Effect of some integrated control factors on controlling different stages of whitefly Bemisia tabaci (Aleyrodidae: Hemiptera) under laboratory conditions

Roaa Rafie Cheflawi[1] , Ali Abdulhuisen Kareem[1*] , Abdulzahra Jabar Ali[1]

[1]Plant Protection Department , College of Agriculture, University of Kerbala, Karbala, Iraq
***Corresponding email: ali.kareem@uokerbala.edu.iq**
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Abstract

The study aimed to use integrated control factors to control the life aspect of whitefly on crops and evaluate the efficiency of chemical and biological pesticides against pests. Chemical pesticides were sprayed on the leaves. Alafsket chemical pesticide recorded the highest mortality rate with the increase in the period of exposure to the pesticide, as it recorded mortality (5-15) days from the treatment of the plant with the pesticide. All pesticides were used on the plant with three concentrations of Baronas the treatment - Oxymatrin to test the effectiveness of the pesticide against the insect, and the chemical pesticides used (Alafsket - the corrected percentage mortality for egg mortality when using the Afiskat pesticide after five days of treatment reached 94.4 compared to the rest of the other chemical treatments. Either in the primary nymphal stages, the offset pesticide recorded corrected mortality within five days of treatment, with an average of 95.2. As for the adult experience, the corrected percentage of mortality during three days of treatment was 86.6. As for the biological pesticides used in the experiment (*Bacillus thuriengiensis* - *Beauveria bassiana* - Entomopathogenic nematodes for both sexes - *Heterohabditis* sp - *Steinernema* sp- *Basilomyces lilacinus*) The treatment results of the used biocides were revealed by the superiority of the suspension of insect-pathogenic nematodes of both sexes in giving them high mortality in eliminating the treated insect stages. The results of the treatment for the first stages of the nymphs were recorded with the superiority of the nematode suspension, which gave corrected mortality for the nymphs amounted to 93.6 within five days of treatment. As for the adult experience, the nematode suspension had higher mortality than other biological treatments. The adult mortality was 77.7 within three days of treatment.

Keywords: *Bemisia tabaci*, Entomopathogenic nematodes, Entomopathogenic fungi.

Introduction

Bemisia tabaci (Genn), belonging to the family Aleyrodidae, order Hemiptera, are among the most important pests that affect field crops and cause direct losses through the absorption of plant sap or indirect losses through the transmission of many plant viruses. One of the most important and harmful types and transmitters of viral diseases is the white tobacco fly, Gennadius Bemisia tabaci, which spreads in most countries and infects many families. It has shown resistance against most of the insecticides used to control it. According to the research, the sweet potato or cotton whitefly, *B. tabaci*, is a complex species with more than 43 genetically different species, as it can be diagnosed through some mitochondrial genes (COI mtDNA) [1,2].

The nymphs and adults of whitefly suck plant sap, which leads to the yellowing of the plant and indirect damage caused by the whitefly. *Bemisia tabaci* has been causing more than four decades of significant annual material losses to plant production in different countries of the world as a result of the damage caused by direct feeding of this pest and the secretion of honeydew that encourages the growth of sooty mold on plant parts as well as its ability to transmit many viral pathogens of plants, which It has an effect in reducing yield in terms of quantity and quality, which leads to a reduction in marketing value and profits[3]. The most important and severe types of whitefly are the sweet potato or cotton whitefly (*B. tabaci*) and the whitefly in greenhouses (*Trialeurodes vaporariorum*) [4]. It has infected wild and susceptible plants from a few minutes to several hours.

Materials and Methods

Laboratory evaluation of pesticides used on the cotton whitefly and raging numbers of the *B. tabaci*.

Eggplant seeds of a local variety (Syrian) were planted in cork dishes filled with peat moss to prepare a laboratory colony of cotton whitefly. After the seedlings became four true leaves, they were transferred to plastic pots with a diameter of 18 cm and a height of 20 cm containing sterile mixed soil and peat moss at a ratio of 1:1, at a seedling mortality per pot. The 10 pots were placed in a wooden box covered with burlap cloth. Then put the cage in place with good lighting and heat, and after the completion of the growth of the seedlings inside the pot, take care of them. Then, the leaves of the eggplant plant containing the whitefly adult were collected using nylon bags with a pin to allow air entry to the insect. Finally, the insects were placed on the seedlings inside the wooden cage, left to mate, and began to multiply inside the cage while continuing to perpetuate the colony and adding new seedlings instead of the damaged ones.

