Studying the efficacy of some insecticides and sporophyte suspension of Beauveria bassiana (Balsam) Vuil. fungus in controlling nymphs and adults of Bagrada hilaris (Burmeister) (Hemiptera: Pentatomidae) on radish crop (Raphanus sativus L.) in vitro and field

Dhia Salem Alwaily **Ayad A. Abdul Kader** **Ahoud Jaafar Tohma**
Department of Plant Protection, College of Agriculture, University of Basra, Basra, Iraq.

ABSTRACT

This study aimed to use the fungal suspension of Beauveria bassiana and the pesticides (Leader and Mospildate) in controlling nymphs and adults of Bagrada hilaris on radish plants. The study showed the effect of the concentration (1.6×10^5) from the suspension of the B. bassiana fungus on the nymphs and adults of the insect, where the percentage of mortality amounted to (42.22% and 40.00%), respectively. The control showed the effect of different concentrations of Leader and Mosepileted on inhibiting the radial growth of the fungus. The highest percentage of inhibition amounted to (33.37%) for Mosepiletid, while the lowest percentage of inhibition amounted to (31.37%) for Leader. The study showed the effect of different concentrations of the two pesticides on the mortality of nymphs and adults of the insect in vitro, where the concentration (0.4) has excelled by giving a percentage of mortality amounted to (86.67%, 93.33%), respectively for Leader and (59.40%, 65.83%) for Mosepileted. The concentration of (0.2) for Leader and Mosepileted showed high compatibility with bassiana fungus. The effect was increased by increasing the concentration of the two pesticides. As for the effect of the interaction between the two pesticides and the fungus in vitro, the treatment of the two pesticides with the fungus has excelled on the rest of the treatments, causing a percentage of mortality amounted to (93.3%, 9.7%, and 96%) for nymphs and adults, respectively. While the interaction between two pesticides and the fungus recorded a percentage of mortality in the pot experiment amounted to (83.3%, 86.7%) for the nymphs and adults, respectively, and the interaction treatment between the fungus and the two pesticides achieved a percentage of mortality in the field amounted to (76.7%, 83.3%) for the nymphs and adults, respectively.

1. INTRODUCTION

The radish plant (Raphanus sativus L.) is considered one of the most important winter vegetables. Its leaves and roots are eaten fresh. It is from the Brassicaceae family, which includes cauliflower, colza, mustard, broccoli ... etc.. It is one of the important plants in Iraq, the Arab world, and all over the world (25). The importance of radish comes because it contains proteins, phosphorous, magnesium, iron, potassium, mustard oil, thiamine, and others (6). The area planted with radish in Iraq has estimated about 2016.1 thousand dunums, and the total productivity is 7,516 tons for the year 2017 (1). Radishes are infected with many insect pests that affect agricultural production, the most important of which is the Bagrada hilaris (Burmeister), which is one of the insects that has a wide global spread. It lives in tropical, semi-tropical, and temperate regions and it has a wide family range. In addition to infecting the Brassicaceae family, it infects many plants such as papaya, cotton, sorghum, yellow corn, and others (25). This insect causes severe economic losses to crops by absorbing plant juices, where the parts of its mouth are piercing and sucking, inserting it into the plant, and sucking the plant juice. Yellow spots appear and then turn white, then the leaves wither and die, and their density increases on plants quickly and accesses the stage of economic damage. It was found that the critical economic limit is (1 bug.m^{-2}) in the seedling stage and (3 bugs.m^{-2}) in the large plants stage (16). Chemical control was used to reduce the

 ISSN 2072-3875

spread of this insect if the pesticides Larivin, Polo and Basudin were used by (5) and Basudin was the best pesticide to control it on rapeseed plants. Recent studies have proven the harmful effects of pesticides on the environment and health, and the pollution that their residues cause, which encouraged researchers to use biological control methods in the field of insect pest control by using insect pathogens, including bacteria and fungi such as Balsam (Vnil.) Beauveria bassiana and Bacillus thuringiensis (Bar.) (27). Insect growth regulators were used and they were highly selective in eliminating insects by affecting bio-activities such as moulting, development, reproduction, and growth (15). Due to the importance of this insect on the Brassicaceae family in general and radish in particular, and to limit its spread in the production areas of these crops, this study came to test different concentrations of two chemical pesticides (Leader and Mosepileted) and bio-fungus (bassiana B.) and the interaction between them in the percentage of mortality for nymphs and adults of the Bagrada hilaris.

