

## **Evaluation of the biological and chemical efficacy of certain pesticides against the cabbage bug *Brevicoryne brassicae* under laboratory conditions**

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### **Abstract**

A series of laboratory experiments were conducted at the Plant Protection Department of the Faculty of Agriculture, University of Kerbala, to evaluate the effectiveness of the chemical pesticide (Conan) and *Trichoderma harzianum* suspension concentrate in controlling insect larvae and adults. Cabbage leaves were prepared and 40 individuals of each of the larvae and adults were placed on them separately. The leaves were then placed in plastic dishes with a diameter of 9 cm, and a piece of cotton moistened with distilled water was placed in each dish to ensure constant humidity. The results showed that the pesticide Conan at concentrations of 25 and 50 g/100 L of water achieved the highest mortality rates of 100% for larvae 72 hours after treatment, while mortality rates for adults reached 85.1% and 85.7%, respectively. The results also showed that concentrations of  $10^4$  and  $10^8$  spores/ml of the fungus led to high mortality rates, especially 72 hours after treatment, as the larvae were more sensitive than the adults. The results indicate the possibility of incorporating biological alternatives into integrated pest management programs to reduce dependence on chemical pesticides.

### **Introduction**

Due to the increasing global interest in plant production as a primary source of food, especially vegetable production, vegetable crops have become one of the most important food crops as a source of organic acids and vitamins. Cabbage, in particular, is of great nutritional importance due to its content of important nutrients, most notably vitamin C. The Food and Agriculture Organization of the United Nations (FAO) has classified cabbage among the 20 most important plant crops as a globally significant food source[7]. Winter

vegetables belonging to the Cruciferae family are grown in Iraq, including *Brassica olearacea* var. Capitata, due to their nutritional content of carbohydrates, calcium, phosphorus, iron, and vitamin C, in addition to protein [14] Despite the prominent and significant role that chemical pesticides play in agriculture and health, most studies and research agree that the widespread and irrational use of these pesticides leads to environmental pollution, which has a negative impact on humans, animals, and other living organisms[2]. Only

0.1% of pesticides affect the target species, while the rest is distributed in the air, soil, and water, resulting in negative effects on other non-target organisms, which in turn constitute one of the requirements for biological balance in the environment [1·10·6]

The study of chemical pesticide residues is an important issue in all developing countries, including Iraq, because some farmers do not adhere to the post-treatment period or the doses recommended by the manufacturer to ensure that the product is safe for human consumption[3]. Countries around the world and international organizations such as the World Health Organization (WHO), the Food and Agriculture Organization (FAO), and the United States Environmental Protection Agency (USEPA) (USEPA) and the European Food Safety Authority (EFSA) have issued Maximum Residue Limits (MRLs)[7].

The values of (MRL) and (ADI Acceptable Daily Intake) vary greatly for a selected pesticide between countries or groups, depending on the system adopted by each country or group in determining these values. The law or system followed in European countries and the United States is characterized by its leniency in terms of the values allowed for each pesticide, followed by Australian and New Zealand law, which is more restrictive, while the laws followed by Scandinavian countries are more stringent and restrictive in terms of these values[22]. The excessive and irrational use of pesticides has led to an increase in cancer and other environmental hazards as a direct result of pesticide residues. Therefore, the optimal use of pesticides and compliance with the conditions for the use, manufacture, and distribution of pesticides by the relevant

authorities are important measures to reduce the damage caused by their residues[4].

Some modern systemic pesticides also rely on their effect on nicotinic acetylcholine receptors (nAChRs) in the insect's nervous system, leading to disruption of nerve transmission, paralysis, and death[17].

In contrast, biological control has emerged as a promising alternative, with the fungus *Trichoderma harzianum* being widely used in agriculture due to its ability to secrete enzymes that break down the insect's body wall and produce secondary compounds that are toxic to insects[16].

