) treatments and replicated three times, which consisting of 15 plots and the experimental unit was 2 x 2m, 0.5m in between and are left as alley.
The treatments were different level of Neem leaf powder and neem oil, they are as follows:
Treatment 1- Neem leaf powder (NLP) – 20g/L of water
Treatment 2 - Neem leaf powder(NLP) – 30g/IL of water
Treatment 3 - Neem oil (NO) – 10m/L of water
Treatment 4 - Neem oil (NO) – 20m/L of water
Treatment 5 - Control – 0.0ml

Parameters Observers: The parameters measured are:

1. Plant height at 2,4 and 6weeks after sowing (WAS)
2. Number of leaves damage at 2.4 and 6 WAS
3. Number of insect pest per plot ware also count& recorded
4. Total yield weight / plot

Statistical Analysis

All data were subjected to analysis of variance using the ANOVA and difference between treatments means identified using least significant difference test (LSD).

Results and Discussion

Table 1: Effect of different levels of Neem leaf powder and oil on plant height (cm) at different weeks on cowpea

Treatments	1week	2 weeks	3weeks	4weeks
Neem leaf powder 20g	15.667^{ab}	17.333^{ab}	20.333^{b}	24.667^{a}
Neem leaf powder 30g	17.667^{a}	20.000^{a}	22.333^{a}	26.333^{a}
Neem oil 10m	17.667^{a}	20.000^{a}	22.000^{ab}	24.667^{a}
Neem oil 20ml	16.667^{ab}	19.667^{a}	22.000^{ab}	26.333^{a}
Control 0.0ml	14.333^{b}	15.667^{b}	18.333^{c}	21.667^{b}
CV	8.55	7.88	4.88	4.61
SE	1.145	1.193	0.837	0.931

Means in the column accompanied by the same letter (a) are not significantly difference at (P< 0.05%) using least significance different (LSD).

Table 1: Shows the effect of different levels of Neem leaf powder and oil on plant height (cm) in different weeks. The result shows that there were significant different among the treatments in week1 except between Neem leaf powder 30g and neem oil 1oml, and also neem leaf powder 20g and neem oil 20ml. However, Neem leaf powder30g and neem oil 10ml had highest number of plant height with 17.667, while the least number of plant height was recorded under control (0.0ml).However, the highest number in plant height was registered under neem leaf powder 20g and neem oil 10ml, while least number was obtained under control.

At 2weeks, the findings shows that, statistically there were no significant different among the treatments except in neem leaf powder 20g and the control (0.0ml). At 3weeks, the result shows that, statically there were significant deferent among the treatments, but no significant different between the neem oil 10 and 20ml.At 4weeks, the findings reveals that, there were no significant different among the treatments, except in the control (0.0ml).

O. A. Olaniran *et.,at* (2013) reported that, The highest height was observed with Plant treated with synthetic insecticide and the combined extracts while untreated plot was the lowest Though the height was not significantly different between control and *A. indica* 25%, all treated plants recorded higher height than the untreated plants. The height was significantly different for the plants extracts (ANOVA, F 5, 71=50.07, P<0.0001).

P.

Table 2: Effect of different levels of Neem leaf powder and oil on number of insects (Aphids) at different weeks on cowpea

Treatments	1week	2 weeks	3weeks	4weeks
Neem leaf powder 20g	20.000^{b}	0.000^{b}	0.000^{b}	0.000^{b}
Neem leaf powder 30g	10.000^{bc}	0.000^{b}	0.000^{b}	0.000^{b}
Neem oil 10ml	6.667^{bc}	0.000^{b}	0.000^{b}	0.000^{b}
Neem oil 20ml	3.333^{c}	0.000^{b}	0.000^{b}	0.000^{b}
Control 0.0ml	86.667^{a}	220.00^{a}	286.67^{a}	356.67^{a}
CV	34.09	73.29	70.35	47.05
SE	7.051	26.331	32.931	27.406

Means in the column accompanied by the same letter (a) are not significantly difference at (P< 0.05%) using least significance different (LSD).

Table 2. Shows the effect of different levels of Neem powder and oil on number of insect (Aphids). At 1week, the result shows that there were significant different among the treatments except between neem leaf powder 30g and neem oil 10ml. howervr, the least number of insects was found under neem oil 20ml with 3.333 followed by neem oil 10ml with 6.667, Neem leaf powder 30g with 10.00 and neem leaf powder 20g with20.000,while the highest number os insects was recorded under control with 86.667.

At week 2, 3 and 4, the result shows that, statistically there were no significant different among the treatments except in the control (0.0ml). And also there were no insects in all the treated plots except in the untreated plot (Control).