Laboratory experiments

1. Treating the Eggs

Seeds of the eggplant crop prepared for the laboratory experiment were taken, and then these seeds were transferred to the insect breeding cages, which contain large numbers of adult insects. These seeds were left for (24-48) hours for the eggs to be laid on the bottom of the leaf for all the leaves used for the laboratory experiment to treat the eggs. Then it was removed from the cage after moving it and removing the adults of the white fly. An anatomical microscope tested it. About (100) eggs were identified on each leaf. The rest of the insect stages were removed with a very soft brush and a fine needle, and then each leaf was placed in a plastic dish, and cotton swabs soaked with water were placed around the blade of the leaf inside the dish to preserve the vitality and appearance of the leaf. The dishes were treated with different concentrations (three concentrations) for each treatment of the pesticides used in the experiment (Alafsket - Baron pesticide - Oxymatrin - *Bacillus thuriengiensis* - *Beauveria bassiana* - *Basilomyces lilacinus*- Entomopathogenic nematodes for both sexes *Heterohabditis* sp - *Steinernema* sp) three replicates were taken. Each one was treated inside a 9 mm plastic dish, and each one was sprayed. It was refined at one of the three concentrations chosen in the experiment and placed in a sprayer with 500 ml of distilled water capacity. The pesticide was diluted with distilled water; then, all concentrations were treated for each treatment of the leaves inside the dishes, with one spray for each dish on the leaf's surface. As for the control treatment, it was sprayed with water only, and the leaves were left to dry. The dishes were examined after 24 hours of treatment. The replicates were examined on the first day after the treatment to calculate the hatched eggs. The test continued for six days, and then the number of hatched eggs on leaves was calculated after each day of treatment to calculate the percentage of The eggs hatched in the treatments and comparisons that were sprayed with water for (1,2,3,4,5,6) days, knowing that the date of the treatment for the laboratory experiment for treating eggs is 9/10/2022.

2. Treatment of the primary nymphs:

Eggplant seeds were grown in plastic pots and placed inside the College of Agriculture, Kerbala University greenhouse. After the plant reached an advanced stage of growth (five true leaves), it was left for 48 hours to allow the adults to lay eggs on the bottom of the leaves, and after ensuring the presence of eggs and continuous examination of the leaves after Hatching directly to eggs from (1-4) days to obtain the primary nymph stages and after a period of (5-10) days the rest of the remaining nymph stages were obtained in a row.50 nymphs of the primary stages were isolated at the bottom of the leaf after placing each leaf inside a plastic dish while preserving the vitality of the leaf. Chemical spraying was done with a 1-litre sprayer for each concentration per treatment, noting that three concentrations of each pesticide were used after being diluted with distilled water. The tests continued for a week in a row, starting today (1,2,3,4,5,6,7), to calculate the number

of adults resulting from the transformation of nymphal stages inside the dish and the number of mortality of nymphal stages after treatment.

3. Treatment of adults

The laboratory experiment was conducted for whitefly adults under laboratory conditions of appropriate temperatures of 35 d and relative humidity of about 60 d. A sheet blade with an opening covered with a turret was placed to ventilate the insect inside the dish, and three replicates were taken for each treatment. Each dish was sprayed with a specific concentration for each treatment, noting that the number of concentrations for the treatment was three concentrations, the first less than the recommended concentration, the second the recommended concentration and the third concentration was more dose than the recommended concentration, i.e. The active substance in the third concentration was more effective in the treatment. After spraying each plate with one spray inside the plate, the following treatments were used with different concentrations (Alafsket - Oxymatrin - Baron - *Bacillus thuriengiensis* - *Beauveria bassiana* - *Basilomyces lilacinus*- Entomopathogenic nematodes for both sexes - *Heterohabditis* sp - *Steinernema* sp) and after 24 spraying each plate was examined and for three days in a row to calculate the mortality for adults inside the dish. After confirming the mortality of the insect, it was moved with soft weeds, and the mortality was 72 per cent after the treatment for each dish. The corrected percentage of mortality was calculated by adopting the [5].

$$\textbf{Corrected Mortality \%}=\frac{\boldsymbol{death\ in\ to\ treatment} * \boldsymbol{death\ in\ control}}{\mathbf{100}- \boldsymbol{death\ in\ control}}$$

Statistical Analysis

After the completion of the laboratory experiments, they were statistically analyzed by a complete randomized design to determine the significant differences between the arithmetic means of the treatments using the Least Significant Difference (L.S.D) below the level of 0.05 [6] using the Gen Stat program, version ten [7].