2. MATERIALS AND METHODS

Preparation of control agents:

Place and date of conducting the research:

The experiment was conducted in Al-Jabasi area in Shatt Al-Arab on 7/10/2019.

Breeding insect in vitro:

Insect samples were collected from Shatt Al-Arab district, Al-Jabasi region, from the radish plant. They were brought to the laboratory and bred in a breeding box with dimensions of 60 x 60 x 60 cm. The box had a wooden base and a wooden frame and the rest of the sides consisted of a metal clip and 4 pots planted with radish were placed in the box for preserving the insect colony in the laboratory and obtaining all the phases of the insect. A number of different phases were brought to the insect every period for the purpose of conducting laboratory experiments.

Preparation of Beauveria bassiana fungus

The source of Beauveria bassiana fungus

A pure isolate was obtained by M. Dr.. Ali Zaji Abdul Qadir, a lecturer in the Department of Plant Protection, College of Agriculture, University of Basra, and the diagnosis of isolates was confirmed by Prof. M. Dr.. Yahya Ashour Saleh, a teacher at the College of Agriculture, University of Basra.

Preparing the culture media for the Beauveria bassiana fungus and growing it in vitro

The isolate was propagated on Potato Dextros Agar media and B. bassiana inoculum was applied by taking a 0.5 cm diameter disc from the prepared colony on P.D.A. After seven days of preparation, by planting them in the center of the dish, the dishes were incubated at a temperature of 25 C, and the incubation period was seven days, and after growth was completed, the dishes were transferred to the refrigerator until use.

Preparation of the fungal suspension

The fungal suspension was prepared by taking a dish containing the colony of fungus kept at the appropriate temperature for the growth of the fungus of 25 °C for 7 days, then placing 10 ml of sterile distilled water in the dish containing the colony and moving a capillary movement and it was then placed in a sterile beaker 90 ml of distilled water was added to it, the product was then used to make dilutions by taking 1 ml of this suspension using a sterile pipette and placing it in a test tube, and a 9ml of the distilled water was then added to it.

Pesticides used in the control:

Using the two pesticides

1- Leader

The rate of use is 30-50 g / 100 L of 5% water, which is produced by KING QUENSON company.

2- Mosepiletd 2% SP

It contains 20% Acetamiprid, which belongs to the group of Neonicotinoids. The rate of use is 5-10 g / 20 L of water, which is produced by the Arab Company for the Manufacturing of Pesticides and Veterinary Medicines in Jordan (10, 3).

Laboratory study.

Collecting the nymphs and adults

Nymphs and adults of Bagrada hilaris were collected from the colony in the laboratory using a brush and placed on clean white sheets for use in laboratory experiments.

Effect of different concentrations for the B. bassiana fungus on the nymphs and adults of the Bagrada hilaris

Agricultural soils were prepared and mixed with peat moss in a ratio of 1:3. The mixture was placed in 5 kg nylon bags, which were placed in an autoclave device at a temperature of 121 °C and under the pressure of 15 pounds per square inch for 20 min. The mixture was then transferred to plastic pots with a capacity of 1 kg and cultivated with radishes (12 pots). After a sufficient period of time, nymphs and adults were brought in each phase separately and 10 insects were placed in each treatment after being covered with a boring cloth and secured from the bottom with a rubber band. Three concentrations were used: 1.6 10^5, 1.4 x 10^6, and 1 x 10^7. As for the control treatment, it was sprayed with water only (6).

