International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 20s, (2025)
https://theaspd.com/index.php/ijes

Testing some elements of Integrated Pest Management (IPM) in controlling the whitefly (Hemiptera: Aleyrdidae) Bemisia tabaci in Samarra

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Abstract:
The effect of different concentrations of Spinnosad on whitefly death was also evident. The highest percentage was 0.500 ml/L after 72 hours of treatment, while the lowest percentage was 23.3% at a concentration of 0.125 ml/L after 24 hours of treatment. Biotach 16% AS concentrations achieved high fly killing rates. Different concentrations of resulted in high fly killing rates, with the highest killing rate being 100% at a concentration of 1.0 ml/L after 72 hours of treatment, while the lowest killing rate was 30.0% at a concentration of 0.25 ml/L after 24 hours of treatment. As for the pupae, after treatment with Biotach 16 AS, the highest killing rate was at a concentration of 1.0 ml/L after 72 hours of treatment, while the lowest killing rate was 13.3% at a concentration of 0.25 ml/L after 24 hours of treatment. The effect of different concentrations of plant extracts on whitefly mortality was assessed. The highest percentage of whitefly mortality was achieved at a concentration of 0.500 ml/L after 72 hours of treatment, while the lowest percentage of mortality was 23.3% at a concentration of 0.125 ml pesticide/L after 24 hours of treatment. The results of the current study confirmed a direct relationship between increasing concentration, exposure time, and percentage mortality. The percentage of whitefly mortality was more sensitive to all treatments under study.
key words: *Bemisia tabaci, , Biotach, IPM, , Spinnosad*

INTRODUCTION:

The species of whiteflies belonging to the family Aleyrodidae and belonging to the order Hemiptera are among the most dangerous pests that infect many agricultural crops around the world, as they are capable of feeding on a wide range of crops inside the greenhouse and cause material losses to agricultural production in the world, the Arab world and Iraq. The percentage of losses due to this pest between 1980 and 2000 was approximately 10 billion dollars (1).

Microbial biopesticides are among the most important alternatives to chemical pesticides, with global sales reaching $3.3 billion annually (2).

in addition to the negative side effects of chemical pesticides on the environment and beneficial organisms such as parasites, predators, bees, flower pollinators, and domestic animals, as well as the impact of their residues on the health of consumers (3), the use of physical control has many benefits, including that insects are unable to develop resistance against them, unlike chemical pesticides, and that they contribute to controlling all insect roles (4).

Control using chemical pesticides has a rapid and significant effect on insects, but they cause great damage to humans, animals, plants, soil, and the environment. Chemical pesticides affect targeted and non-targeted insects, and their cost is high, in addition to their persistence in animal and plant tissues, which leads to the emergence of resistance in vectors [4].

The insecticide (Diphenyl-Dichloro-Trichloroethane) DDT was among the first pesticides used to control arthropods that transmit diseases. It was originally sprayed to combat malaria and typhus during World War II , With the end of the war, DDT became used to control mosquitoes that transmit malaria after it was proven Its effectiveness in Europe. Through the application of DDT, malaria infection rates decreased significantly throughout the world. In 1947, the first resistance to DDT appeared in Anopheles taeniorhynchus mosquitoes. *Bemisia tabaci* in Baghdad became resistant and tolerant to high concentrations of DDT, despite widespread resistance, For both organophosphorus pesticides and

brothroids, large numbers of their pesticides are still used to control *Bemisia tabaci*, largely because there are very few effective alternatives [5].
Biopesticide: Spinosad is one of the pesticides that has been recently used in pest control and is a natural metabolic product produced by Actinomycetes bacteria, For the spinosa species, Saccharopolyspor Spinosad is a mixture of two types of metabolites, Spinosy A and Spinosyn B, which are deadly infectious toxins when taken orally, as it has a direct effect on the nervous system of the insect, as it works in binding to the Nicotinic Acetyl cline receptor of the insect and thus causes involuntary movement of the body's muscles that It results in tremors and paralysis of the insect's body, all chemical pesticides, regardless of their method of action, will lead to the emergence of resistance in the target species, and thus the necessity of finding new pesticides to replace them, In addition to that, the unintended harm to non-target species that results from the application of pesticides determines their benefit [6]

The aim of the study

1- Evaluation of the effectiveness of the chemical pesticide Biotac, Spinosad on the whitefly *Bemisia tabaci.*

2- The killing effect of chemical pesticides and its comparison with biological pesticides on the whitefly *Bemisia tabaci*.

