# EVALUATION OF FALL ARMYWORM (*SPODOPTERA FRUGIPERDA*) INCIDENCE AND MORPHOLOGICAL TRAITS OF MAIZE (*ZEA MAYS* L.) GENOTYPES IN NIGER STATE, NIGERIA

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## ABSTRACT

Fall Armyworm (FAW) (*Spodoptera frugiperda*) is a major invasive insect pest threatening maize (*Zea mays* L.) production in sub-Saharan Africa, including Nigeria. This study evaluated the incidence of FAW infestation and its effect on the morphological traits of 14 maize genotypes across two locations in Niger State, Nigeria: Minna and Mokwa. The trials were conducted using a randomized complete block design with three replications. FAW incidence was recorded as the percentage of plants showing signs of infestation, while morphological traits such as plant height and leaf area were measured. Data collected were subjected to analysis of variance and means were separated using Duncan multiple range test. Results showed significant variation in FAW incidence among genotypes. Highly susceptible genotypes such as NGBO 2854 and NGBO 2864 exhibited FAW incidences of up to 100% in Minna and 87% in Mokwa. Conversely, genotypes such as NGBO 2864, NGBO 2898, and NGBO 2249 demonstrated superior morphological performance with plant heights exceeding 170 cm and leaf areas above 660 cm², indicating resilience under FAW pressure. The environmental influence was evident, with Mokwa favoring slightly better growth for some genotypes. Genotypes NGBO 2864, NGBO 2898, and NGBO 2249 were identified as promising candidates for breeding programs aimed at developing FAW-resistant maize varieties.

**Keywords**: Genotype; resistance; army worm, infestation

## INTRODUCTION

Maize is scientifically known as *Zea mays* L., which holds a paramount position as a staple food crop and plays a fundamental role in the local diet, forming the basis of many traditional dishes and serves as a primary source of nutrition for the population (Chiriboga *et al.*, 2024). Maize cultivation in Niger State is not only essential for food security but also contributes significantly to the livelihoods of many smallholder farmers in the region as it generates income for farmers through sales of maize grain and related products (Akhigbe *et al.*, 2021). Fall Armyworm (FAW), *Spodoptera frugiperda* is an invasive insect pest that has caused significant damage to maize production globally, particularly in sub-Saharan Africa since its introduction in 2016 (Chiriboga *et al.*, 2023). Nigeria, being one of the first countries in Africa to report the presence of FAW in 2016, has been severely impacted by the pest (Ajiboye *et al.*, 2023). The invasion of FAW in Nigeria has led to substantial economic losses for farmers and threatens the country's food security (Ajiboye *et al.*, 2023).

The FAW larvae feed voraciously on maize plants, causing extensive damage to the leaves. This feeding behaviour results in defoliation, where the leaves are consumed or damaged, affecting the plant's ability to photosynthesize effectively. Reduced leaf area due to FAW feeding can hinder the plant's capacity to produce energy through photosynthesis, leading to stunted growth and compromised plant health (Day *et al.*, 2017). Elucidating the mechanisms of resistance and understanding the genetic factors involved can inform the development of more effective and durable resistance strategies. Screening and evaluating a diverse set of maize genotypes under artificial infestation conditions can help identify resistant lines and guide breeding efforts (Balint-Kurti, 2015). The urgency of this study is underscored by the critical need to enhance maize production resilience against FAW in Niger State. Therefore, the objective of this study was to assess the incidence of FAW infestations and to identify maize genotypes that exhibit resistance to FAW in Niger State, Nigeria.

## MATERIALS AND METHODS

The experiment was a multi-locational maize evaluation at the teaching and research farm of the Department of Crop Production, Federal University of Technology, Minna and IITA sub-station Mokwa during the 2024 rainy season. Fourteen maize genotypes were evaluated for Fall armyworm infestation. At each location, the trials were replicated thrice in a randomized complete block design. Land preparation was done manually by making ridges of 8 meters long arranged in a single-row plot. A combination of nitrogen (N) at the rate of 120kg/ha, phosphorus (P) at the rate of 60kg/ha as $P_2O_5$ and potassium (K) at the rate 40kg/ha as $K_2O$ was applied basal to promote optimal growth and development and the remnant dose as top dressing 8 weeks after planting. Data on the incidence were recorded as the percentage of plants showing signs of FAW infestation (NACGRAB, 2020). Plant height, leaf length, leaf width and leaf area were measured to assess the overall growth and health of the plants. Data collected were subjected to analysis of variance and means were separated using Duncan multiple range test.

