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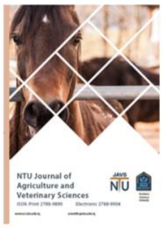

# Antifeeding effect of some plant extracts on tobacco cutworm Spodoptera litura (Lepidoptera: Noctuidae)

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**A B S T R A C T**

A study was conducted to test the anti-nutritional effect of ethanolic extracts of *Nerium oleander*, *Melia azedarach*, *Mentha arvensis* , and *Ocimum basilicum* plants on fifth-instar larvae of the tobacco cutworm *Spodoptera litura*, where *N. oleander*, *M. azedarach*, plants showed activity in preventing larval feeding. The results showed that the extract of *N.oleander* leaves, *M azedarach* leaves, and fruits was significantly superior to *M. arvensis* and *O. basilicum* leaves in all tested criteria. The values of the nutrition prevention factor reached (55.5, 51.4, 51.3, 16.9, and 10.9%), respectively, while the values of the leaf protection rate reached (59.7, 57.3, 59.3, 25.7, and 20.6%) , respectively. This variation in anti-nutritional activity may be due to the variation in the types and concentrations of the active alkaloid and phenolic compounds revealed by chemical analysis. The statistical analysis showed that there was a positive and significant correlation between the nutritional intake factor and the alkaloid compounds Atropine and Xanthine, whose values reached( 0.943 and 0.947), respectively, and a significant correlation with the two phenolic compounds, Galic acid and Rutine, whose values reached (0.860 and 0.864), respectively. Hence, it can be said that *N.oleander* , *M azedarach* plants can be alternative materials to pesticides in pest management programs that rely on compounds that are safe for the environment and human health.

# Introduction

Scientists have increased their knowledge of the actual harmful effects of the intensive use of synthetic pesticides, and the direction of research has changed to find new solutions alternative to synthetic pesticides that are more environmentally friendly, friendly, highly efficient, and have low levels of environmental degradation [1] . Plant-based insecticides are the ideal alternative to synthetic pesticides. They are natural substances that can be obtained from environmental components such as plants, microorganisms, animals, and some minerals as natural substances that can control pests with non-toxic or low-toxic mechanisms [2] . It has also been reported that several plant extracts of several higher plants showed anti-feeding properties in laboratory experiments [3] and [4] . This led researchers to screen a large number of plant extracts in the laboratory for their deadly and anti-feeding activity against several important insect pests. The different parts of most of these plants contain a complex group of chemical complicated with unique biological activity, such as terpenes, alkaloids, glycosides, and phenols. [5] , which affects the nervous system, amino transfer processes, energy transfer processes, and inhibition of the acetylcholinesterase enzyme. Non-chemical technologies, including synthetic biocides (plant extracts), are safer for human health and the environment. [6] . Therefore, there is an urgent need for discoveries regarding new natural pesticides to prevent damage to crops and the environment. Much scientific research literature has indicated that *N. oleander*, *M, azedarach*, *M. arvensis* and *O. basilicum* plants contain chemical complicated with biological activity [7] , [8] , [9] . The study aimed to test the effect of extracts of these plants on some nutritional parameters of tobacco cutworm larvae, which would ultimately reduce the population of this insect pest.

# Materials and Methods

The study was conducted in the Entomology Laboratory/Plant Protection Department/College of Agriculture and Forestry .Healthy leaves of oleander, safflower, mint, and basil plants were collected, in addition to the safflower fruits. They were washed with water, then they were spread in the laboratory away from direct sunlight for five days. The samples were then ground, then a weight of 10 grams was taken from each sample and placed in a glass baker. 50 ml of alcohol (ethanol) was added to it. The samples were shaken and then placed on an electric shaker for 24 hours. The liquid was then filtered with filter paper and the filtrate was placed in glass bottles. The filtrate was then placed in a rotary evaporator device under rarefied pressure at a temperature of 45°C in order to evaporate the solvent (methanol) and get rid of it. The concentrated crude extract, free of solvent residue, was then placed in clean glass bottles. Harbornd, 1984.