Results and Discussion

Evaluation of the efficiency of some elements of integrated control of the cotton whitefly

1. Treating the eggs

The laboratory results of treating cotton whitefly eggs with chemical and biological pesticides showed a slight decrease in the percentage of hatching eggs. For all treatments used for different pesticides, there were significant differences for the treatments. As shown in Table (1), it was noted that the Alafsketinsecticide excelled among the rest of the chemical pesticides and its three concentrations used. The mortality rate of use the

concentrations were given the lowest percentage of hatching eggs and giving the lowest average for primary nymphs, where the corrected percentage for the mortality of eggs during the period and for a week in a row was the percentage was 94.4, with significant differences from the rest of the chemical treatments. As for the Oxymatrine and Baron treatments, the mortality for eggs was (92.4%- 89.7%), respectively. These results were consistent with his findings (that the pesticides used as spraying on the plant had an effect against the pest eggs, which led to reducing the number of nymphs to the lowest possible number [8], and is noted in Table (1) when using the lowest concentration of the pesticide, it gave the lowest mortality for hatching eggs.

At the same time, the percentage increased when using the recommended and higher concentrations for all treatments used in the experiment. It was also shown in the experiment that the eggs treated on the first day were more sensitive to the pesticide and gave the highest mortality for eggs. The percentages for the chemical treatments on the first day were 95.1, on the third day 91.9, and on the fifth day 89.4, respectively, so we note that the time factor has a role in the mortality. Besides, less effect of the pesticide to mortality with the increase in the hatching mortality of the insect eggs. As for the biological treatments used, the entomopathogenic nematodes outperformed the rest of the treatments, as they gave the lowest mortality of hatching eggs through the effect of the active larvae of the third instar nematodes on the eggs of the insect and gave the lowest mean for the primary nymphs. The nematode suspension was used at varying temperatures (25-30) Celsius, which is the appropriate degree for the growth of effective larvae. As it greatly affected the mortality of the hatching of eggs, three different concentrations of larvae were used after diluting them with sterile distilled water (5000-10000-20000) - + larva/ml. It is one of the very important factors in the effectiveness of nematodes [9]. The mortality for hatching eggs for the three concentrations was 93.1%, and it gave the lowest mortality for the number of primary nymphs compared to the rest of the biological treatments (*Bacillus thuriengiensis-Beauveria bassiana –Basilomyces- lilacinus*). The mortality for hatching eggs was (87.2% - 85.1% - 82.7%), respectively. The eggs either time factor affected the mortality of eggs. The general average for all transactions for the first day was (89.8), for the third day (86.9) and for the fifth day (83.9), respectively. That is, there is an inverse relationship between the time factor and the percentage of egg mortality. We note that the hatching mortality is affected by time, so the general mortality of all vital parameters for the first day was (89.8), while the third day was (86.9). On the fifth day was (83.9), respectively, the inverse relationship between the time factor and the percentage of egg mortality. We notice that the hatching mortality increases on the fifth day, as shown in table (1).

Table (1): Effect of different pesticides concentrations against whitefly eggs after 24 hours of exposure under laboratory conditions

Treatments	Concentration	Corrected Egg Mortality percentage			
		First day	Third day	Fifth day	Average
Alafsket	g0.75	95.9	91.8	87.7	91.8
	g 1	97.9	93.8	89.7	93.8
	g 1.25	100	95.9	97.7	97.8
					94.4.4
Oxymatrin	cc 1.50	93.8	98.7	85.7	89.7
	cc 2	95.9	91.8	87.7	91.8
	cc 2.50	97.9	95.9	93.8	95.8
					92.4
Baronas Al-Baron	g 0.50	89.7	87.7	85.7	87.7
	g 0.75	91.8	89.7	87.7	89.7
	g 1	93.8	91.8	89.7	91.7
					89.7
0.05 L.S.D	treatments 4.39	concentration 3.78	2.81 day	interaction 6.88	

Table (2): Effect of biopesticides concentrations on whitefly eggs after 24 hours of exposure under laboratory conditions

