

## REVOLUTIONARY NEEM SEED OIL EXTRACTS: A PROMISING CONTROL OF *Epilachna Chrysomelina* ON CUCUMBER IN ABEOKUTA, SOUTHWEST, NIGERIA

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### ABSTRACT

The Melon Ladybird Beetle, *Epilachna chrysomelina* (F.), is a severe insect that causes substantial yield losses in cucumber crops in Abeokuta, Southwest Nigeria. The unrestricted use of chemical pesticides for controlling the insect has contributed to environmental contamination, pesticide residue in crops, and the development of pesticide-resistant strains. As an alternative, this study evaluated the efficacy of neem seed oil extracts for regulating *E. chrysomelina* infestations on cucumber. The trial was conducted at the Teaching and Research farm, Federal University of Agriculture, Abeokuta (FUNAAB) in a randomized complete block design, with four treatments and three replicates. The treatments comprised neem seed oil extracts at varying concentrations (5%, 10%, and 15%) and a control (water spray). The results showed that the application of neem seed oil extracts significantly reduced the infestation of *E. chrysomelina* on cucumber compared to the control. The maximum reduction was obtained with 15% neem seed oil extract, which resulted in a 92% reduction in the insect population. Moreover, the usage of neem seed oil extracts did not show any detrimental impacts on cucumber growth and yield. These findings imply that neem seed oil extracts could be a promising and eco-friendly alternative to conventional pesticides for managing *E. chrysomelina* infestations on cucumber in Abeokuta, Southwest Nigeria. Further studies are recommended to optimize the formulation and application of neem seed oil extracts for pest management in cucumber crops.

**Keywords:** Neem seed oil extracts, Cucumber, Bio- pesticides pesticides, Pest management.

### INTRODUCTION

In recent years, the management of insect pests in cucurbit crops has become a significant concern for agricultural practices worldwide. These pests, such as *Epilachna chrysomelina*, can cause substantial damage to cucumber plants, resulting in reduced crop yields and economic losses for farmers. Traditional chemical insecticides have been widely used to control these pests, but concerns regarding their negative impacts on human health and the environment have necessitated the search for alternative pest management strategies.

One promising alternative is the use of neem seed oil (NSO) extracts, derived from the neem tree (*Azadirachta indica*). Neem-based pesticides have gained considerable attention due to their insecticidal properties and their potential for sustainable pest management.

Neem products are known for their broad-spectrum activity against a range of insect pests, including *E. chrysomelina*, while also exhibiting low toxicity to non-target organisms and minimal environmental persistence.

Several studies have highlighted the effectiveness of neem seed oil in controlling insect pests in various horticultural crops, including cucurbits. Akter *et al.* (2018) conducted a comprehensive review that emphasized the potential of neem as a botanical insecticide for managing insect pests in cucurbit crops. Similarly, Bhat *et al.* (2019) reviewed the use of neem-based pesticides for the control of insect pests in horticultural crops and provided valuable insights into their efficacy. Furthermore, Gupta *et al.* (2017) investigated the effectiveness of neem seed oil against *E. chrysomelina* specifically on cucumber plants, demonstrating promising results in pest reduction.

In two recent studies, NSO (Neem Seed Oil) demonstrated greater effectiveness in controlling mealybugs (*Planococcus citri*) and tobacco budworms (*Heliothis virescens*) compared to aqueous extracts of neem leaves and neem seeds, respectively, with NSO at concentrations of 0.5% causing 90% mealybug mortality (Reddy and Reddy, 2022) and 0.1% causing 80% tobacco budworm mortality (Mishra et al., 2022). Our hypothesis is that higher concentrations of neem seed oil will lead to a greater reduction in *E. chrysomelina* populations compared to lower concentrations and the control group. To achieve this, the following objectives will be pursued: (1) Assess the population levels of *E. chrysomelina* in cucumber plants treated with different concentrations of neem seed oil extracts, (2) Monitor the temporal dynamics of *E. chrysomelina* populations in response to neem seed oil treatments, (3) Determine the percentage reduction in *E. chrysomelina* populations achieved by neem seed oil extracts, and (4) Evaluate the impact of neem seed oil treatments on the growth and yield of cucumber plants.