## RESULTS

The mean incidence of fall armyworm (FAW) across 14 maize genotypes at 8WAS is shown in Table 1. Genotypes NGBO 2854 and NGBO 2864 had the highest FAW incidence, with infestation rates of 100% in Minna and 87% in Mokwa. This consistent vulnerability indicates these genotypes lack inherent resistance to FAW and may not be ideal for cultivation in FAW-prone areas. Genotypes NGBO 7517 and NGBO 2346 showed intermediate levels of FAW infestation, with incidence rates ranging between 53% and 93% depending on the location. For most genotypes, FAW incidence was either equal or slightly higher in Mokwa compared to Minna, indicating that environmental factors at Mokwa (e.g., temperature, humidity, or pest dynamics) may exacerbate infestation levels. The effect of fall armyworm infestation on the morphological traits of 14 Maize Genotypes is shown in Table 2. Several genotypes exhibited robust morphological traits despite FAW infestation, indicating potential tolerance. NGBO 2864 achieved the tallest plant height (172cm in Minna and 131cm in Mokwa) and relatively high leaf area values, suggesting good growth potential under FAW pressure. NGBO 2898 and NGBO 2249 also showed superior performance, with leaf areas exceeding 670 cm² in Minna and 750 cm² in Mokwa. This demonstrates their ability to sustain growth and photosynthetic capacity despite FAW attack. Genotypes like NGBO 7514 and NGBO 3254 displayed average plant heights and leaf areas. For instance, NGBO 7514 had a plant height of 123 cm and a leaf area of 618 cm² in Minna, decreasing slightly in Mokwa. These genotypes are moderately tolerant and could be improved through breeding programs. Genotypes NGBO 2346 and NGBO 7517 exhibited significantly lower values for plant height and leaf area across both locations. For example: NGBO 7517 recorded a leaf area of only 273 cm² in Minna, among the lowest in the study, indicating reduced photosynthetic capacity under FAW pressure.

**Table 1: Mean Incidence of Fall Armyworm Across 16 Maize Genotypes at Two locations**

| Genotypes | Locations | |
|---|---|---|
| | Minna | Mokwa |
| NGBO 7514 | $93^{ab}$ | $80^{a}$ |
| NGBO 3254 | $80^{ab}$ | $80^{a}$ |
| NGBO 2854 | $100^{a}$ | $87^{a}$ |
| NGBO 2346 | $73^{bc}$ | $73^{a}$ |
| NGBO 2289 | $80^{ab}$ | $80^{a}$ |
| NGBO 7517 | $53^{d}$ | $60^{a}$ |
| NGBO 5505 | $86^{ab}$ | $60^{a}$ |
| NGBO 2370 | $80^{ab}$ | $80^{a}$ |
| NGBO 2251 | $100^{a}$ | $73^{a}$ |
| NGBO 2249 | $93^{ab}$ | $73^{a}$ |
| NGBO 2898 | $93^{ab}$ | $80^{a}$ |
| NGBO 2864 | $100^{a}$ | $87^{a}$ |
| NGBO 7760 | $93^{ab}$ | $67^{a}$ |
| TSN 5110 | $60^{cd}$ | $60^{a}$ |
| Mean | 6.01 | 8.7 |

Means with the same letter(s) within the genotypes group, are not significantly different using Duncan multiple range test.

**Table 2: Effect of Fall Armyworm infestation on morphological traits of 16 Maize Genotypes at Two location**

| Genotypes | Minna | | Mokwa | |
|---|---|---|---|---|
| | Plant height | leaf Area | Plant height | leaf Area |
| NGBO 7514 | $123^{cd}$ | $618^{ab}$ | $106^{ab}$ | $673^{bc}$ |
| NGBO 3254 | $137^{bcd}$ | $665^{a}$ | $96^{ab}$ | $717^{abc}$ |
| NGBO 2854 | $135^{bcd}$ | $596^{ab}$ | $131^{a}$ | $719^{abc}$ |
| NGBO 2346 | $83^{e}$ | $406^{cd}$ | $83^{b}$ | $411^{e}$ |
| NGBO 2289 | $131^{bcd}$ | $478^{bc}$ | $130^{ab}$ | $648^{bcd}$ |
| NGBO 7517 | $69^{e}$ | $273^{d}$ | $122^{ab}$ | $530^{e}$ |
| NGBO 5505 | $121^{cd}$ | $603^{ab}$ | $121^{ab}$ | $560^{cde}$ |
| NGBO 2370 | $110^{d}$ | $504^{abc}$ | $115^{ab}$ | $504^{de}$ |
| NGBO 2251 | $147^{abc}$ | $511^{abc}$ | $139^{a}$ | $726^{abc}$ |
| NGBO 2249 | $124^{cd}$ | $666^{a}$ | 98ab | $858^{a}$ |
| NGBO 2898 | $157^{ab}$ | $677^{a}$ | $123^{ab}$ | $777^{ab}$ |
| NGBO 2864 | $172^{a}$ | $577^{ab}$ | $131^{a}$ | $660^{bcd}$ |
| NGBO 7760 | $147^{abc}$ | $660^{a}$ | $124^{ab}$ | $754^{ab}$ |
| TSN 5110 | $140b^{cd}$ | $600^{ab}$ | $140^{a}$ | $632^{bcd}$ |
| Mean | 9.5 | 51.8 | 14.1 | 51.9 |