Ten Disk of known weight from Swiss chard leaves were treated with 20% ethanolic *N.oleander* leaf extract by immersing them in the extract solution for 10 seconds. The disk were dried in a laboratory condition and then transferred individually to plastic containers. After that, Fifth instar larvae were transferred to These plastic containers are individually packaged. The plastic pots were then placed in an incubator at a temperature of 27°C and a humidity of 60%, and the larvae were left to feed on the leaf discs of the Swiss chard plant. After 24 hours, the remaining plant discs were weighed individually, and the larvae were weighed after feeding. The same process was repeated for the rest of the extracts (*M azedarach* leaves, and *M. azedarach* fruits , *M. arvensis* leaves and *O. basilicum* leaves), while the chard disk in the control experiment were treated with distilled water. The experiment was designed in a completely randomized design(RCD) with 10 replicates of each plant extract in addition to the control treatment so that the number of experimental units became 60 experimental units. The percentage of the feeding rate, the feeding prevention factor, the starvation rate, as well as the plant protection rate, and the Consumption rate, were calculated using the equations [10] , [11].

**Feeding%** = Disk Space - Area of the remaining part in treetment / Disk Space -Aera the remaining part in control*100

**Antifeeding Index (AFI) %** = 1- Consumption rate in the transaction / Consumption rate in the comparison *100

$$\textbf{Starvation}\ \% = \frac{A - B}{A} * 100$$

Where

A: The difference in the weight of individuals before and after the comparison

B: the difference in the weight of the individuals before and after the treatment

**Consumption %** = area of the consumed part/area of the paper before the transaction * 100

**Protection%** = area of the leaves before the transaction – area of the consumed part / area of the paper before the transaction * 100

To interpret the results, plant extracts were analyzed using HPLC technology to determine the quality and quantity of biologically active alkaloid and phenolic compounds and to determine their relationship to nutritional indicators through statistical correlation analysis.

**Results and discussion :**

**First:** The effect of plant extracts on the feeding rate of leaf-biting larvae.

shows Table (1) that the feeding rate of tobacco cutworm larvae varied depending on the type of plant extract, as the ranged between (34.98 - 75.55)%, and the larvae feeding on leaves treated with *M. arvensis* and *O. basilicum* extract recorded the highest feeding rates of (72.23, 75.55)%. respectively. While feeding rates were low in larvae treated with extracts of *N.oleander* leaves, *M. azedarach* leaves, and *M. azedarach* fruits, their averages reached 36.50, 37.80, and 34.98%, respectively. The analysis showed that there were significant differences

between the averages at a probability level of 0.05. The table also indicates the relatively large area of food remaining without nutrition in the pellets treated with extracts of *N. oleander* leaves, leaves, and fruits of *M. azedarach* , which amounted to 38.2, 34.5, and 33.1 cm². This indicates the inefficiency of *O. basilicum* and *M. arvensis* leaves in preventing caterpillar feeding.

The reason may be due to the presence of alkaloid compounds ( Atropine , Rutine , Xanthine , Quinie) In safflower and oleander extracts in larger quantities than mint and basil, the correlation analysis showed that there was a significant negative correlation between the aforementioned compounds with the feeding rates of the larvae, and the correlation values reached 0.968, 0.835, 0.931, and 0.826, respectively. Table No. (2). The results were consistent with what was indicated by [12] , that the tobacco Cutworm fed on *M. arvensis* naturally without any effects.

**Table 1**. The effect of some plant extracts on the feeding rate of fifth-instar larvae of tobacco cutworm *S.litura*

| No. | extracts | | Disk space before nutrition in treatment | The area of the remaining part in treatment | The area of the remaining part in comparison | Average feeding rate% | |
|---|---|---|---|---|---|---|---|
| | Plant | Vegetal part | | | | range | Average |
| 1 | *N.Oleander* | Leaves | 63.8 | 38.2 | 7.3 | 33.6 –39.8 | 36.50±2.5 b |
| 2 | *M azedarach* | Leaves | 60.2 | 34.5 | 7.3 | 32.3– 46.6 | 37.80±4.6 b |
| 3 | *M azedarach* | fruits | 55.9 | 33.1 | 7.3 | 26.6– 42.8 | 34.98±5.9 b |
| 4 | *M. arvensis* | Leaves | 68.2 | 18.2 | 7.3 | 64.6– 87.1 | 72.23±8.6 a |
| 5 | *O. basilicum* | Leaves | 65.8 | 14.0 | 7.3 | 71.3- 77.5 | 75.55±2.3 a |

Similar letters within one sector mean that there are no significant differences at the probability level 5%.