Effect of different concentrations of Leader and Mosepiletd on the growth of B. bassiana fungus

In this experiment, the two pesticides (Leader and Mosepiletd) were used, and flasks with a capacity of 250 ml were prepared using a autoclave device at a temperature of 121 °C and a pressure of 15 pounds/inch for a period of 20 min. 100 ml of dextrose Agar potato was added after sterilization with the autoclave device, at a temperature of 121 ml and under the same pressure of 15 pounds/inch for the same time period of 20 min, the media was then left for a period to cool, then the two pesticides were added, where 0.4 g of Leader was weighed and dissolved it in 10 ml of distilled water and a 0.5 ml of Mosepiletd were weighed and dissolved it in 10 ml of distilled water, and a group of concentrations was made from it before the media solidified, and these concentrations are (0, 0.1, 0.2, 0.3, 0.4). The media was shaken for the purpose of homogeneity of the pesticides and the media, and three dishes with a diameter of 9 cm were poured from each concentration, then left to solidify. It was then inoculated with a disc of a fungus with a diameter of 0.5 cm from the fungus colony, which was 7 days old. A cork piercing was used for that. The disc was placed in the middle of the dish, then the dishes were incubated at a temperature of 25 m in the incubator until the growth is completed in the control dishes, which contain only PDA nutrient media, and the results were recorded by taking two perpendicular diameters of the developing colony by passing them through the center of the dish, the percentage of inhibition was then calculated as mentioned in the equation in (9).

The percentage of inhibition =

$$\frac{\text{Average diameter of radial growth in the control - Average diameter of radial growth in treatment}}{\text{Average diameter of radial growth in the control}} \times 100$$

Effect of different concentrations of Leader and Mosepiletd on nymphs and adults of Bagrada hilaris in vitro

Petri dishes with a size of 9 cm were sterilized with an autoclave device at a temperature of 121°C and a pressure of 15 pounds/inch2 for 20 minutes. The sterilization was repeated on the next day, and 10 adults and 10 nymphs were placed in each dish separately, in three dishes for each concentration. where 0.4 g of Leader was weighed and dissolved it in 10 ml of distilled water and 0.5 ml of Mosepiletd were weighed and dissolved in 10 ml of distilled water, and a group of concentrations was made from it before the media solidified, and these concentrations are (0, 0.1, 0.2, 0.3, 0.4). The dish was covered with a boring cloth and tied with a rubber band and a small hand sprayer with a capacity of 10 ml was used and one ml was used for each dish and the pesticide was sprayed in the four concentrations. The control was sprayed with distilled water only and the readings were taken after 72 hours of spraying. The percentage of mortality was then found, which was corrected using the equation of (9).

The percentage of mortality (corrected)=

$$\frac{\text{The percentage of mortality in the treatment} - \text{The percentage of mortality in the control}}{\text{The percentage of mortality in the control}} \times 100$$

Effect of two pesticides (Leader and Mosepiletd) and fungus Suspension on nymphs and adults in vitro

Plastic containers with dimensions of (5 x 10 x 20 cm) were used, the filter paper was placed in each container, radish leaves were placed for the purpose of feeding insects. 10 nymphs and 10 adults were placed in each container, each phase separately, and a small hand sprayer was used for the purpose of spraying the pesticides and the fungus suspension. After conducting the calibration, the required amount of spraying was known. The solutions were sprayed with three replicates for each treatment. As for the control treatment, it was sprayed with distilled water only, and the percentage of mortality was calculated after three days of spraying according to the previously mentioned equation.

1- Spraying the fungus suspension at a concentration of (1.6 x 10^5 spores/ml) after placing the insects.
2- spraying Leader pesticide at a concentration of (0.2 g/L) after placing insects.
3- Spraying fungus suspension at a concentration of (1.6 x10^5 spores/ml) + Leader pesticide at a concentration of (0.2 g/L).
4- Spraying Mosepiletd pesticide at a concentration of (0.2 g/L) after placing insects.
5- Spraying the fungus suspension at a concentration of (1.6 x 10^5 spores/ml) + Mosepiletd pesticide at a concentration of (0.2 g /L).
6- spraying Leader pesticide at a concentration of (0.2 g/L) + Mosepiletd pesticide at a concentration of (0.2 g /L).
7- Spraying the fungus suspension at a concentration of (1.6 x 10^5 spores/ml) + Mosepiletd pesticide at a concentration of (0.2 g/L) + spraying Leader pesticide at a concentration of (0.2 g/L).
8- The control treatment was sprayed with water only.