MATERIALS AND METHODS:

The current study was conducted in the Graduate Studies Laboratory / Samarra University / College of Education / Department of Life Sciences / from August 2024 to March 2025 AD. 2-3- 2 Laboratory rearing of the whitefly *Bemisia tabaci*:
Sites were selected from Salah al-Din Governorate / Samarra District / Al-Huwaish, where large quantities of the whitefly *Bemisia tabaci* are present, due to the availability of crops infested by the fly during the summer. The insect is active in large numbers, and these farms were not treated with pesticides to ensure accurate results in the experiments conducted in our study during the months of June, July, and August. *Bemisia tabaci* was classified at the University of Baghdad / Research Center / Museum of Natural History in book number (10) dated (February 13, 2024), issue 240. *Bemisia tabaci* were collected in 1-liter plastic containers prepared for this purpose. The leaves of the plants infected with the insect were transferred to the incubator under laboratory conditions at a temperature of 26 ± 2°C, a relative humidity of 5 ± 65%, and a light period of 10-14 hours. They were then placed in the rearing cage. The whitefly *Bemisia tabaci* had dimensions of 85 cm length x 50 cm width x 85 cm height.

Whitefly rearing cage *Bemisia tabaci* (designed by the researcher)
Preparing Biotac chemical pesticide concentrations to eliminate whiteflies.
Various concentrations of Biotac were prepared, including 1, 0.5, and 0.25 ml/L, according to the manufacturer's recommendations. 1000 ml of distilled water was added to each concentration. For the control, distilled water alone was used without the pesticide. Three replicates were used for each concentration, with 10 *Bemisia tabaci* flies in each replicate after 24, 48, and 72 hours. The results were

recorded, showing that the highest *Bemisia tabaci* kill rate was achieved after 72 hours at a concentration of 1 ml/L.
Trade name: Biotech AS 16%
Active ingredient: Abilomactin
Recommended dosage by the manufacturer: 0.5 ml/L
Producer: HOUSE AGRICULTVRE
Production date: 09/2022
Expiration date: 09/2025
Different concentrations of spinosad pesticide were prepared, namely (0.125, 0.250, 0.5) ml/liter, and 1000 ml of distilled water was added to each concentration. As for the control, only distilled water was used without adding the pesticide for a period of (24, 48, 72) hours.
Trade name: Mozkill
Active ingredient: spinosad 12%
Dosage recommended by the manufacturer: 1 ml/L
the Producing company:
Production date: 2023/6
Effective date: 6/2025
For each concentration, three replicates of mosquito larvae were used after 24, 48 and 72 hours. The results were recorded and it was found that the highest percentage of killing larvae was after 72 hours at a concentration of 0.5 ml/l The same previous steps were performed on the.

Active ingredient of Biotech pesticide:
The dose used for Biotech pesticide is 1 ml/liter. The pesticide should be diluted with water. The shelf life is 3 days. It can be diluted with water according to the manufacturer's recommendations on the pesticide package.

The term AS for Biotech pesticide:
It is a formulation obtained by suspending insoluble solid pesticides to produce a liquid that can be applied in a sprayer or directly sprayed.

The killing effect of Biotech AS 16%:
A slow-acting toxicant compared to some other chemical pesticides for controlling whiteflies, such as pyrethroids and organophosphates. Despite the characteristic toxicity symptoms that occur within several hours, the highest mortality rate occurs within 72 hours.
Different concentrations of the chemical pesticide Biotac were prepared, namely (0.25, 0.5, 1) ml/liter, and 1000 ml of distilled water was added to each concentration. As for the control, only distilled water was used without adding the pesticide for a period of (24, 48, 72) hours. Mortality was recorded after 24, 48, and 72 hours of treatment.

Statistical Analysis:

The results analyzed statistically by applying the statistical program (MINITAB VER.17) according to the Anova analysis test (Anova), the mathematical averages were compared according to the Duncuns Multiple Range test and at a possibility of $0.05 \geq p$ [7].

RESULTS

The results of the table showed significant differences in the killing rates due to the interaction between concentration and exposure duration, as the highest rate was 96.7% after 72 hours of treatment, while the lowest killing rate was 33.3% after 24 hours of treatment, while the average killing rate with the effect of concentration showed that the highest killing rate was at a concentration of 0.625, reaching 76.67%, while the lowest average killing rate was at a concentration of 0.250, reaching 31.10%. As for the average killing rate with the effect of killing duration, the highest killing rate was after 72 hours, reaching 74.47%, and the lowest killing rate was after 24 hours, 33.30%. The results showed that the whitefly killing rate increased with increasing concentration and treatment duration.