**Table 2.** Correlation values for the relationship between some nutritional standards and concentrations of alkaloid and phenolic compounds in plant extracts.

| | Alkaloidal compounds | | | Phenolic compounds | |
|---|---|---|---|---|---|
| | Atropin | Quine | Xanthin | Galice acid | Rutine |
| feeding | -0.931 ** | -0.826 * | -0.968 ** | -0.805 | -0.835 * |
| AFI | 0.943 ** | 0.765 | 0.947 ** | 0.860 * | 0.864 * |
| Starvation | 0.854 * | 0.725 | -0.952** | 0.833 * | 0.742 |
| Consumption | -0.941** | -0.764 | -0.944** | -0.860 * | -0.86 * |
| Protection | 0.934 ** | 0.840 * | 0.956 ** | 0.828 * | 0.840 * |

**Second:** The effect of plant extracts on the feeding inhibition index of larvae.

Table (3) shows that the average nutritional inhibition factor (AFI) was the highest possible for the *N.oleander* leaf extract, which amounted to 55.52%, while it was the lowest possible for the *O. basilicum* leaf extract, which amounted to 10.97%, followed by the *M. arvensis* leaf extract, which amounted to 16.93, as no significant differences appeared between the two averages. Here we find The factor of nutritional inhibition was good and high with the *N. oleander* plants, while it was not the case with the *O. basilicum* and *M. arvensis* plants. A positive and highly significant correlation was found with the two alkaloid compounds Atropine and Xanthine, and their values reached 0.943, and 0.947, respectively, while the correlation was positive and significant with the two phenolic compounds, Galic acid and rutine, and their values reached 0.860, o.864, respectively, Table (2).

**Table 3.** Effect of food treated with plant extract on the average feeding inhibition factor (AFI) of tobacco cutworm larvae *S. litura*.

| No. | Extracts | | The area of the eaten part in the treatment cm² | The area of the untreated eaten part is cm² | AFI % | |
|---|---|---|---|---|---|---|
| | Plant | Vegetal part | | | Range | Average |
| 1 | *N.Oleander* | Leaves | 25.58 | 69.72 | 43.5 - 69.4 | 55.5±7.9 a |
| 2 | *M azedarach* | Leaves | 26.34 | 69.72 | 34.5 - 61.5 | 51.4±8.7 a |
| 3 | *M azedarach* | fruits | 24.12 | 69.72 | 42.1 - 64.4 | 51.3±7.3 a |
| 4 | *M. arvensis* | Leaves | 49.85 | 69.72 | 3.0 – 34.8 | 16.9 ± 13.2 b |
| 5 | *O. basilicum* | Leaves | 52.57 | 69.72 | 0 – 26.2 | 10.9±10.7 b |

Similar letters within one sector mean that there are no significant differences at the probability level 5%.

The results agreed with what was reported by [13] , that the nutritional inhibition factor for *N.oleander* plants at a concentration of 15% was 72%. The results were also close with [14] , that the nutritional inhibition factor for the *O. basilicum* plant extract at a concentration of 15% reached 33.7. The results also agree with [15] , that the use of Niimbecidine (0.03 Azadrichtin) against the fourth instar of cotton leafworm larvae at concentrations of 500, 100, and 10 ppm gave a feed prevention factor of 30.1, 16.0, and 6.1%, respectively. Researchers [16] indicated that the feeding prevention index was very low for the *O. basilicum* plant among several plant extracts tested in the experiment. [17] indicated that the *O. basilicum* plant had no effect in preventing tobacco cutworm larvae from feeding and reached the nutritional restriction index value of (zero) when extracted with diethyl ether and dichloromethane solvents.