*Trichoderma harzianum* is one of the most widely used biofungi in biological control and integrated pest management programs, due to its wide range of biochemical and physiological mechanisms that enable it to affect many agricultural pests and pathogens. Recent studies have indicated that this fungus is characterized by its ability to adapt to different agricultural environments and produce a wide spectrum of effective bioactive compounds, which enhances its efficiency as an alternative or complementary biocontrol agent to chemical pesticides in integrated pest management programs [13·11]Enzymes that break down the components of insect cuticle are among the most important mechanisms of biological action of this fungus. *Trichoderma harzianum* produces extracellular enzymes such as chitinase and protease that break down the chitin and proteins that make up the insect's body wall, facilitating the penetration of fungal hyphae into the cuticle and their spread within the insect's body, thereby disrupting the insect's vital functions and ultimately killing it [12·18].

Fungi also produce a range of secondary metabolites such as peptibols, polyketides, shown that these compounds directly contribute to the increased efficiency of fungi in controlling many insect pests [21]Based on these biochemical and biological characteristics, *Trichoderma harzianum* is considered a promising biocontrol agent in integrated pest management (IPM) programs, combining several modes of action, including the production of degradative enzymes and bioactive secondary compounds, in addition to its ability to interact with the agricultural ecosystem and promote biological balance, which contributes to reducing dependence on chemical pesticides and achieving sustainability in agricultural production systems[23].

is a biotic fungus widely used in biological control, as it has the ability to secrete

## Materials and methods

Laboratory experiments were conducted in the laboratories of the Plant Protection Department, Faculty of Agriculture, University of Karbala.

## Diagnosis of insects

A sufficient number of insects were collected from infected cabbage plants, placed in plastic bags, and used in subsequent laboratory experiments. The insect was identified by M.D. Thamer Salman Jabr and M.M. Zahra Jawad Kazim.

## Study of the effect of different concentrations of the pesticide Conan on nymphs and adults of the

and terpenes, which have toxic or inhibitory effects on insect activity. Studies have enzymes that break down the insect's body wall (such as chitinase and protease), as well as producing secondary compounds that are toxic to insects, making it a promising agent in integrated pest management programs[13'20].

The cabbage bug *Brevicoryne brassicae* is one of the most important pests of cruciferous crops, causing direct damage by sucking plant sap and indirect damage by transmitting pathogens, and showing varying sensitivity to chemical pesticides and biocontrol agents[5].

Based on the above, the objective of this study was to evaluate the biological and chemical efficacy of certain pesticides in controlling the insect *Manella* under laboratory conditions.

## leafhopper under laboratory conditions.

Leaves from the *Allium* plant were prepared and 40 individuals of each of the nymphs and adults were placed on them separately. The leaves were placed in plastic dishes with a diameter of 9 cm and a piece of cotton moistened with distilled water was placed in each dish to ensure constant moisture. Three replicates were made for each, then sprayed with 25 and 50 g concentrations of the pesticide Conan. of the pesticide Conan, then sprayed each dish using a 5 ml syringe. The control treatment was sprayed with sterile distilled water only, and the numbers of live and dead individuals were recorded after 24, 48, 72 hours after treatment and placed in an incubator at a temperature of  $25\pm 2$  °C and relative

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humidity of 70%. The percentage of mortality was calculated according to the

Orell and Schneider equation.

Loss ratio in transaction – loss ratio in comparison

$$\text{Mortality rate} = \frac{\text{Loss ratio in transaction} - \text{Loss ratio in comparison}}{\text{Loss ratio in comparison}} * 100$$

100- Mortality rate in comparison

**Study of the effect of different concentrations of the pesticide ----- on nymphs and adults of the leafhopper under laboratory conditions**

The fungus *Trichoderma harizanium* was obtained from the Ministry of Science and Technology. Leaves from the plant were prepared and 40 individuals of each of the nymphs and adults were placed on them separately. The leaves were placed in plastic dishes with a diameter of 9 cm and a piece of cotton moistened with distilled water was

placed in them to ensure constant humidity, with three replicates for each. They were then sprayed with concentrations of 1\*410 and 1\* 610 and 1\*810 of the fungicide *Trichoderma harizanium*. Each dish was then sprayed using a 5 ml syringe. The control treatment was sprayed with sterile distilled water only. The number of live and dead individuals was recorded after 24, 48, 72 hours after treatment and placed in an incubator at a temperature of 25±2 °C and relative humidity of 70%. The percentage of mortality was calculated according to the Orell and Schneider equation

Mortality rate in the treatment – mortality rate in the comparison

$$\% \text{ mortality} = \frac{\text{Mortality rate in the treatment} - \text{Mortality rate in the comparison}}{\text{Mortality rate in the comparison}} * 100$$

100- Mortality rate in the comparison.