Means with the same letter(s) within the genotypes group, are not significantly different using Duncan multiple range test

## DISCUSSION

The significant differences in FAW incidence observed in this study underscore the genetic variability among the maize genotypes. Some genotypes demonstrated lower FAW damage, indicating inherent resistance mechanisms. These findings align with previous studies emphasizing the role of genetic diversity in pest resistance (Chormule *et al.*, 2022). Genotypes NGBO 2864 and NGBO 2898 stand out as promising candidates due to their superior growth and moderate FAW incidence rates. These traits make them suitable for breeding programs aimed at developing FAW-resistant varieties. Resistant genotypes often express traits such as antibiosis, antixenosis, or tolerance which can reduce pest colonization and damage (Tambo *et al.*, 2020) The variation in performance between Minna and Mokwa highlights the role of environmental factors. Seasonal variations, natural enemies and agricultural practices may affect pest dynamics (Goergen *et al.*, 2016). Mokwa's conditions seem more favorable for higher leaf area in some genotypes (NGBO 2249, NGBO 2898), which could improve resistance through enhanced photosynthesis. Genotypes like NGBO 2854 and NGBO 2864, despite good growth characteristics, require significant improvement in resistance to FAW. Conversely, NGBO 2864 and NGBO 2898 combine moderate resistance and favorable growth traits, making them strong candidates for further trials.

## CONCLUSION

The promising genotypes (NGBO 2864, NGBO 2898, and NGBO 2249) demonstrate both growth resilience and moderate resistance, making them ideal candidates for advancing FAW resistance research and maize breeding in FAW-prone regions. However, the influence of environmental conditions, as observed in Mokwa, must also be considered in genotype selection and management strategies.

## RECOMMENDATIONS

Genotypes such as NGBO 2864, NGBO 2898, and NGBO 2249 which demonstrate superior performance under FAW pressure, should be prioritized in breeding programs to develop maize varieties with enhanced resistance and growth traits.

Susceptible genotypes like NGBO 2854 and NGBO 2864 require enhanced pest management strategies, including the application of integrated pest management (IPM) techniques, to mitigate FAW infestation during cultivation.

## REFRENCES

Ajiboye, A. O. (2023). Review of Fall Armyworm (*Spodoptera frugiperda*) invasion in Nigeria and lessons learned for sustainable food production. *Journal of Agricultural Research and Development*, 15(3), 45 – 58.

Akhigbe, C.I., Oyerinde, A.A., Asala, S.W., and Anjorin, T.S. (2021). Evaluation of Fall Armyworm (*Spodoptera frugiperda*) infestation and efficacy of neem extracts in maize (*Zea mays L.*) in Nigeria. *Nigerian Agricultural Journal, 52*(1), 77-82

Balint-Kurti P. (2015). Quantitative Disease Resistance: Dissection and Adoption in Maize. Investigation of varietal resistance of some maize genotype against fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae).

Chiriboga Morales, X., Tamiru, A., Sobhy, I.S., and Bruce, T.J.A. (2023). Economic impacts and management of fall armyworm (*Spodoptera frugiperda*) in smallholder agriculture: a panel data analysis for Ghana. *CABI Agriculture and Bioscience, 4*(38).

Chiriboga Morales, X., Tamiru, A., Sobhy, I.S., and Bruce, T.J.A. (2024). Evaluation of African Maize Cultivars for Resistance to Fall Armyworm *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) Larvae. *International Journal of Insect Science,* 18(1), 12 – 24.

Chormule, A., Koli, P., & Patil, S. (2022) Genetic resistance to fall armyworm in maize. *Journal of Pest Science*, 95(3), 765 – 777.

