Al-Turath Journal for Biology (ATJB)
Open Access Journal
ISSN Print: 3080-5732
ISSN Online: 3080-5740

The Lethal Effect of the Insecticide Deltamethrin and Basil (*Ocimum basilicum*) Seed Extract on the Larvae of the Corn Stem Borer *Sesamia cretica* L. (Lepidoptera: Noctuidae)

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KEYWORDS
Basil; larvae; deltamethrin; Sesamia cretica; corn stem borer; mortality

Received: 05/08/2025
Accepted: 16/09/2025
Available online:30/09/2026

ABSTRACT
This study was conducted in the Department of Biology, Faculty of Education, University of Samarra, with the aim of controlling the larvae of the corn stem borer *Sesamia cretica* L. using the chemical insecticide deltamethrin, determining its efficacy against the larvae, and comparing it with the petroleum-ether seed extract of basil (*Ocimum basilicum*) to identify which agent was more effective in eliminating the pest. Three concentrations of deltamethrin (0.25, 0.5, and 1 ml/L) were tested, with distilled water only serving as a control, over exposure periods of 24, 48, and 72 hours for each concentration. Likewise, three concentrations of the basil seed extract (0.5, 1, and 2 ml/L) were tested under the same control and exposure conditions. Each concentration was applied in three replicates, with ten larvae per replicate. Both the insecticide and the plant extract showed high efficacy in eliminating the pest: the chemical insecticide was most effective at 1 ml/L after 72 hours, whereas the plant extract was most effective at 2 ml/L after 72 hours. The results confirmed a direct relationship between increasing concentration, exposure time, and mortality rate, and indicated that the larvae of the corn stem borer were highly susceptible to all treatments under investigation.

DOI: https://doi.org/10.63964/atjb.2025.3.6
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1. INTRODUCTION

Yellow maize plants are subject to infestation by large numbers of corn stem borers, causing substantial crop losses and severe economic damage in many countries, particularly across Europe, the Americas, Mexico, Canada, Iran, Egypt, Iraq, Jordan, Libya, Saudi Arabia, Tunisia, and Morocco [1]. Basil is an aromatic herbaceous plant belonging to the family *Lamiaceae*, and is known by several common names such as sweet basil. It is distinguished by its fragrant aroma and characteristic flavour, which make it widely used in food, traditional medicine, and the pharmaceutical industry. Deltamethrin is a synthetic pyrethroid insecticide that exhibits a very high level of activity against a wide range of insects, including Lepidoptera, Hemiptera, Diptera, and Coleoptera. It acts through both direct contact and ingestion and is used mainly for crop protection (about 85% of total use), of which roughly 45% is applied to cotton, 25% to fruit and vegetable crops, 20% to cereals, maize, and soybean, and the remaining 10% to various crops such as coffee. It is also used in public-health programmes (against Chagas disease and malaria) and to protect stored products, especially grains, coffee beans, and dry beans, and can be applied in livestock facilities [2].

The most distinctive features separating the male from the female in *S. cretica* are the smaller body size of the male and its pectinate antennae, whereas the female possesses filiform antennae. The male also bears two tufts of setae at the end of the abdomen surrounding the clasper, while the female has a single tuft surrounding the ovipositor. A single female lays, on average, between 45 and 225 eggs [3]. The female deposits her eggs on the inner surface of the leaf sheaths; after hatching, the larvae begin to bore into the stem. Following a period of feeding on plant tissues, the growing apex of the stem is damaged and dries out, leading to the condition known as "dead heart." Overwintering occurs in late autumn, and the larval stage lasts about five weeks on average. The pupa forms within roughly two weeks, and in early spring the first-generation adults usually emerge between June and July [4]. In cases of severe infestation, the larvae continue feeding on the stem contents and move into the cob, infesting and feeding on its contents [5].

Some researchers have resorted to the use of plant extracts as alternatives or complements to chemical insecticides, since they are safe natural materials that are degraded by microorganisms and environmental factors within a short time, in addition to their high efficacy against insects and their low toxicity to humans, mammals, and beneficial insects [6]. The present study aimed to evaluate the efficacy of the petroleum-ether seed extract of basil against the corn stem borer *S. cretica* under laboratory conditions, and to compare the efficacy of the chemical insecticide deltamethrin with that of the basil seed extract in killing the corn stem borer *S. cretica* under laboratory conditions.