O. A. Olaniran *et.,at* (2013) shows the effect botanical treatments on *P. uniformsi.* Plants treated with botanicals were able to reduce the number of this insect found on the treated plots. At four weeks after spraying, no insect was found on treated plots except on *A. indica* treated plots. Application of *A. indica* at 25% concentration was more effective against *P. sjostedti* than *A. indicia* at 15% w/v. No significant difference was observed between the plants treated with *A. indica* 25% w/v and *T. vogelii* 25% w/v and they both reduced the number of *P. sjostedti* similar to synthetic insecticide and mixed plant extracts. All the imposed botanical insecticides recorded 100% efficacy by third week after spraying exceptplants treated with *A. Indica* at 15%. Highest mean value of *Z. variegatus* waobserved from untreated plant. By third week after spraying, no insect was found on alltreated plots except plots treated with *T. vogelii* 25% and this recorded zero insect by fourth week after spraying. Plant treated with *A. indica* at 15% and 25% w/v exhibited high insecticidal activity than *T. vogelii* at 25% w/v. Combination of the two plant extracts had equal efficacy with synthetic insecticide (deltamethrin). However, all the botanical treated plants effectively controlled *Z. variegatus* compared to the untreated plants.

Table 3: Effect of different levels of Neem leaf powder and oil on number of damaged leaves at different weeks on cowpea

Treatments	1week	2 weeks	3weeks	4weeks
Neem leaf powder 20g	3.000^{b}	0.333^{b}	0.000^{b}	0.333^{b}
Neem leaf powder 30g	1.000^{bc}	0.333^{b}	0.000^{b}	0.333^{b}
Neem oil 10ml	1.333^{bc}	0.000^{b}	0.000^{b}	0.000^{b}
Neem oil 20ml	0.333^{c}	0.000^{b}	0.000^{b}	0.000^{b}
Control 0.0ml	7.000^{a}	16.333^{a}	26.333^{a}	38.333^{a}
CV	49.93	78.92	40.13	32.43
SE	1.033	2.191	1.726	2.066

Means in the column accompanied by the same letter (a) are not significantly difference at (P< 0.05%) using least significance different (LSD).

Table 3. Shows effect of different levels of Neem leaf powder and oil on number of damaged leaves in different weeks on cowpea. At week 1, the result shows that, statistically there were significant different among the treatments, except between neem leaf powder 30g and neem oil 10ml. however the highest number damaged leaves was recorded under control with 7.000, while the least was found under neem oil 20ml with 0.333.

At 2, 3 and 4 weeks, the findings shows that, there were no significant different among the treatments except in the control (0.0ml). The result obtained shows that, no insects obtained in all treated plots, only in the control (0.0).

In a similar experiments, O. A. Olaniran *et.,al* (2013) reported that**,** Percentage defoliation: The least percentage leaves defoliation was observed from the plants treated with synthetic insecticide. However, all treated plants prevented the leaves from being defoliated compared to untreated plants (ANOVA *P*<0.0001). *A.indica* applied 25% w/v recorded highest percentage of defoliation among the botanical insecticides.

Table 4: Effect of different levels of Neem leaf powder and oil on yield weight (g) of cowpea after harvest

Treatments	Yield weight (g)
Neem leaf powder 20g	406.67^{c}
Neem leaf powder 30g	653.33^{b}
Neem oil 10ml	716.67^{b}
Neem oil 20ml	846.67^{a}
Control 0.0ml	236.67^{d}
CV	12.04
SE	56.253

Means in the column accompanied by the same letter (a) are not significantly difference at (P< 0.05%) using least significance different (LSD).

Table 4: shows the effect of different levels of Neem leaf powder and oil on yieldweight (g) of cowpea after harvest. The result shows that there were significant different among the treatments, except between Neem leaf powder 30g and neem oil 10ml. However neem oil 20ml had highest yield weight with 846.67g, followed by the neem oil 10ml with 716.67g, neem leaf powder 30g with 653.33g and neem leaf powder 20g with 406.67g. While the least yield weight was registered under control (0.0ml). O. A. Olaniran *et.,al* (2013) The yield obtained from the plants treated with the combination of the extracts was significantly higher than the single application of *A. indica* and *T. vogelii* extracts and untreated plants. Among the single extracts used, calyx yield obtained from *A. indica* at 15% w/v was the least but higher than yield obtained from untreated plants (ANOVA *P*<0.0001).

Conclusion

The study revealed that all the treatments (neem leaf powder 20g and 30g and neem oil 10ml and 20ml) gave positive result in suppressing the insect population. However neem oil 20ml had highest yield weight with 846.67g, followed by the neem oil 10ml with 716.67g, neem leaf powder 30g with 653.33g and neem leaf powder 20g with 406.67g. While the least yield weight was registered under control (0.0ml).

Recommendation

1. It is recommended that, farmers should use neem laef powder and oil at a rate of 20, 30g and 10 and 20ml in controlling aphids in cowpea.
2. Further research should be done to elucidate more possible mechanisms of insecticidal and deterrent activities other than acting on acetylcholinesterase. This will create a major break-through in the management of Aphids insect pest.
3. A study should be carried out to determine the residual effect of neem oil on Cowpea.

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