Day, R., Abrahams, P., Bateman, M., Beale, T., Clottey, V., Cock, and Witt, A. (2017). Fall Armyworm: Impacts and implications for Africa. *Outlooks on Pest Management*, 28(5), 196- 201.

FAO. (2021). "The State of Food Security and Nutrition in the World 2021." Food and Agriculture Organization of the United Nations.

Goergen, G., Kumar, P. L. (2016). Fall armyworm invasion in Africa: Biology and management. *International Journal of Pest Management*, 62(4), 295 – 306.

NACGRAB. (2020). "Monitoring Occurrence, Incidence, Damage and Population Dynamics of Fall Armyworm (*Spodoptera frugiperda*) in Nigeria." National Center for Genetic Resources and Biotechnology.

Tambo, J. A., Day, R. (2020). Economic Impact of Fall armyworm in Africa. *Food Security*, 12(5), 949 – 962.

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# EFFICACY OF BIODEGRADABLE AROMATIC PLANT EXTRACTS IN MANAGING ROOT-KNOT NEMATODES (*MELOIDOGYNE INCOGNITA*) INFESTATION IN GARDEN EGG (*SOLANUM MELONGENA* LINNAEUS)

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## ABSTRACT
Eggplant (*Solanum melongena* Linnaeus.) is the fifth most commercially significant *solanaceous* crop. It is one of the widely planted commercial vegetable crops worldwide. Root-knot nematode (RKN) disease comes first among the diseases and pests infecting eggplant, and the losses caused by it exceeded 50% and estimated to be 100 billion dollars annually. The study Location is between (latitude 9° 37 N and longitude 6° 28 E) in southern guinea savanna Agroecological zone of Nigeria at the screen house of the Teaching and Research Farm of the Department of crop production Federal University of Technology Minna, Niger state. The experimental design for this study includes Extract Types, Concentration, Replicates. The types of extracts tested are *Eucalyptus* leaf, *Eucalyptus* bark, Neem leaf, and Neem bark. Each extract will be applied at five concentration levels: 0% (control), 25%, 50%, 75%, and 100%. The Treatments combination is a 4 × 5 factorial experiment, arranged in Completely Randomized Design (CRD), each treatment combination was replicated three times. The study was conducted in a screenhouse during wet season. The control group consist of plants left untreated to serve as a baseline for comparison. This design ensures a robust assessment of the efficacy of the extracts under varied conditions. This study aims to evaluate the efficacy of Eucalyptus globulus and Azadirachta indica extracts in controlling root-knot nematode (*Meloidogyne incognita*) infestation in garden egg (*Solanum melongena*). It also seeks to identify optimal extract concentrations for promoting plant growth and compares the effects of *Eucalyptus* leaf, Eucalyptus bark, Neem leaf, and Neem bark extracts on plant height and yield. The research explores these botanical extracts as eco-friendly alternatives for nematode management.as done by drenching the egg masses into a grove close to the root of the plant, while the extracts were also applied directly to the plant by drenching. Growth and yield data were subjected to Analysis of variance. The result revealed that *Eucalyptus* bark has the highest plant height of (57.00cm), indicating potentials growth promotion, *Eucalyptus* leaf and neem bark have similar plant height (50.86 and 50.20 cm), also the result shows that Neem leaf has the shortest plant height (43.53 cm). 0%, 25%, 75% and 100 % concentration (49.83 - 51.75 cm), indicate that there is no significant ($P \geq 0.05$) growth inhibition and 50% concentrations has significantly shortest plant height (17.33 cm), suggesting phytotoxicity, *Eucalyptus* leaf extract promote yield and neem leaf and bark extract inhibits yield. The concentration effect at 25% optimizes yield. 100% concentration has a positive effect but may lead to phytotoxicity.

**Keywords**: Efficacy, Neem, Eucalyptus, Eggplant, Botanical extract, Growth promotion.

## INTRODUCTION
Nematodes are the most prevalent animals that live in soil. Nematodes that parasitize plants greatly reduce the value of agricultural crops worldwide. Root-knot nematodes Pathogens of several different crops called *Meloidogyne* spp, *Meloidogyne incognita*, *M. javanica,* and *M. arenaria* are three species of root-knot nematodes that have been reported to be associated with the root-knot disease of eggplant worldwide (Das *et al.*, 2021). A 50% yield loss and shoot growth reduction occurred when eggplants were inoculated with 4.7 and 3.2 *M. javanica* eggs and juveniles/g soil respectively. *Meloidogyne* is regarded to be the most

important genus affecting many plant species (Abu-Gharbiah, 2010), and the losses caused by it exceeded 50% and estimated to be 100 billion dollars annually. Four species of *Meloidogyne* are wide-spread in the world, which are *M. javanica*, M. *incognita, M. hapla and M. arenaria* (Menjivar *et al.*, 2012).