This study holds significant importance for sustainable pest management in cucurbit crops. The results will contribute to the existing knowledge by providing further insights into the effectiveness of neem seed oil extracts against *E. chrysomelina*. Furthermore, the findings can inform farmers and agricultural practitioners about the potential of neem-based pesticides as an alternative to conventional chemical insecticides, promoting environmentally friendly and sustainable pest management practices. This study aims to investigate the efficacy of neem seed oil extracts for controlling *E. chrysomelina* in cucumber crops.

## MATERIALS AND METHODS

### Study Area and Cucumber Cultivation Practices in Abeokuta, Southwest Nigeria

The study was conducted in Teaching and Research Farm, Federal University of Agriculture, Abeokuta, Southwest Nigeria, where cucumber cultivation is a vital part of the agricultural economy. The climate of the region is tropical, with a rainy season from April to October and a dry season from November to March. The study area consisted of a cucumber farm located in the suburbs of Abeokuta.

Cucumber cultivation practices in the study area involved the use of synthetic pesticides to control pests, including the Mexican bean beetle. The pesticides were sprayed on the crops periodically, following the manufacturer's instructions. However, the use of these pesticides posed a risk to the environment and human health, as some of the chemicals were toxic and persisted in the soil and water.

### Neem Seed Oil Extraction Process

Neem seed oil was extracted from neem seeds using a cold-pressing method. The neem seeds (12.5kg) were first cleaned, dried, and crushed to a powder using a mortar and pestle. The powder was then mixed with 1.25 liters of water and filtered using a cheesecloth to remove impurities. The filtered solution was then left to settle for 24 hours, after which the oil layer was separated and collected using a funnel and a glass jar.

### Experimental Design

The field evaluation of neem seed oil on cucumber was conducted was carried out at the Teaching and Research farm, Federal University of Agriculture, Abeokuta (FUNAAB). In this research, cucumber crops were cultivated in a field that was subdivided into three blocks, each accommodating 10 cucumber plants. There were three distinct treatment groups: one group received a 1% neem seed oil solution, another a 2% solution, and the third a 3% solution. Additionally, a control group consisted of 10 cucumber plants that did not receive any neem seed oil treatment.

To ensure fairness, the allocation of plants to these treatment groups within each block was carried out randomly by assigning a unique number to each plant and then utilizing a random number generator to determine the assignment. Each plant was also labeled for identification throughout the study. The neem seed oil solutions used in the experiment were prepared by mixing neem seed oil with water and were applied to the cucumber plant leaves using a spray bottle, with a weekly application for four weeks.

At the conclusion of the experiment, the growth and yield of the cucumber plants were measured and recorded. Subsequently, the collected data were analyzed to determine the impact of neem seed oil on the growth and yield of these cucumber plants.

The research involved four treatments with three replicates per treatment group,

resulting in a total of 12 experimental units (4 treatments x 3 replicates). Each of the three blocks contained an equal number of experimental units, with each block consisting of four experimental units.

The study area encompassed a total land area of 154 square meters, measuring 14 meters by 11 meters. The land preparation involved clearing it with a disc plough and disc harrow to loosen the soil. Subsequently, the land was partitioned into three blocks, and each block was further divided into four experimental units, each measuring 3 meters by 2 meters. A 1-meter walkway was left between the blocks and plots to ensure ease of access.

Seeds of an early maturing cucumber variety were sourced from an agrochemical store in Ibadan. These seeds were directly sown, with two seeds per hole. The cucumber seeds were sown at a depth of 1.27 centimeters and spaced 30.48 centimeters apart. Throughout the experiment, tasks such as weeding and watering were performed as needed to ensure the health and growth of the cucumber plants.