Effect of the two pesticides (Leader and Mosepiletd) and fungus suspension on nymphs and adults in pots.

agricultural soils were taken and mixed with peat moss in a ratio of 3:1. The mixture was placed in nylon bags with a size of 5 kg and placed with an autoclave at a temperature of 121 C and a pressure of 15 pounds/inch^2 for 20 min. The mixture was then transferred to plastic containers with the size of 6 kg. The radish was cultivated by 24 pots, and after the plants grew, ten adults and ten nymphs were placed separately in the pots. It was sprayed with the two pesticides and the fungus suspension with three replicates for each treatment and the percentage of mortality was calculated after 72 hours as in the previous equation in the laboratory experiment and the same eight treatments were applied.

Effect of the two pesticides (Leader and Mosepiletd) and fungus suspension on nymphs and adults in the field.

The experiment was conducted in Al-Kabasi region on October 7, 2019. The radish plants were cultivated scattering on five plots. The length of the plot was 10 m and its width was 1.5 m. After an appropriate period of cultivating the radish plant in the field, the plants were covered with a mull cloth (Gauze), and an elastic band after conducting the calibration to determine the required quantity for each treatment. The treatments were then sprayed with a manual sprayer with a capacity of (500 ml) using three replicates for each treatment. As for the control treatment, water was used only. 10 adults and 10 nymphs were placed separately. After 72 hours of treating, the previous equation was used to calculate the percentage of mortality, and the same eight treatments were applied.

Statistical analysis

The laboratory experiments were conducted according to the completely randomized designs (CRD) as bi-factor experiments. As for the field experiments, they were conducted by The randomized complete block design (RCBD), the results were then compared with the least significant difference (LSD) method, under a probability level of 0.01 in laboratory experiments and a probability level of 0.05 in field experiments (11, 8). The data was analyzed using Genstat discover 3 and the SPSS program using a computer.

3. RESULTS AND DISCUSSION

Effect of different dilutions of B. bassiana fungus on the percentage of mortality for nymphs and adults of Bagrada hilaris in vitro.

Table (1) indicates that there were significant differences in the effect of different concentrations of the bassiana B. fungus on the percentage of mortality for nymphs and adults of Bagrada hilaris. The highest percentage of mortality amounted to (41.11%) at the concentration of (1.6×10^5) and the lowest percentage of mortality amounted to (3.33%) at the control treatment, while the highest percentage for the effect of phase was 20.83% at the adult phase. As for the interaction effect between phase and concentration, the highest While the highest rate of role effect was 20.83% for the adult role. As for the interaction effect between role and concentration, the highest percentage of mortality was 42.22% at the nymphs phase and the concentration of (1.6×10^5), and the lowest percentage of mortality was 3.33% at the control treatment. The spores of the B. bassiana fungus are able to penetrate epicuticle, and the process of penetration depends on the type of insect and is affected by the thickness of the cuticle wall and the secretions secreted by the insect's body that affect the penetration process (26). Insects have a reserve amount of nitrogen that they use to manufacture the protein necessary for fungus germination, with a sufficient amount of carbohydrates present on the surface of the host, especially starch, glucaamine, glucose, amino acids, and a small amount of fat (4). Akbar et al., (12) mentioned that treating the red flour beetle (Tribolium castaneum) with fungus suspension at the rate of 100, 200 and 300 mg/kg of the fungal suspension for wheat seeds achieved a percentage of mortality for larval amounted to (15.5, 29.4 and 40.0%), respectively. Al-Imara, (2) showed the effect of different concentrations of this fungus on the percentage of mortality for insect, where the percentage of mortality increases with the increase in the concentrations of the suspension. The reason is that the increase in concentrations increases the number of spores growing around the insect's body, which leads to the insect's inability to repel the attack of the fungus, and its pathogenicity increases, when treating the emerald ash borer (Agrilus planipennis) with a suspension of this fungus at a concentration of ($1x10^7$), the percentage mortality for the larvae amounted to 100% after six days, while the concentration of ($1x10^6$) amounted to 100% after the passage of 10 days (18).