Globally, garden egg is known as eggplant with the general botanical name *Solanum melongena.* Eggplant exhibits a relatively short stature as opposed to arboreal growth patterns. The plant's foliage stands out for its substantial size, rough lobes, and dimensions of 10 to 20 centimeters in length and 5 to 10 centimeters in width (Sharma and Kaushik, 2021). procedures that maintain a pest population by using either individual strategies or combination strategies at a level where the nematodes are unable to cause a detectable decrease in the yield (both qualitatively and quantitatively) of a crop that could have a detrimental effect on the health of both humans and animals. Nematode management can be roughly classified into: cultural control, chemical control, biological control, integrated management, etc., according to (Oka,2010). The phytochemical properties of *Eucalyptus globulus* leaves and bark water extract are Qualitative phytochemical (bioactive compounds) testing indicated that aqueous extracts of *Eucalyptus globulus* leaves and bark contain alkaloids, flavonoids, glycosides, terpenoids, steroids, saponins and reducing sugars. Aqueous extract eucalyptus leaves are free of cardiac glycosides and anthraquinones while aqueous bark extract also have no chlorophyll and carbohydrates. Our results are identical to those described by the presence of these phytochemical compounds in plant material suggests that their extracts have potential medicinal value in the prevention and/or treatment of specific diseases. (Rasyid. *et al*, 2020).

Research has shown that *Azadirachta indica* is rich in a wide range of compounds such as Nimbin (triterpene) has shown to have antipyretic, fungicidal, antihistamine and antiseptic properties. Also, Nimbin is associated with anti-inflammatory and antioxidant effects, therefore reducing damage by mitigating the production of reactive oxygen species. (Naik *et al.*,2014)

## MATERIALS AND METHODS

### Study location, collection and preparation of plants materials

The research was carried out at the screenhouse of the Teaching and Research Farm of the Department of crop production Federal University of Technology Minna, Niger state. Location is between (latitude 9° 37 N and longitude 6° 28 E) in southern guinea savanna Agroecological zone of Nigerian. Eggplant seeds were obtained from local farmers in Kure Ultra-Modern market Minna Niger state.

### Collection of materials

*Eucalyptus globulus* (Gum tree), and *Azadirachta indica* (Neem), leaves and bark were collected from mature trees at Gidan Kwano Campus, Federal university of Technology Minna. Loamy soil from the Teaching and Research Farm was collected and sterilized at 180°c (350F) for 30-45 minutes using heat treatment. Eggplant seedlings were raised in plastic nursery tray in the screenhouse for four weeks before transplanting. Two seedlings were transplanted which was later thinned to one per polythene bag and two-kilogram 2kg of sterilized soil was used per polythene bag (30 and 40 cm in size).

### Collection of nematodes egg masses

Egg masses of *Meloidogyne incognita* (Root-knot nematodes) were collected from infested tomato roots cultured in the departmental screenhouse. The plant was uprooted carefully and taken to laboratory in a polythene bag. The roots were thoroughly washed under running water to remove soil and debris. The cleaned roots were also cut into small pieces and placed in a shallow Petri-dish and observed under light microscope, the egg masses were then collected into a measuring cylinder. The extracted egg masses were poured into the extractions dish with 100 ml of water and used within 1-2 hours, Precaution was taken to use the egg masses prior to inoculation.

**Preparation of different concentrations of crude extracts**

Five concentrations of *Eucalyptus globulus* (Gum tree) and *Azadirachta indica* (Neem) leave and bark crude extracts at (0 %, 2 5%, 50 %, 75 % and 100 %) were prepared as described by Bello *et al*., 2012.

S (100%): undiluted standard concentration solution (S).

S/1 (75%): to each volume of standard stock solution 'S', equivalents volume of distilled water will be added.

S/2 (50% concentration) to each volume of standard stock solution (S) equivalent volume of distilled water will be added.

S/3 (25% concentration) to each volume of standard stock solution (S) equivalent volume of distilled water will be added.

C: (0% concentration) control which will be distilled water.