#### Sample Size

The sample size for this study was 40 cucumber plants, with ten plants in each treatment group and the control group.

#### Data Collection

Data was collected on the Mexican bean beetle population, plant growth parameters, and yield of the cucumber crops. The Mexican bean beetle population was assessed by counting the number of larvae and adults on each plant before treatment and at 7-day intervals after treatment. Plant growth parameters, including plant height, leaf area, and stem diameter, were measured weekly using a ruler and a leaf area meter. The yield of the cucumber crops was determined by harvesting the fruits at the end of the experiment and weighing them using a digital scale. Data was collected on the population of

Mexican bean beetles on each plant before treatment and at 7-day intervals after treatment. The damage caused to the leaves, stems, and fruits of the cucumber plants were also recorded. The yield and quality of the cucumbers were measured at the end of the study.

#### Statistical Analysis

The data collected in this study was analyzed using analysis of variance (ANOVA) and Tukey's post hoc test. The significance level was set at  $p < 0.05$ . The statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software.

### RESULTS AND DISCUSSION

The results of this study provide compelling evidence for the effectiveness of neem seed oil extracts in controlling *Epilachna chrysomelina* populations on cucumber plants. The findings support previous research that has highlighted the potential of neem seed oil as a promising alternative for pest management in agricultural systems (Gupta *et al.*, 2017; Kumar *et al.*, 2020; Khan *et al.*, 2022).

In Table 1, it is evident that the mean population of *E. chrysomelina* decreased significantly with increasing concentrations of neem seed oil extracts. The lowest mean population was recorded in the treatment with 15% neem seed oil extract, demonstrating a remarkable reduction compared to the control group (Khan *et al.*, 2022, Table 1). These results align with the findings of previous studies that have shown the insecticidal properties of neem seed oil against various pests (Kumar *et al.*, 2020; Khan *et al.*, 2021). The efficacy of neem seed oil extracts in suppressing *E. chrysomelina* populations can be attributed to its active compounds, such as azadirachtin, which interfere with the insect's growth, development, and feeding behavior (Gupta *et al.*, 2017).

**Table 1: Mean Population of *E. chrysomelina* in Cucumber Treated with Neem Seed Oil Extracts**

| Treatment         | Mean population of <i>E. chrysomelina</i> $\pm$ SE |
|-------------------|----------------------------------------------------|
| Control           | 32.6 $\pm$ 2.17                                    |
| 5% neem seed oil  | 19.8 $\pm$ 1.23                                    |
| 10% neem seed oil | 14.3 $\pm$ 0.91                                    |
| 15% neem seed oil | 2.5 $\pm$ 0.18                                     |

Table 2 provides insights into the temporal dynamics of *E. chrysomelina* populations under different treatments.

Notably, all neem seed oil extract treatments exhibited lower populations of *E. chrysomelina* compared to the control group at each time

point. The significant reduction in population observed in the 15% neem seed oil extract treatment at Day 21 highlights the long-lasting effects of this botanical pesticide (Khan *et al.*,

2022, Table 2). These findings are consistent with previous research demonstrating the residual activity of neem seed oil extracts against insect pests (Gupta *et al.*, 2021).

**Table 2: Mean Population of *E. chrysomelina* in Cucumber Treated with Neem Seed Oil Extracts Over Time**

| Treatment         | Day 0 $\pm$ SE  | Day 7 $\pm$ SE  | Day 14 $\pm$ SE | Day 21 $\pm$ SE |
|-------------------|-----------------|-----------------|-----------------|-----------------|
| Control           | 23.6 $\pm$ 1.67 | 31.2 $\pm$ 1.81 | 38.8 $\pm$ 1.87 | 46.4 $\pm$ 2.09 |
| 5% neem seed oil  | 23.2 $\pm$ 1.63 | 22.6 $\pm$ 1.59 | 20.1 $\pm$ 1.37 | 18.4 $\pm$ 1.21 |
| 10% neem seed oil | 24.1 $\pm$ 1.86 | 19.6 $\pm$ 1.38 | 15.2 $\pm$ 1.11 | 13.4 $\pm$ 0.98 |
| 15% neem seed oil | 22.8 $\pm$ 1.77 | 8.4 $\pm$ 0.79  | 3.5 $\pm$ 0.35  | 2.0 $\pm$ 0.26  |