Table 1: Effect of different dilutions of B. bassiana fungus on the percentage of mortality for nymphs and adults of Bagrada hilaris in vitro.

Concentrations (Spore/ml)	The percentage of mortality for nymphs	The percentage of mortality for adult	Average effect of concentrations
$1x10^7$	10.37	13.33	11.85
$1.4 x10^6$	21.48	26.67	24.07
$1.6 x10^5$	42.22	40.00	41.11
Control	3.33	3.33	3.33
Average effect of phase	**19.35**	**20.83**	
L.S.D value (0.01)= phase: 5.44, concentration: 7.69, interaction: 10.88			

Effect of different concentrations of the two pesticides (Leader and Mospildate) on the inhibition of radial growth for the fungus.

Table (2) shows the effect of different concentrations of the two pesticides (Leader and Mospildate) on the inhibition of radial growth for the fungus. The results showed that there were significant differences between the pesticides averages. The highest average of inhibition was 33.37% for Mosepiletid. As for the lowest percentage of inhibition was 31.37% for Leader, as for the effect of the averages of concentration, it was also found that there were significant differences between the average concentrations. It was found that the inhibition increased with increasing concentration. The highest average of inhibition amounted to 50.25% for concentration of (0.4 ml/L) and the lowest average of inhibition was 13.05% for concentration of (0.1 ml/L). As for the interaction between the average effect of concentrations and the average effect of pesticide showed the presence of a significant difference, the highest average of inhibition was 52.80% for Mosepiletid at a concentration of 0.4 ml/L and the lowest average of inhibition was 10.80% for Leader at a concentration of 0.1 ml/L. The effect of some nicotinic pesticides such as Thiamethoxam, Acetamipride and Imidaclopride had an effect on the percentages of inhibiting the growth of B. bassiana by 5.1 cm, 4.09 cm and 6.4 cm for pesticides, respectively (23). The pesticides (Imidaclopride, Endosulfan and Flufenoxuron) affect the averages inhibition of radial growth for this fungus by 37, 67 and 95% for pesticides, respectively. As for the production of spores was ($46 x 10^4$, $67 x 10^4$, and $100 x 10^4$ spores/ml) for pesticides, respectively (15), the active substance in the Mospildate pesticide using in the controlling is Acetamipride.

Table 2: Effect of different concentrations of the two pesticides (Leader and Mospildate) on the inhibition of radial growth for the fungus.

Concentrations / pesticides	Percentage of inhibition (%)				Average
	Concentrations (ml.L)				
	0.4	0.3	0.2	0.1	
Leader	47.70*	37.80	29.20	10.80	31.37
Mospildate	52.80	41.80	23.60	15.30	33.37
Average	50.25	39.80	26.40	13.05	
L.S.D value (0.01)= concentration: 0.26, interaction: 0.37, pesticide : 0.18					

• Each number in the table represents an average of three replicates

Effect of different concentrations of the pesticides (Leader and Mospildate) on the nymphs and adults of the Bagrada hilaris in the laboratory.