**Statistical analysis**

Statistical data analysis was performed using Two-way ANOVA to study the effects of pesticide concentration, time period, and

their interaction on the mortality rate. Means were compared using the Revised Least Significant Difference (R.L.S.D.) test at a significance level of 0.01

## Results and Discussion

The results showed that the chemical pesticide (Conan) had a high toxic effect on the nymphs of the cabbage bug *Brevicoryne brassicae*, with a 100% mortality rate 72 hours after treatment for both concentrations (25 and 50 g/100 L of water). This indicates high efficacy of the pesticide under the approved laboratory conditions, with no significant differences between the two concentrations, suggesting that the lower concentration was sufficient to produce the maximum toxic response within the time frame studied. The results also showed a clear statistical effect of the time factor, with mortality rates

increasing gradually over time, reflecting the cumulative effect of the pesticide within the insect's body. The high sensitivity of nymphs compared to adults can be explained by their physiological and anatomical characteristics, including lower cuticle hardness and higher metabolic rate, which increase the rate of absorption of the active substance and its effect on the nervous system. In adult insects, mortality rates reached 85.1% and 85.7% for concentrations of 25 and 50 g/L, respectively, after 72 hours, with no significant differences between the two concentrations, while the time factor had a highly significant effect. This reflects that the adult stage shows a relatively higher degree of tolerance compared to nymphs, without affecting the overall trend of toxic response[15].

With regard to biological treatment, *Trichoderma harzianum* spores showed remarkable effectiveness in causing high mortality rates in nymphs and adults, especially at a concentration of  $10^8$  spores/ml after 72 hours of treatment. It was also observed that mortality rates increased with longer exposure times, confirming the time-dependent effect of biocidal agents. No significant differences were recorded between the studied concentrations of fungi in both stages, but the time factor had a highly significant effect, indicating that the success of fungal infection depends largely on allowing sufficient time for spore germination, penetration of the insect body wall, and secretion of digestive enzymes. Nymphs also showed higher sensitivity compared to adults, which can be explained by the weaker cuticle thickness and ease of penetration in incomplete stages[19].

Taken together, these results indicate that both chemical and biological treatments showed clear efficacy under laboratory conditions, with the chemical pesticide showing a marked advantage in terms of speed of reaching maximum mortality, while the biological fungus showed a gradual, time-dependent efficacy. These data support the possibility of integrating biological agents with chemical pesticides within integrated pest management (IPM) programs to achieve a balance between efficacy and environmental safety.

**Table (1) Effect of different concentrations of the pesticide Conan on the mortality of cabbage aphids**

age concentration	r hour	entration g/liter
t		
		parative treatment
		age time period effect
R.L.S.D. <sup>0.01</sup> pesticides	11.22 time	8.69 interference19.44

**Table (2) Effect of different concentrations of the pesticide Conan on the mortality of adult cabbage moths**

age concentration	r hour	entration g/liter
t		
		parative treatment
		age time period effect
R.L.S.D. <sup>0.01</sup> pesticides	7.28 time	5.63 interference12.60

## Effect of different concentrations of *T. harizanium* mushroom suspension on nymphs and adults of the leafhopper

The results showed that concentrations of 1\*810 and 1\*410 of *T. harizanium* fungus resulted in high mortality rates for both nymphs and adults of the leafhopper. Figure 1 shows that a concentration of 1\*810 resulted in high mortality rates for nymphs and adults 72 hours after treatment. It was also observed that the fungus achieved a high mortality rate on nymphs compared to adult insects. No significant difference was observed between nymphs and adults. In terms of the effect of time, it was observed that the mortality rate of adult insects 72 hours after treatment did not differ

The increased concentration led to a higher mortality rate. The effectiveness of the fungus may be due to its production of certain extracellular enzymes, as demonstrated by [9] that some pathogenic fungi

significantly from that 48 hours after treatment, while there was a difference in the percentage of nymphs between 72 and 24 hours after treatment.

The results in Figure 2 showed that the concentration of 1\*410 achieved a high kill rate after 72 hours of treatment in both nymphs and adults, and that the results differed significantly after 72 hours of treatment for both stages.