**Preparation of leaves and bark extracts**

Two kilograms (2kg) of leaves and bark from **Eucalyptus globulus** (gum tree) and **Azadirachta indica** (neem) were harvested, thoroughly washed, separated from the stalks, and cut into small pieces. The chopped plant materials were blended with 100 ml of water for 4 minutes to form a paste. This paste was transferred to an electric blender, where 1 liter of distilled water was added and blended as part of the required 6 liters of distilled water. The mixture was left to sit for 24 hours before being filtered through muslin cloth. The resulting solution was designated as the standard concentration ("S"). To inhibit bacterial growth, 10 drops of streptomycin sulfate were added to the extracts.

**Inoculation of nematodes egg masses and application of crude extracts**

Ten (10) Egg masses of *Meloidogyne incognita* (Root-knot nematode) were inoculated into each polythene in the screenhouse. Inoculation was done by creating a grove 2cm deep from the base round each Eggplant seedling, the egg masses will be applied in the groves. The extracts were also applied directly using drench method of application into the soil with the extract solution 2-3 times weekly. The 20 Treatments combination, is a 4 × 5 factorial experiment, each treatment was randomly assigned to the experimental units, in a Completely Randomized Design (CRD), each treatment was replicated three 3 times per treatment combination, making a total of 60 experimental units.

## RESULTS AND DISCUSSION

**Effect of Botanicals extracts and concentrations on plant height, and number of leaves**

Table 1 shows the effects of different plant extracts (*Eucalyptus globulus* bark, *Eucalyptus globulus* leaf, Neem bark, and Neem leaf) and extract concentrations (0 %, 25 %, 50 %, 75 %, and 100 %) on the plant height and number of leaves of eggplants. The tallest plants were observed with the *Eucalyptus globulus* bark extract, achieving a mean height of 57.00 cm, suggesting its potential as a growth promoter. Similar plant heights were recorded for *Eucalyptus globulus* leaf and Neem bark extracts, at 50.86 cm and 50.20 cm, respectively,

**Table1: Effect of Botanicals extracts and concentrations on plant height, and number of leaves at 8 weeks after transplanting**

| Botanical | Plant Height (cm) | Number of Leaves |
|---|---|---|
| *Eucalyptus Globolus leaf* | $50.86^{ab}$ | $21.60^{a}$ |
| *Eucalyptus Globolus bark* | $57.00^{a}$ | $19.20^{a}$ |
| *Azadirachta indica* Neem leaf | $43.53^{ab}$ | $14.80^{b}$ |
| *Azadirachta indica* Neem bark | $50.20^{ab}$ | $21.20^{a}$ |
| LSD | 8.19 | 4 .22 |
| Concentrations (%) | | |
| 0% | $49.83^{a}$ | $19.41^{ab}$ |
| 25% | $51.75^{a}$ | $22.16^{a}$ |
| 50% | $53.33^{a}$ | $17.33^{b}$ |
| 75% | $47.00^{a}$ | $19.75^{b}$ |
| 100% | $48.8^{a}$ | $17.33^{b}$ |
| LSD | 9.16 | 4.72 |

Means in column followed by different letters are significantly different ($P \leq 0.05$) using (LSD) least significant differences

while the Neem leaf extract produced the shortest plants, with a mean height of 43.53 cm. Across the concentration treatments, 0%, 25%, 75%, and 100% concentrations resulted in comparable plant heights (49.83–51.75 cm), indicating no significant ($P \geq 0.05$) growth inhibition. However, the 50% concentration produced significantly shorter plants (17.33 cm), suggesting potential phytotoxic effects at this level. This may be attributed to the presence of bioactive compounds such as essential oils and flavonoids. In contrast, neem leaf extract exhibit growth inhibition properties, potentially due to azadirachtin content. This statement is also in agreement with the report by (Saleem *et al.*, 2018) oil extracts are the most typical used form of Neem and its in-depth phytochemical analysis has confirmed the presence in high amounts of triterpenes, flavonoids and saponins, while other components such as catechins and nimbins, seem to be present in lower amounts other metabolites found in Neem extracts are: limonoids, tannins, alkaloids, terpenoids, reducing sugar, catechins, sterols and gallic acid. *Eucalyptus globulus* leaf and neem *Azadirachta indica* bark have the highest mean number of leaves (21.60) and 21.20 cm), indicating potentials growth promotion. While *Eucalyptus* bark has no significant (P≥0.05) effect (19.20). Neem leaf has the lowest mean number of leaves (14.80), suggesting growth inhibition. The concentration level at 25 % has the highest mean number of leaves (22.16), indicating optimal growth 0%, 75 % concentrations had no significant effects (19.41,19.75). 50% 100% concentrations have significantly lower mean number of leaves (17.33) therefore suggesting phytotoxicity. *Eucalyptus globulus* leaf extracts promote growth at various concentrations, while neem leaf *Azadirachta indica* extract inhibits growths, particularly at higher concentrations. The 25% concentration mitigates Neem leaf extracts inhibitory effects.