Table (3) shows the effect of different concentrations of the pesticides (Leader and Mospildate) on the nymphs and adults of the Bagrada hilaris. There were significant differences in the average effect of the phase, where the highest average effect for the phase amounted to 64.2% for the nymphs phase and the lowest average of the adults phase was 56.7%. It did not observed significant differences between the concentrations, where the highest average effect of the concentrations was 77.5% at the concentration of 0.4 and the lowest average for the effect of the concentrations was 45.0 at the concentration of 0.1. As for the effect of the interaction between the pesticide, the phase and the concentration, no significant differences were observed, where the highest percentage of mortality amounted to 93.3% at the interaction between the Leader, adult phase, and concentration of 0.4, and the lowest percentage of mortality was 23.3% at the interaction between Mospildate and adult phase, and the concentration of 0.1. Jabaar, (6) mentioned that using the nicotinic pesticides (Acetamiprid, Lufenuron, Cyrmazin and Imidacloprid), which were used to affect the radish beetle (Colaphellus apicalis), was highly effective with an effect on it. where the Acetamiprid pesticide had the highest average effect amounted to (78.0%) and the lowest average for the Lufenuron pesticide which amounted to 46.6%. As for the pesticides (Cyrmazin and Imidacloprid), their average effect was 59.9 % and 54.6%, respectively. When treating Encarsica Formosa with Acetamiprid and Imidacloprid, it caused a percentage of mortality amounted to 62.9% and 49.5% for adults, respectively (14). In a study conducted by (13) that the Imidacloprid pesticide has excelled on the two pesticides (dimethoat phoxim, chlorpyriphos-ethyl), which was used in the control of insects that infect onions. It was found that this pesticide has a property that enables it to exudate between vascular cells inside plants, so it is considered a systemic infectious pesticide.

Table 3: Effect of different concentrations of the pesticides (Leader and Mospildate) on the nymphs and adults of the Bagrada hilaris in the laboratory.

Phase	Pesticides	The percentage of mortality (%)				Average effect of phase	Average effect of Pesticide
		0.4	0.3	0.2	0.1		
nymphs	L	86.7	73.3	66.7	56.7	56.7	77.1
	M	63.3	46.7	33.3	26.7		
adult	L	93.3	86.7	80.0	73.3	64.2	43.8
	M	66.7	53.3	36.7	23.3		
Average effect of concentration		77.5	65.0	54.2	45.0		
L.S.D value (0.01)= phase: 13.11, pesticide: 13.11, concentration : 18.54, interaction: 37.08							

• Each number in the table represents an average of three replicates

Effect of the two pesticides (Leader, Mospildate) and fungus suspension on nymphs and adults in vitro.

Table (4) shows the effect of the interaction between the two pesticides and the fungus suspension on the percentage of mortality for nymphs in vitro, where the results showed that there were significant differences between the treatments, it was found that the highest percentage of mortality for nymphs was 93.3% at the interaction between the two pesticides and the fungus suspension, and the lowest percentage of mortality was 6.7% at the control treatment. Table (4) shows the effect of the interaction between the two pesticides and the bio-fungus on the percentage of mortality for adults of Bagrada hilaris in vitro. The results showed that there were significant differences between the treatments. It was observed that the highest percentage of mortality was 96.7% at the two pesticides and B. bassiana suspension treatment, and the lowest percentage of mortality was 6.7% at the control treatment.

Table 4: Effect of the two pesticides (Leader, Mospildate) and fungus suspension on nymphs and adults in vitro.

Treatment	percentage of mortality for nymphs (%)	percentage of mortality for adults (%)
fungus suspension (B. bassiana) at a concentration of (1.6×10^5 spores/ml) after placing the insects.	*43.3	46.7
Leader pesticide at a concentration of (0.2 g/L)	56.7	80.0
fungus suspension at a concentration of (1.6×10^5 spores/ml) + Leader pesticide at a concentration of (0.2 g/L).	83.3	86.7
Mosepiletd pesticide at a concentration of (0.2 g/L)	26.7	26.7
the fungus suspension at a concentration of (1.6×10^5 spores/ml) + Mosepiletd pesticide at a concentration of (0.2 g /L).	43.3	46.7
Leader pesticide at a concentration of (0.2 g/L) + Mosepiletd pesticide at a concentration of (0.2 g /L).	63.3	83.3
the fungus suspension at a concentration of (1.6×10^5 spores/ml) + Mosepiletd pesticide at a concentration of (0.2 g/L) + spraying Leader pesticide at a concentration of (0.2 g/L).	93.3	96.7
The control treatment	6.7	6.7
LSD (0.01)	9.33	9.99

• Each number in the table represents an average of three replicates

Effect of the two pesticides (Leader, Mospildate) and fungus suspension on nymphs and adults in the pots.