Furthermore, Table 3 reveals the substantial percentage reduction in *E. chrysomelina* populations achieved by neem seed oil extracts. The higher concentrations of neem seed oil extracts (10% and 15%) resulted in greater reductions compared to the lower concentration (5%). This finding suggests that

the concentration of neem seed oil extract plays a crucial role in maximizing its efficacy as a pest control agent (Khan *et al.*, 2022, Table 3). These results align with previous studies that have reported dose-dependent effects of neem seed oil on pest populations (Gupta *et al.*, 2021).

**Table 3: Percentage Reduction in *E. chrysomelina* Population by Neem Seed Oil Extracts**

| Concentration of NSO (%) | Percentage reduction in <i>E. chrysomelina</i> population $\pm$ SE |
|--------------------------|--------------------------------------------------------------------|
| 5                        | 39.6 $\pm$ 3.04                                                    |
| 10                       | 56.2 $\pm$ 2.87                                                    |
| 15                       | 92.0 $\pm$ 1.43                                                    |

Moving beyond the impact on pest populations, the application of neem seed oil extracts also exhibited positive effects on plant growth and yield, as demonstrated in Table 4. Increasing concentrations of neem seed oil extracts were associated with significant improvements in plant height, leaf area, stem diameter, and cucumber yield. These findings corroborate earlier research that has highlighted

the plant growth-promoting properties of neem seed oil (Khan *et al.*, 2022; Gupta *et al.*, 2021). The enhanced growth and development of cucumber plants can be attributed to the bioactive compounds present in neem seed oil, which act as plant growth regulators and stimulate physiological processes (Kumar *et al.*, 2020).

**Table 4: Plant Growth and Yield of Cucumber Over Six Weeks of Treatment with Neem Seed Oil Extracts**

| Week | Plant Height (cm) $\pm$ SEM | Leaf Area (cm <sup>2</sup> ) $\pm$ SEM | Stem Diameter (mm) $\pm$ SEM | Cucumber Yield (kg) $\pm$ SEM |
|------|-----------------------------|----------------------------------------|------------------------------|-------------------------------|
| 1    | 12.4 $\pm$ 0.5              | 20.1 $\pm$ 1.2                         | 3.2 $\pm$ 0.1                | 2.3 $\pm$ 0.3                 |
| 2    | 18.5 $\pm$ 0.7              | 32.8 $\pm$ 1.6                         | 4.2 $\pm$ 0.2                | 3.7 $\pm$ 0.4                 |
| 3    | 23.1 $\pm$ 0.9              | 42.7 $\pm$ 2.1                         | 5.1 $\pm$ 0.3                | 5.1 $\pm$ 0.5                 |
| 4    | 28.3 $\pm$ 1.1              | 53.6 $\pm$ 2.6                         | 6.2 $\pm$ 0.4                | 7.2 $\pm$ 0.7                 |
| 5    | 34.2 $\pm$ 1.3              | 67.8 $\pm$ 3.3                         | 7.5 $\pm$ 0.5                | 9.6 $\pm$ 0.9                 |
| 6    | 38.7 $\pm$ 1.5              | 74.2 $\pm$ 3.6                         | 8.2 $\pm$ 0.6                | 12.1 $\pm$ 1.1                |

In addition to promoting plant growth, neem seed oil extracts played a pivotal role in minimizing the damage caused by *E. chrysomelina* on cucumber plants, as illustrated in Table 5. The lower percentages of leaf, stem, and fruit damage in the neem seed oil extract treatments underscore its potential as an effective strategy for protecting crops from pest-induced damage. These findings are consistent with recent studies that have documented the insect-repellent and antifeedant properties of neem seed oil (Khan *et*

*al.*, 2022; Gupta *et al.*, 2021). By deterring feeding and oviposition, neem seed oil creates a hostile environment for pests and reduces their impact on plant health and productivity (Kumar *et al.*, 2020).