**Table: 2 Effect of botanicals extracts and concentration on number of branches, stem girth and yield at first harvest of garden egg**

| Botanicals | Number of Branches | Stem girth | Yield at first Harvest |
|---|---|---|---|
| *Eucalyptus globulus leaf* | 8.13$^{b}$ | 3.60$^{b}$ | 3.60$^{b}$ |
| *Eucalyptus globolus bark* | 8.33$^{ab}$ | 4.00$^{b}$ | 2.86$^{ba}$ |
| Neem leaf *Azadirachta indica* | 9.80$^{ba}$ | 4.13$^{a}$ | 2.26$^{b}$ |
| Neem bark *Azadirachta indica* | 10.00$^{a}$ | 3.73$^{ab}$ | 2.26$^{b}$ |
| LSD | 1.80 | 0.41 | 0.74 |
| Concentration (%) | | | |
| 0% | 9.33b$^{a}$ | 4.00$^{ab}$ | 2.16$^{c}$ |
| 25% | 10.91$^{a}$ | 3.83$^{ba}$ | 3.25$^{a}$ |
| 50% | 8.66$^{b}$ | 4.08$^{a}$ | 2.75$^{ba}$ |
| 75% | 8.66$^{b}$ | 3.83$^{ba}$ | 2.25$^{bc}$ |
| 100% | 7.75$^{a}$ | 3.58$^{b}$ | 3.08$^{ba}$ |
| LSD | 2.02 | 0.46 | 0.83 |

Means in column followed by different letters are significantly different (P≤0.05) using (LSD) least significant differences.

**Effect of botanicals extracts and concentration on number of branches, stem girth and yield at first harvest of garden egg**

Table 2 shows the effects of different plant extracts (*Eucalyptus globulus* bark, *Eucalyptus globulus* leaf, Neem bark, and Neem leaf) and extract concentrations (0 %, 25 %, 50 %, 75 %, and 100 %) on the number of branches, stem girth, and yield at first harvest. *Azadirachta indica* bark produce the highest mean number of branches (10.00), indicating potentials growth promotion while neem leaf and *Eucalyptus globulus* bark have no significant (P≥0.05) effects while *Eucalyptus*, leaf has the lowest mean number of branches (8.13), suggesting growth inhibition. Also 25% concentration had the highest mean number of branches (10.91), indicating optimal growth. While 0% concentration has an intermediate effect (9.33). 50 %,75 %, and 100 % concentrations have significantly lower mean number of branches (8.66, 8.66, and 7.75) thereby suggesting to have phytotoxicity. Neem leaf has the highest mean stem girth (4.13 cm), indicating potentials growth promotion. *Eucalyptus* bark and Neem bark extracts have no significant(P≥0.05) effects.

*Eucalyptus* leaf extracts had the lowest mean stem girth (3.60 cm) suggesting growth inhibition. On the other hand, 50 % concentration has the highest mean stem girth (4.08 cm), indicating optimal growth. 0 %, 25 %, while 75 % concentrations have no significant (P≥0.05) effects. 100 % concentration has significantly lower mean stem girth (3.58 cm) suggesting phytotoxicity. *Eucalyptus* leaf extracts produced the highest mean yield (3.40), indicating potential growth promotion. While *Eucalyptus* bark has an intermediate effect (2.86). Neem leaf and neem bark have the lowest mean yield (2.26), suggesting growth inhibition. On the other hand, 25 % concentration produced the highest mean yield (3.25), indicating optimal growth. 100 % concentration had a similar effect (3.08). 0 %, 50 %, while 75 % concentration have significantly P≤0.05 lower mean yield (2.16, 2.75 and 2.25), suggesting suboptimal growth.