Table (5) indicate the effect of the interaction between the two pesticides and the bio-fungus suspension on the percentage of mortality for nymphs in the pots. The results showed that there were significant differences between the treatments. It was found that the highest percentage of mortality for nymphs was 83.3% at the treatment of two pesticides and B. bassiana fungus and the lowest percentage of mortality was at the control treatment, which amounted to 3.3%. Table (5) shows that the effect of the interaction between the two pesticides and the fungus suspension on the percentages of mortality for adult in the pots, where the results showed that there were no significant differences between the treatments. The highest percentages of mortality amounted to 86.7% at the treatment of the two pesticides and the bio-fungus (bassiana B.) and the lowest percentages of mortality was at the control treatment which amounted to 6.7 %. Ladurner et al., (19) reported that controlling the cherry fly (Rhagoletis cerasi) with B. bassiana with Dimethoate gave a percentage of mortality amounted to (39.0%, 72.9% and 80.4%) for the pesticide, the fungus, and the pesticide + fungus, respectively.

 ISSN 2072-3875

Table 5: Effect of the two pesticides (Leader, Mospildate) and fungus suspension on nymphs and adults in the pots.

Treatment	percentage of mortality for nymphs (%)	percentage of mortality for adults (%)
fungus suspension (B. bassiana) at a concentration of (1.6 x 10^5 spores/ml) after placing the insects.	*36.7	40.0
Leader pesticide at a concentration of (0.2 g/L)	53.3	73.3
fungus suspension at a concentration of (1.6 x10^5 spores/ml) + Leader pesticide at a concentration of (0.2 g/L).	60.0	80.0
Mosepiletd pesticide at a concentration of (0.2 g/L)	23.3	23.3
the fungus suspension at a concentration of (1.6 x 10^5 spores/ml) + Mosepiletd pesticide at a concentration of (0.2 g /L).	43.3	43.3
Leader pesticide at a concentration of (0.2 g/L) + Mosepiletd pesticide at a concentration of (0.2 g /L).	56.7	76.7
the fungus suspension at a concentration of (1.6 x 10^5 spores/ml) + Mosepiletd pesticide at a concentration of (0.2 g/L) + spraying Leader pesticide at a concentration of (0.2 g/L).	83.3	86.7
The control treatment	3.3	6.7
LSD (0.01)	9.35	8.65

• Each number in the table represents an average of three replicates

Effect of the two pesticides (Leader, Mospildate) and fungus suspension on nymphs in the field.

Figure (1) indicates the effect of the interaction between the two pesticides and the bio-fungus suspension on the percentages of mortality of nymphs in the field. The results showed that there were significant differences between the treatments. It was found that the highest percentages of mortality of nymphs was 76.7% at the treatment of pesticides and B. bassiana and the lowest percentage of mortality for Mospildate treatment, which amounted to 23.3%. Nelson et al., (22) mentioned that the Condia of the bassiana.B fungus remains effective and depends on moisture and can remain in the soil for two weeks. Meyling, (21) shows that this fungus is able to survive in the form of throwing over the organic matter present in the soil in the absence of the host.