2. MATERIALS AND METHODS

2.1. Study site and period

The present study was carried out in the Postgraduate Studies Laboratory, Department of Biology, Faculty of Education, University of Samarra, during the period from October 2025 to April 2026.

2.2. Laboratory rearing of the corn stem borer Sesamia cretica

Sites were selected in Salah al-Din Governorate / Samarra District, where large numbers of *S. cretica* were present owing to the availability of maize crops infested by stem borers during the autumn season, when the insect is active. These fields were not treated with insecticides in order to ensure accurate experimental results, during the months of June, July, and August. The species *S. cretica* was identified at the University of Baghdad / Research Centre / Natural History Museum. Specimens were collected in plastic containers of 1 L capacity prepared for this purpose from infested plants and transferred to the incubator under laboratory conditions at a temperature of 26 ± 2 °C, a relative humidity of 65 ± 5%, and a photoperiod of 10–14 hours. They were then placed in the rearing cage for the corn stem borer, the dimensions of which were 85 cm length × 50 cm width × 85 cm height.

2.3. Preparation of the plant extract for controlling S. cretica

Extraction was performed using the organic solvent petroleum ether by means of a Soxhlet apparatus and a vacuum rotary evaporator [7]. The basil extract was prepared in the laboratory of the Faculty of Education, University of Samarra. The seeds of the plant used in the present study were ground with an electric mill (Miller Electric). A 100 g portion was placed in the thimble (tubular filter paper) of a Soxhlet extractor fitted with a 500 ml flask containing 250 ml of petroleum ether (95%). Extraction was carried out for 48 hours at 55–60 °C. After extraction, the extract was concentrated using a vacuum rotary evaporator and the Soxhlet apparatus in the Central Laboratory for Postgraduate Studies at the University of Samarra, at 55–60 °C, to remove residual solvent until a dense, gel-like liquid was obtained, i.e., after the petroleum ether had ceased evaporating. The process was repeated several times until sufficient quantities of the concentrated extract were obtained. The extract was subsequently placed in dark glass bottles and stored in the refrigerator until use [8].

2.4. Preparation of the required concentrations of the plant extract

To obtain the required concentrations (stock solution), 1 g of the basil seed extract was placed in a 100 ml glass container, to which 99 ml of distilled water was added. Polysorbate 80 (Tween 80) was then added dropwise to the mixture (distilled water and extract) until a uniform, easily mixable and sprayable suspension was obtained, thereby yielding a stock solution of 1% (equivalent to 10,000 ppm). Using Dalton's dilution equation $C_1V_1 = C_2V_2$, the working concentrations applied in the experiment were prepared, namely 0.5, 1, and 2 ml/L. The control consisted of distilled water only.

2.5. Preparation of the insecticide concentrations for controlling S. cretica

Different concentrations of the insecticide deltamethrin were prepared, namely 0.25, 0.5, and 1 ml/L, in accordance with the manufacturer's recommendations, and each concentration was made up to 1000 ml with distilled water. In the control, distilled water only was used without the insecticide. Each concentration was applied in three replicates, with ten larvae of *S. cretica* per replicate. Results were recorded after 24, 48, and 72 hours. The highest mortality of *S. cretica* was obtained after 72 hours at a concentration of 1 ml/L. The insecticide kills the target insect through contact and through damage to the insect gut by contaminating the food, leading to disruption of the digestive tract of the target insect. The field dose recommended by the manufacturer is 0.8 ml/L, diluted with water, with a pre-harvest safety interval of 3 days, according to the manufacturer's instructions printed on the product label.

2.6. Statistical analysis

Results were analysed statistically using the MINITAB program (version 17) according to one-way analysis of variance (ANOVA). Means were compared using Duncan's multiple-range test at a significance level of $p \leq 0.05$ [9].

3. RESULTS AND DISCUSSION

The results in Table 1 revealed significant differences in mortality rates for the interaction between concentration and exposure period. The highest mortality, 96.7%, was recorded 72 hours after treatment, while the lowest, 3.3%, was recorded 24 hours after treatment. With respect to concentration, the highest mean mortality (74.4%) occurred at 2 ml/L, whereas the lowest (10.0%) occurred at 0.5 ml/L. With respect to exposure period, the highest mean mortality (50.0%) was recorded after 72 hours and the lowest (26.6%) after 24 hours. These results indicate that the mortality of the corn stem borer increased with increasing concentration and exposure period.