Treatments	Concentration	Corrected Egg Mortality Percentage			Average
		First day	Third day	Fifth day	
Entomopathogenic nematodes	5000 larvae/ effective	93.8	91.8	87.7	91.1
	10000 larvae/ effective	95.9	91.8	89.7	92.4
	20000 larvae/ effective	97.9	93.8	95.9	95.8
					93.1
Beauveri. bassiana	g 3	85.7	81.6	79.5	82.2
	g 5	87.7	83.6	81.6	84.3
	g 7	91.8	89.7	85.7	89
					85.1

Bacillus. thuriengiensis	**g 0.50**	**87.7**	**85.7**	**81.6**	**85**
	g 1	**89.7**	**87.7**	**83.6**	**87**
	g 1.50	**91.8**	**89.7**	**87.7**	**89.7**
					87.2
Basilomyces. lilacinus	**g 3**	**83.6**	**81.6**	**75.5**	**80.2**
	g 5	**87.7**	**81.6**	**79.5**	**85**
	g 7	**87.7**	**85.7**	**81.6**	**85**
					82.7
L .S .D 0.05	**treatments 5.62**	**concentration 4.11**	**4.65 day**	**interaction 7.91**	

2- Treatment of primary nymphs

The laboratory results showed that the chemical pesticides used were effective against the primary nymphs of the white cotton fly, which include the nymphal stage (first - second - third), as shown in Table (3). For the rest of the transactions and significant differences, the average corrected mortality percentage during a week of treatment, respectively, was (95.2), followed by the pesticide (Oxymatrine), as the average corrected mortality for nymphal stages was (94.5), as for the insect growth regulator (Baron), its effect on nymphal stages was (93.4). It is noted that the discrepancy between the mortality achieved for one treatment depended on the variation in the three concentrations used for each treatment, and it gradually increased from the low concentration to the high concentration for all pesticides and for all treatment phases. The mortality followed the same path but with significant differences; as for the results of biopesticides used against 1st, 2nd and 3rd nymphs, As shown in Table (4), the laboratory results showed the superiority of the suspension of insect-pathogenic nematodes at (25-30) Celsius, which is the appropriate degree for the survival of active larvae. The suspension was used with three different concentrations (5000-10000-20000) against nymphal stages, as the corrected mortality was (92.5), then followed by treatment (*Bacillus thuriengiensis*). The corrected mortality percentage was (90.3). The two fungi used in the experiment were followed by *Basilomyces lilacinusif* the mortality of effect against the primary nymphs reached (89.1). At the same time, treatment of (*Beauveria bassiana*) had an effect on mortality against the primary nymphs, reaching (88.9%).

Through the results, we notice that there are significant differences for the biological treatments that used all pesticides with three concentrations, starting from the low concentration and going up to the high concentration, as all the used concentrations achieved high mortality and in varying ways according to the type of pesticide and the concentration used in the experiment. The sensitivity of the nymphs was different to the pesticides used, as it was inversely associated with the age of the nymph stage. This difference is due to the waxy coating that the nymphs secrete to envelop their body. The

thickness of the cover increases as the nymph progresses in age, and it acts as an insulator that hinders the penetration of the insecticide [10]. It's found that the nymph phases are more sensitive than the advanced phases, as indicated by the scientist. These results agreed with what was found by [11] that the mortality of nymphs on the first day had the highest mortality compared to the results of the third and fifth days. The mortality results for the vital organisms were (93.6%) for the first day, (90.4%) for the third day, and (86.7%) for the fifth day, respectively. We note the decrease in the effect of the pesticide with time.

Table (3): Effect of chemical pesticides with spray treatment against primary nymphs of whitefly after 24 hours of exposure under laboratory conditions

Treatments	Concentration	Corrected Mortality percentage of primary nymphs			Average
		First day	Third day	Fifth day	
Alafsket	0.75	96	94	91	93.6
	1g	98	95	92	95
	1.25g	99	96	96	97
					95.2
Oxymatrin	1.50cc	95	93	90	92.6
	2cc	97	96	90	94.3
	2.50cc	98	95	93	95.3
					94.5
Al-Baron	0.50g	95	94	88	92.3
	0.75g	96	95	90	93.6
	1g	97	95	91	94.3
					93.4
L.S.D0.05	treatments 4.69	concentration 5.66	day 3.71	interaction 8.11	

Table (4): Effect of biopesticides with spray treatment against primary nymphs of whitefly after 24 hours of exposure under laboratory conditions