The results of Table 16 showed the effect of different concentrations of Spinnosad pesticide on whitefly mortality, indicating significant differences in the mortality rates due to the interaction between concentrations and exposure duration. The highest percentage of fly mortality was 96.7% at a concentration of 0.250 ml pesticide/liter after 48 hours of treatment, while the lowest percentage of mortality was 0.13% at a concentration of 0.625 ml pesticide/liter after 24 hours of treatment. The average mortality rates according to the effect of concentrations showed that the highest mortality rate was at a concentration of 0.250 ml pesticide/liter, reaching 76.70%, while the lowest average mortality rate was at a concentration of 0.125 ml pesticide/liter, reaching 35.53%. The average mortality rates according to the effect of the duration of mortality were the highest mortality rate after 72 hours, reaching 77.8%, and the lowest mortality rate was after 24 hours, reaching 34.43%. The results of the current study are consistent with those (8) conducted in Egypt, in which Spinosad was used to control whiteflies. They used different concentrations of the pesticide, with the percentage of kills reaching 89.99% on the first day and 92.99% on the second day.

The results are consistent with those of (9) in his study on the use of Spinosad to control *Tuta absoluta* larvae, with the larval mortality rate reaching 84.26% at a concentration of 0.25 ml/L.

Average concentration	**Time**			**Concentration ml/L**
	72 hour	**48 hour**	**24 hour**	
35. 53 c	**60. 0 bc**	**33. 3 d**	**13. 3 e**	**0.625**
76. 70 a	**96. 7 a**	**7.67 b**	**56. 7 c**	**0.250**
55. 57 b	**76. 7 b**	**5.67 c**	**33. 3 d**	**0.125**
	77. 8 a	**55. 57 b**	**34. 43 c**	**Average time**
0.0 d	**0.0 d**	**0.0 d**	**0.0 d**	**Control**

The results are consistent with the results of (10), which showed that this pesticide had a significant effect on first-stage fly larvae, with mortality rates reaching 33.33% and 86.66% at a concentration of 0.024%, 24 and 48 hours after treatment with the first-stage fly larvae. The results were also consistent with the study by (11), who confirmed in their study the significant superiority of the biopesticide Spinosad compared to other pesticides used in the study when used to control whitefly larvae and adults, achieving a 100% mortality rate for the first, second, and third larval stages after seven days of treatment. These results were consistent with the findings of researchers (12), who indicated that biopesticides played a role in reducing the number of whitefly stages by 82.7%, respectively. However, the time factor had an inverse effect on the mortality rate of larvae, with Pl, B.b, and B. recording 28.6%. The longer the time, the less the pesticide's effect on the hatching rate, meaning there is an inverse relationship between them.

Using different concentrations of Biotac to eliminate whiteflies.

The results of Table on the effect of different concentrations of Biotac on whitefly mortality showed significant differences in mortality rates due to the interaction between concentrations and exposure duration. The highest whitefly mortality rate reached 100% at a concentration of 1 ml of pesticide per liter, 72 hours after treatment. While the lowest mortality rate was 13.3% at a concentration of 0.250 ml pesticide/liter after 24 hours of treatment, the average mortality rate, depending on the concentration, showed that the highest mortality rate was at a concentration of 1 ml pesticide/liter, reaching 90.00%, while the lowest average mortality rate was at a concentration of 0.250 ml pesticide/liter, reaching 34.43%. The average mortality rate, depending on the duration of the treatment, showed the highest mortality rate after 72 hours, reaching 76.67%, and the lowest mortality rate after 24 hours, reaching 39.97%. The results were also consistent with the study by Al- (11), who confirmed in their study the significant superiority of the chemical pesticide compared to other pesticides used in the study when used to control whitefly pupae and adults, as it achieved a mortality rate of 100% for the first, second, and third larval stages after 7 days of treatment. The results are consistent with the study by (13),

Average concentration	Time			Concentration ml/L
	72 hour	48 hour	24 hour	
34. 43 c	56. 7 c	33. 3 d	13. 3 e	0.25
54. 43 b	73. 3 b	56. 7 c	33. 3 d	0.50
90 .00 a	100 a	96. 7 a	73.3 b	1
	76. 67 a	62. 23 a	39. 97 b	متوسط الوقت
0.0 d	0.0 c	0.0 c	0.0 c	Control

who confirmed a decrease in whitefly numbers from 94.6% to 50% during the cultivation period when using this pesticide. This decrease in the number of this insect pest has led to the use of biological pesticides to control harmful insects on farms, given their low or minimal side effects on human health, the environment, and biological enemies, as well as their high effectiveness against insects. The results of the current study are consistent with the findings of in his study on the use of Spinosad to control the whitefly (*Bemisia tabaci*), as the mortality rate of this insect reached 60% when using a 5% concentration after three days of treatment with whole plants. The current results contradict the results study (11), which showed that this pesticide has a significant effect on the first-stage larvae of flies, as the death rates reached 33.33% and 86.66% at a concentration of 0.024% after 24 and 48 hours of treating the first-stage larvae of flies.

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