Table 1. Effect of the petroleum-ether seed extract of basil on the larvae of the corn stem borer (mortality %).

Concentration (ml/L)	24 h	48 h	72 h	Mean (by conc.)
0.5	3.3 d	10.0 d	16.7 d	10.0 C
1	23.3 c	36.7 b	36.7 b	32.2 B
2	53.3 b	73.3 a	96.7 a	74.4 A
Control	0 g	0 g	0 g	0.00
Mean (by time)	26.6 b	40.0 a	50.0 c	—

Means followed by different letters differ significantly at $p \leq 0.05$ (Duncan's multiple-range test).

The present findings are consistent with those of Hassan [10] on the insecticidal activity of the powders of *Teucrium polium*, wild sesame *Sesamum spinosa*, and *Sterculia palestina* against the corn stem borer, in which the powders of *T. polium* and wild sesame achieved complete (100%) mortality at a 5% concentration five days after exposure. The results also agree with Khalaf [11], who confirmed the high efficacy of the leaf extract of basil *O. basilicum*, in which mortality reached 100% of adults at a low concentration of 0.12 mg/ml and over short exposure periods, in addition to its significant effect on larval mortality. This shared toxic superiority is attributed to the

ability of secondary metabolites and active compounds in these plants to penetrate the insect body wall and inhibit its vital activity, which explains the success of our plant extracts in achieving complete elimination of the insect stages.

Table 2. Effect of the chemical insecticide deltamethrin on the larvae of the corn stem borer (mortality %).

Concentration (ml/L)	24 h	48 h	72 h	Mean (by conc.)
0.25	16.7 d	26.7 cd	33.3 c	25.5 C
0.5	66.7 b	66.7 b	73.3 b	68.9 B
1	80.0 b	100.0 a	100.0 a	93.3 A
Control	0 g	0 g	0 g	0.00
Mean (by time)	54.4 b	66.6 b	66.6 a	—

Means followed by different letters differ significantly at $p \leq 0.05$ (Duncan's multiple-range test).

The results in Table 2 revealed significant differences in mortality rates for the interaction between concentration and exposure period. The highest mortality, 100%, was recorded 72 hours after treatment, while the lowest, 16.7%, was recorded 24 hours after treatment. With respect to concentration, the highest mean mortality (100.0%) occurred at 1 ml/L, whereas the lowest (25.5%) occurred at 0.25 ml/L. With respect to exposure period, the highest mean mortality (93.3%) was recorded after 72 hours and the lowest (54.4%) after 24 hours. These results indicate that the mortality of the corn stem borer increased with increasing concentration and exposure period. These results agree with the study of Atef et al. [12], who reported a decline in whitefly numbers from 94.6% to 50% during the cultivation period when this insecticide was used. This reduction in the numbers of this insect pest encouraged a shift toward the use of biological insecticides for controlling agricultural pests, owing to their low side effects on human health, the environment, and natural enemies, together with their high efficacy against insects. The present findings are also consistent with those of Ghosh [13], who studied the use of the insecticide Spinosad against *Sesamia cretica*, obtaining 60% mortality at a 5% concentration three days after treating the adults.

4. CONCLUSION

The chemical insecticide deltamethrin showed high efficacy in eliminating the insect, leading to mortality of the corn stem borer three days after treatment, with a direct relationship between concentration and mortality rates. The petroleum-ether seed extract of basil showed clear efficacy against the corn stem borer *Sesamia cretica* under laboratory conditions three days after treatment, with a direct relationship between concentration and mortality rates.

5. RECOMMENDATIONS

• The use of plant extracts at low concentrations is recommended for controlling other agricultural pests that cause economic losses and crop damage.

• Continued studies on the corn stem borer using biological insecticides are recommended, in order to reduce the use of harmful chemical insecticides and to assess their compatibility and efficacy in insect control.

• Numerous studies should be conducted in Salah al-Din Governorate to identify and record other species belonging to the genus of the corn stem borer.

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