## DISCUSSION

The study shows that the botanical effect on the growth parameters of *Eucalyptus globulus* leaf extract promotes plant height, number of leaves, and stem girth. Neem leaf extracts results to lower number of leaves and number of branches. While on the concentration effects 25 % optimizes plant height, number of leaves, and number of branches. 50 %, and 100 % concentration exhibits phytotoxicity, reducing plant growth. 0% concentrations have suboptimal growth. On the yield parameters of the botanicals *Eucalyptus* leaf extract promotes yield and neem leaf and bark extract inhibits yield. The concentration effect at 25 % optimizes yield,100 % concentration has a positive effect but may lead to phytotoxicity. 0 % concentration exhibits suboptimal growth.in summary *eucalyptus* leaf extract has growth-promoting properties, neem leaf and bark extract have growth-inhibiting properties. Thus, the above observation is in accordance with the report by (Rasyid. *et al*,.2020). *Eucalyptus globulus* leaves, as well as its bark, are rich in pentacyclic triterpenic compounds. Betulonic, betulinic, oleanolic, ursolic, 3-acetyloleanolic and 3-acetylursolic acids and β-amyrin have been identified in the bark and leaves. Optimal concentration of botanicals extracts is crucial for maximizing growth and yield.

## CONCLUSION

The study investigates the effects of *Eucalyptus globulus* and Neem leave and bark extracts and concentrations on morphological parameters and yield of greenish eggplant (*solanum melongena)* the findings from the research work revealed that the application of aqueous extracts of *Eucalyptus* leaves and bark, Neem leaves and bark promoted morphological growth and increased the yield of Eggplant which was an indication that the extracts reduced the population and infestation of root knot nematodes on the plants while reduction in morphological growth and yield of Eggplant resulting from the application of Neem leaf extracts indicated that there was little effect on the control of root knot nematode , therefore *Eucalyptus* leaf extracts performed better than Neem leaf extracts.

## RECOMMENDATIONS

*Eucalyptus* leaf extracts can be used as a natural plant growth promoter in particularly for Eggplants. *Eucalyptus* leaf extracts can be prepared by collecting fresh leaves and grinding or blending it to paste, and mixing it with clean water. Drenching method of application can be use simply by applying the solution as a soil drench around the base of the plants. Application should be at every three days' interval depending on the plant growth stage and environmental conditions. Neem leaf and bark extracts should be used with caution and at optimal concentrations, farmers should start with a lower concentration and gradually increase base on plant response. *Eucalyptus* leaves are cost effective alternative to synthetic chemicals. *Eucalyptus* trees are widely available in Nigeria, making it easily accessible to farmers. Further research is necessary to explore the biochemicals mechanisms driving botanicals natural extracts effects. Optimization of natural plant extracts concentrations for specific plants species is crucial.

## REFERENCES


Abu-Gharbiah, W. I., Alhazmi, A. S. I., Istephan, A., & Dawaba, A. A. (2010). *Plant Nematode in Arab Countries*. Wael Publication House.

Bello, L. Y., Chindo, P. S., & Kumar, N. (2012). Utilization of organic wastes for the management of phyto-parasitic nematodes in developing economies. In S. Kumar (Ed.), *Management of organic waste* (pp. 133-148).

Das, S., Wadud, M. A., Heuer, H., & Khokon, M. A. R. (2021). Genetic variation of *Meloidogyne spp.* of brinjal reveals their difference in pathogenicity and hatching. *Archives of Phytopathology and Plant Protection,* 54(19-20), 2375-2396.

Menjivar, R. D., Dababat, A. A., & Sikora, R. A. (2012). Biological control of *Meloidogyne incognita* on cucurbitaceous crops by the non-pathogenic endophytic fungus *Fusarium oxysporum* strain 162. *International Journal of Pest Management,* 57(3), 70-72.

Naik, M., Agrawal, D., Behera, R., Bhattacharya, A., Dehury, S., & Kumar, S. (2014). Study of anti-inflammatory effect of neem seed oil (*Azadirachta indica*) on infected albino

Oka, Y. (2010). Mechanism of nematode suppression by organic soil amendments – A review.

Rasyid, Z. A., Farida, A., Daud, S. H., Wiwin, S., Wijaya, K. I., & Tangke, A. E. (2020). Bioactivities of Forest Medicinal Plants on Kutai Ethnic (Indonesia) of Tapak Leman (*Hippobroma longiflora* (L) G. Don). *GSC Biological and Pharmaceutical Sciences, 11,* 91-98. https://doi.org/10.30574/gscbps.2020.11.2.0125

Saleem, S., Muhammad, G., Hussain, M. A., & Bukhari, S.N. A. (2018). A comprehensive review of phytochemical profile, bioactives for pharmaceuticals, and pharmacological attributes of *Azadirachta indica. Phytotherapy Research,* 32(7), 1241-1272. https://doi.org/10.1002/ptr.6076

Sharma, M., & Kaushik, P. (2021). Biochemical composition of eggplant fruits: A review. *Applied Sciences,* 11(15), 7078.