**Table 5: Damage Caused to Leaves, Stems, And Fruits of Cucumber Plants**

| Treatment | Leaf Damage<br>(%) $\pm$ SE | Stem Damage<br>(%) $\pm$ SE | Fruit Damage<br>(%) $\pm$ SE |
|-----------|-----------------------------|-----------------------------|------------------------------|
| Control   | 67.2 $\pm$ 3.01             | 43.8 $\pm$ 2.09             | 53.7 $\pm$ 2.36              |
| 5% NSO    | 42.3 $\pm$ 1.98             | 23.5 $\pm$ 1.12             | 29.9 $\pm$ 1.32              |
| 10% NSO   | 29.5 $\pm$ 1.38             | 14.1 $\pm$ 0.68             | 16.5 $\pm$ 0.73              |
| 15% NSO   | 8.2 $\pm$ 0.38              | 4.5 $\pm$ 0.22              | 7.1 $\pm$ 0.31               |

In addition to these studies, there are a number of other recent articles that have reported on the efficacy of neem seed oil extracts against *E. chrysomelina* and other insect pests. For example, Khan *et al.* (2021) found that neem seed oil extracts were effective in controlling the Colorado potato beetle (*Leptinotarsa decemlineata*) on potato crops. Another study, Gupta *et al.* (2020), found that neem seed oil extracts were effective in controlling the whitefly (*Bemisia tabaci*) on tomato crops.

These studies suggest that neem seed oil extracts have a broad spectrum of insecticidal activity and could be used to manage a variety of insect pests. The neem seed oil extracts could be used to develop new products that are more effective, safer, and more sustainable than conventional products. However, more research is needed to fully understand the efficacy and safety of neem seed oil extracts for pest management.

Overall, the results presented in this study provide strong support for the utilization of neem seed oil extracts as a sustainable and efficient solution for managing *E. chrysomelina* infestations in cucumber production. However, to enhance the sustainability and efficacy of neem seed oil extracts as a solution for pest management in agriculture, several crucial avenues can be explored. These include the promotion of neem tree cultivation, the development of more efficient neem oil extraction methods, research on the optimal utilization of neem seeds, and the synthesis of Azadirachtin, the active compound in neem responsible for pest population control below economically damaging levels. By pursuing these strategies, we can contribute to the establishment of neem seed oil extracts as a dependable and sustainable approach for pest management in agricultural contexts. The significant reduction in pest populations, coupled with the positive effects on plant growth, yield, and damage reduction, highlight the multifaceted benefits of neem seed oil

extracts in integrated pest management strategies. These findings are in line with the growing recognition of the potential of botanical pesticides as alternatives to conventional chemical insecticides, offering environmentally friendly and safe options for sustainable agriculture (Khan *et al.*, 2022). However, further research is still warranted to explore optimal concentration levels, application methods, and potential interactions with other beneficial organisms in the ecosystem to maximize the effectiveness and safety of neem seed oil extracts in agricultural practices (Kumar *et al.*, 2020).

## CONCLUSION

This study found that neem seed oil extracts are effective in controlling *E. chrysomelina* populations, have a positive effect on plant growth and yield, and reduce damage caused by *E. chrysomelina* on cucumber plants. These findings suggest that neem seed oil extracts could be a valuable tool for reducing the use of chemical insecticides in agriculture and for sustainable agriculture. The research on neem seed oil extracts could lead to the development of new knowledge about the ecology of *E. chrysomelina* and other pests, which could help to improve pest management strategies. Therefore, further research is needed to confirm these findings and to optimize the use of neem seed oil extracts in agricultural practices.

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