The results showed no significant differences between the two concentrations on nymphs and adults, while a highly significant effect of time was observed, as the killing rate increased with time.

produce extracellular enzymes in liquid media. The fungus affected the aphid *Aphis craccivora*, resulting in a mortality rate ranging from 58-91% seven days after treatment

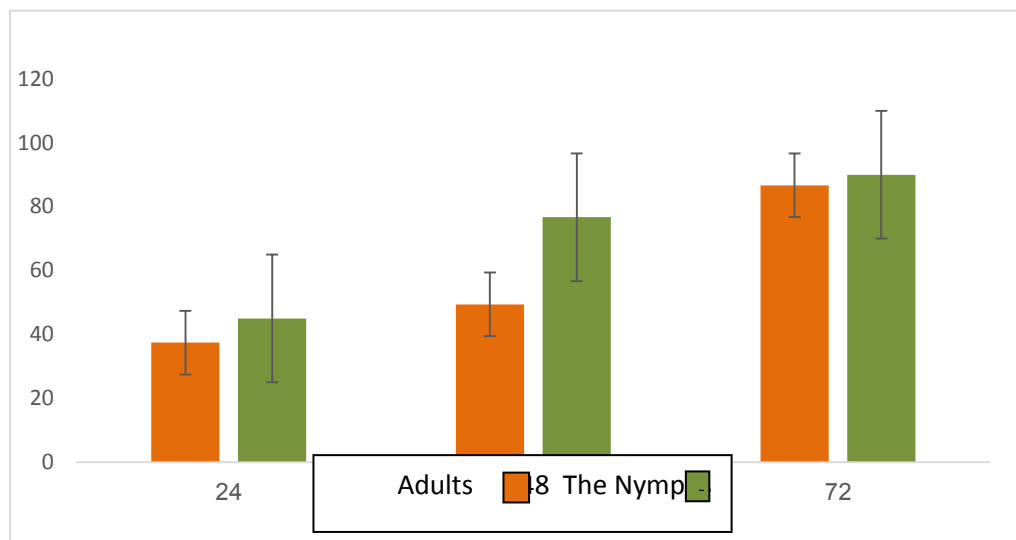


Figure 1. Effect of 1\*810 concentration of *T. harizanium* fungus on nymphs and adults of the aphid

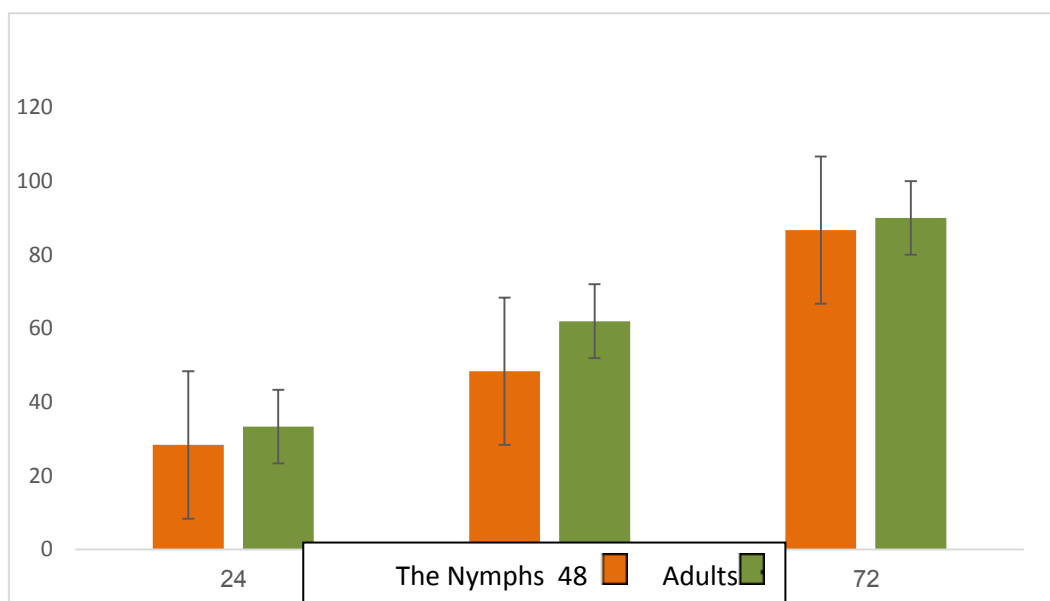


Figure 2. Effect of 1\*410 concentration of *T. harizanium* fungus on nymphs and adults of the aphid