**Third:** The effect of plant extracts on the Starving rate of larvae.

The results of the experiment showed a variation in the weights of the larvae, as the weights of the larvae fed on food treated with *M. arvensis* and *O. basilicum* extract exceeded and reached 0.74 and 0.72 grams, respectively. The values were reflected in the starvation rate, as starvation values showed a decrease with *M. arvensis* and *O. basilicum* extracts while

Starving rates were high with *N. Oleander* and *M. azedarach* extracts, and the values reached 13.10, 30.95, 54.76, 50, and 53.57%, respectively, Table (4). A significant positive correlation was found with the compounds Atropine and Galic acid, and the values reached 0.854, 0.833, Table (2).

**Table 4.** Effect of food treated with plant extract on the average Starving rate of tobacco cutworm larvae.

| NO. | Extracts | | Weight of larvae per treatment/g | | The difference in weight of larvae in comparison/g | Starvation rate % | |
|---|---|---|---|---|---|---|---|
| | Plant | Vegetal part | Before feeding | After feeding | | range | Average |
| 1 | *N.Oleander* | Leaves | 0.72 | 0.84 | 0.114 | 50– 66.6 | 54.7 a±8.1 |
| 2 | *M azedarach* | Leaves | 0.51 | 0.62 | 0.118 | 33.3 - 66.6 | 50 a±9.6 |
| 3 | *M azedarach* | fruits | 0.51 | 0.62 | 0.114 | 33.3 - 75 | 53.5 a±13.4 |
| 4 | *M. arvensis* | Leaves | 0.57 | 0.74 | 0.171 | 0 - 50 | 30.9 b±8.4 |
| 5 | *O. basilicum* | Leaves | 0.54 | 0.72 | 0.214 | 0– 33.3 | 13.1 c±6.2 |

Similar letters within one sector mean that there are no significant differences at the probability level 5%.

The results agreed with [18] , where indicated a decrease in the weights of pink cotton cutworm larvae by 50% when fed on food treated with *N. oleander* leaf extract. The results were also close to [19] , that the use of *M. azedarach* fruit extract in a concentration of 5 mg/m led to a reduction in the weight of tobacco cutworm larvae by 35% in the second instar and by 55% in the sixth instar. Researchers [20] indicated that treatment with plant extracts leads to the Starving of feeding larvae at different rates depending on the type of extract. He stated that the rates of Starving of tobacco cutworm larvae when fed with garlic and lemon extracts amounted to 55.7 and 16%, respectively. [21] also indicated that treating fall armyworm larvae with *N. oleander* extract led to a reduction in the weights of the larvae in different percentages depending on the concentration of the extract, and the percentage of weight reduction reached 34% when treated with a concentration of 0.88%.

Fourth: The effect of plant extracts on the rate of food consumption by larvae.

Table (5) shows that the consumption rate of food treated with *O. basilicum* and *M. arvensis* extract was the highest possible and amounted to 80.50 and 74.64%, respectively. This means that the food was palatable to some extent, while the rates of food consumption were low with the rest of the extracts, as the averages reached 40.24. 43.88, and 43.92% for each of the extracts of *M. azedarach* leaves, *N. oleander* leaves, and *M. azedarach* fruits, respectively. This gives evidence of the anti-Feeding behavior of these natural pesticides due to the presence of alkaloid and phenolic compounds, which were inversely and significantly related, such as Atropine, Galic acid, Rutine, and Xanthine, where the values reached 0.941, 0.860. , 0.862, 0.944 respectively.

The results agreed with what was reported by [21] , that fall armyworm larvae decreased their food consumption when treated with *N. oleander* extract, the concentration of 0.88%, compared to the control experiment, where the averages of food consumed reached 162 and 665 mg, respectively, after twenty days of treatment. The results were also similar. [15] , found that the use of Niimbecidine (0.03 Azadrichtin) against the fourth instar of cotton leafworm larvae at concentrations of 500, 100, and 10 ppm, the amount of food consumed was 125, 168, and 206 milligrams, respectively. This is evidence that the higher the concentration of Azadrichtin, the lower the consumption rate. It is a toxic substance and a nutritional deficiency, as there is an inverse relationship between the rate of food consumption and the concentrations.