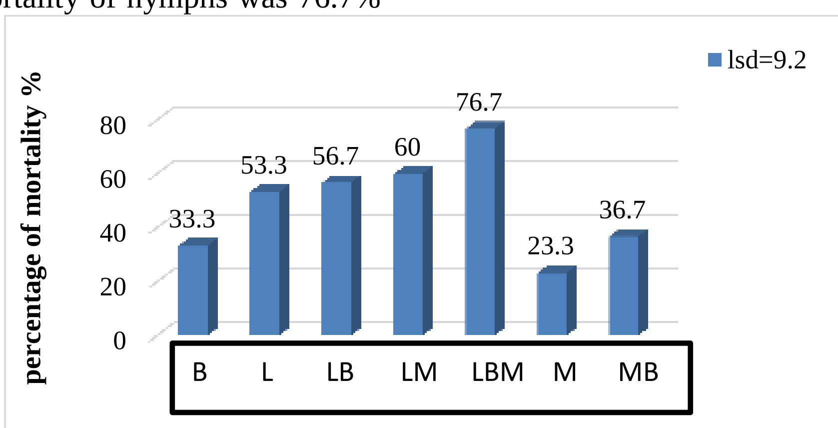

Figure 1: The percentage of mortality nymphs in the field. (• Each number in the table represents an average of three replicates).

Effect of the two pesticides (Leader, Mospildate) and fungus suspension on adults in the field.

Figure (2) shows the effect of the two pesticides (Leader, Mospildate) and fungus suspension on the percentages of mortality for adult in the field. The results showed that there were no significant differences between the treatments. The highest percentages of mortality was 83.3% at the treatment of the two pesticides and the bio-fungus (bassiana B.) and the lowest percentages of mortality for the treatment of Mospildate amounted to 26.7%. Palumbo, (24) mentioned that the Neonecotinoid group is a systemic pesticides that affect contact and usually is the mechanism of action of this type of pesticide through its effect on acetylchline receptors located in the central nervous system in the head of the insect. It was found that an integrated control for the Colorado potato beetle (Leptinotarsa decemlineata) by using the aldicarb pesticide, the bio-fungus (B. bassiana) and Bacillus thuringiensis was able to achieve success by controlling the insect in a field planted with potatoes and reduced the rate of insects in the soil in the spring season per square meter to 1.2 And 2.0 and 2.4 for pesticide, fungicide and bacteria, respectively, while the triple interaction gave 0.6 insects/m^2 (17). It was observed that the effect of the fungus suspension differed between laboratory and field experiments, and the reason was due to the environmental conditions, especially temperature and humidity, where Meyling and Eilenberg, (21) showed the effect of environmental conditions represented by wind, humidity, sunlight and temperature and their contribution to reducing the efficiency of the bio-fungus (B. bassiana) in the events of infection, it was found that relative humidity 90% and a temperature of 27 ° C is considered the most appropriate conditions for the occurrence of infection. The oil suspension of this fungus is more efficient than the water suspension when controlling the red palm weevil because the oil suspension is more resistant to drought in the field (7). When controlling the migratory locust Melanoplus sangninipes of the Acrididae family with a suspension of this fungus, it was able to achieve a percentage of mortality amounted to (74% and 46%) inside greenhouses and fields, respectively, and the reason for this difference was due to environmental conditions (20).

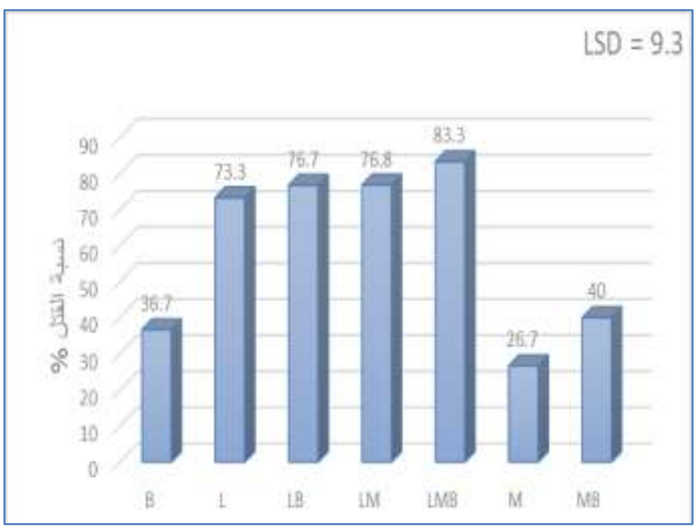

Figure 2: The percentage of mortality adults in the field. (• Each number in the table represents an average of three replicates).

ISSN 2072-3875

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