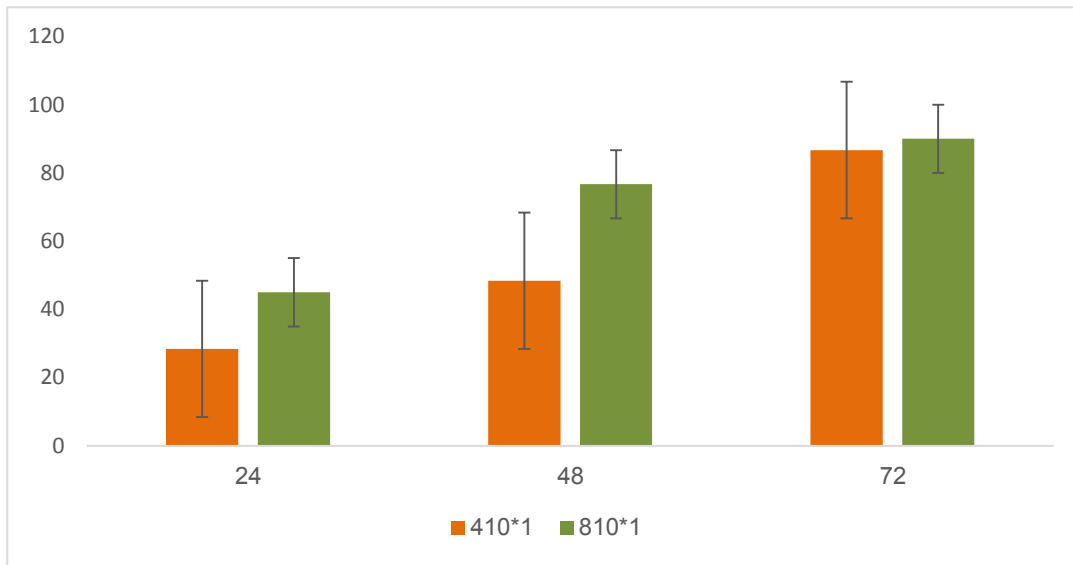


Figure 3. Effect of different concentrations of *T. harizanium* fungus on the mortality of adult aphid.

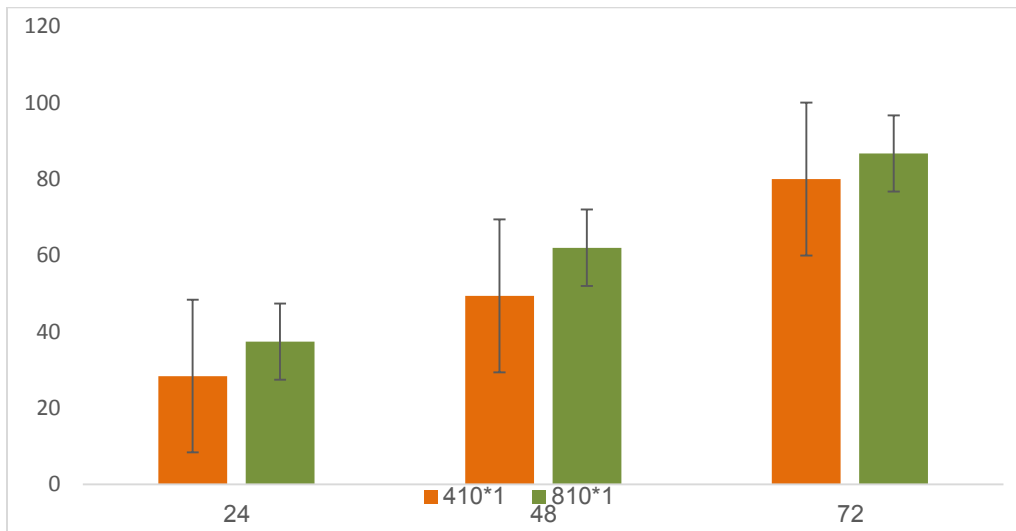


Figure 4. Effect of different concentrations of *T. harizanium* fungus on the mortality of adult aphid

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