Regarding pesticides, [22] indicated in their test of the effect of sublethal concentrations of the pesticides Orizon, Siltac, Cyromazine, and Recharge, that they varied in their effect on the rates of larval consumption of treated food, and he mentioned that the growth promoter Cyromazine was the best among pesticides, as it gave the lowest rate of food consumption. The average coefficient reached 16.49%. Researchers [17] also indicated that the tested plant extracts caused a reduction in the amount of food consumed by tobacco cutworm larvae, which indicates that death may be mostly due to the effects of malnutrition.

**Table 5.** Effect of food treated with plant extract on the average consumption of tobacco cutworm larvae.

| NO. | Extracts | | The area of the consumed part in the treatment | The area of the paper before the treatment | Consumption rate % | |
|---|---|---|---|---|---|---|
| | Plant | Vegetal part | | | range | Average |
| 1 | *N.Oleander* | Leaves | 25.6 | 63.9 | 28.5- 51.5 | 40.24±8.2 b |
| 2 | *M azedarach* | Leaves | 26.3 | 60.2 | 35– 61.4 | 43.88 ± 8.7 b |
| 3 | *M azedarach* | fruits | 24.1 | 55.9 | 33.3 - 50 | 43.92 ±7.2 b |
| 4 | *M. arvensis* | Leaves | 49.9 | 68.2 | 61.1 – 84 | 74.64 ±10.3 a |
| 5 | *O. basilicum* | Leaves | 52.6 | 65.9 | 68.7– 100 | 80.50 ±12.3 a |

Similar letters within one sector mean that there are no significant differences at the probability level 5%.

**Fifth:** The effect of plant extracts on the rate of Plant protection.

The results presented in Table (6) showed that there are significant differences between the averages of protection for the tested extracts, as the extracts of *N.oleander* leave, *M. azedarach* fruits, and *M. azedarach* leaves were significantly superior to *M. arvensis* and *O. basilicum* leaves in protecting the treated plant leaves, and the rates reached 59.76, 59.34, 57.31. , 25.74 and 20.66%, respectively. The table also shows that the amount of food consumed was high for the *M. arvensis* and *O. basilicum* extracts, reaching 49.8 and 52.5 cm², while the area of the consumed portion was the least possible for the *M. azedarach* fruit extract, amounting to 24.1 cm². As in the previous criteria, the protection rate was positively and significantly associated with the compounds Atropine and Routine. , Xanthine, and Galic acid, and the values reached 0.934, 0.840, 0.956, and 0.828, respectively. This is consistent with what was indicated by researcher [12] , that the tobacco Cutworm consumed large quantities of *M. arvensis* leaves without any effect.

**Table 6.** Effect of food treated with plant extract on average plant protection from feeding by tobacco cutworm larvae .

| NO. | Extracts | | Disk space before nutrition into the treatment | The area of the consumed part | Protection rate % | |
|---|---|---|---|---|---|---|
| | Plant | Vegetal part | | | range | Average |
| 1 | *N.Oleander* | Leaves | 63.8 | 25.5 | 48.4 - 71.4 | 59.76±8.2 a |
| 2 | *M azedarach* | Leaves | 60.2 | 26.3 | 38.6– 66.6 | 57.31±9.6 a |
| 3 | *M azedarach* | fruits | 55.9 | 24.1 | 50 - 72.6 | 59.34±8.9 a |
| 4 | *M. arvensis* | Leaves | 68.2 | 49.8 | 16.6 – 38.8 | 25.74±7.6 b |
| 5 | *O. basilicum* | Leaves | 65.8 | 52.5 | 0 - 31.2 | 20.66±12.7 b |

Similar letters within one sector mean that there are no significant differences at the probability level 5%.

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