Treatments	Concentration	Corrected Mortality Percentage of primary nymphs			Average
		First day	Third day	Fifth day	
Entomopathogenic nematodes	5000 larvae/ effective	92	88	85	88.3
	10000 larvae/ effective	93	89	84	88.6
	20000 larvae/ effective	94	92	87	91
					89.3
Beauveria. bassiana	3g	91	86	82	86.3
	5g	93	89	84	88.6
	7g	95	92	89	92
					88.9
Bacillus. thuriengiensis	0.50g	94	90	85	89.3
	1g	94	91	86	90.3
	1.50g	96	91	87	91.3
					90.3
Basilomyces. lilacinus	3g	91	87	82	86.6
	5g	93	90	86	89.6
	7g	94	92	88	91.3
					89.1
L.S. D0.05	5.99treatments	5.23 concentration	4.51 day	interaction 7.82	

Treatment of Adults

All treatments used (chemical-biological) were effective against adults of the white fly, with significant differences between the different treatments) with very high mortality compared to the rest of the treatments and with higher concentrations than the rest of the other treatments (Oxymatrine - Baron), respectively. For the next two days (the second-third), adult mortality s were graded for the three days after treatment. The mortality rate in the first period of exposure is due to the effect of contact with the

insecticide, and as time progresses, the cumulative mortality increases as the systemic and infectious action of these insecticides are added to the action of contact, and their effect becomes in contact, infectious and systemic [12] in a previous study. The mortality of the treated adults increased by an increase, and this is what was indicated. Concentrations were used for one treatment, and the highest mortality for all treatments was achieved after 72 hours. As for the biological treatments, they gave similar results to the chemical agents but with lower percentages and significant differences, as the insecticidal nematode suspension was superior to the rest of the treatments, and the mortality was uneven according to the concentration used and the duration of exposure. The higher the concentration and the longer the exposure time, the higher the mortality. The results agreed with the findings of the researchers [13,14,15,16]. The mortality for the vital transactions on the third day of treatment was (77.7). (64.4, 62.2, 57.7).

Table (5): Effect of chemical pesticides after spraying treatment on adult whitefly after 72 hours of exposure under laboratory conditions

Treatments	Concentration	Corrected Percentage of Adult Mortality %			Average
		First day	Second day	Third day	
Alafsket	0.75g	40	100	100	80
	1g	60	100	100	86.6
	1.25g	80	100	100	93.3
					86.6
Oxymatrin	1.50cc	40	60	100	66.6
	2cc	40	80	100	73.3
	2.50cc	60	80	100	80
					73.4
Al-Baron	0.50g	20	60	100	60
	0.75g	40	80	100	73.3
	1g	60	80	100	80
					71.1
L.S.D 0.05	treatments 3.76	concentration 3.07		day4.22	interaction5.88

Table (6): Effect of biopesticides after spray treatment on adult whiteflies after 72 hours of exposure under laboratory conditions

Treatments	Concentration	Corrected Percentage of Adult Mortality %			Average
		First day	Second day	Third day	
Entomopathogenic nematodes	**5000 larvae/ effective**	60	60	80	66.6
	10000 larvae/ effective	60	80	80	73.3
	20000 larvae/ effective	80	100	100	93.3
					77.7
Beauveri bassiana	**g 3**	20	20	80	40
	g 5	20	40	100	53.3
	g 7	60	80	100	80
					57.7
Bacillus thuriengiensis	**g 0.50**	20	40	80	46.6
	g 1	20	80	100	66.6
	g 1.50	60	80	100	80
					64.4
Paecilomyces lilacinus	**g 3**	20	60	80	53.3
	g 5	20	60	100	60
	g 7	40	80	100	73.3
					62.2
0.05 L.S. D	**treatments 5.71**	**concentration 3.91**	**3.65 day**	**interaction 6.41**	

The research showed the presence of the white cotton fly, *Bemisia tabaci*, widespread in Karbala province. This spread led to using some elements of integrality d control to eliminate and limit the spread of the insect, so some chemical pesticides were used. The Alafsket pesticide excelled by giving it the highest mortality in the laboratory insect instars (eggs - primary nymphs - adult larva), and the nematode suspension excelled. Of biological preparations by giving them the highest mortality for the insect phase (eggs, nymphs and adults) in the laboratory. There are many researchers reported high mortality

of insects pests using alternative methods such as plant extraction and bioagents [17,18, 19].

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