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COMPATIBILITY OF Vertimec 1.8% EC WITH OLEANDER EXTRACT AND SOME INSECT PATHOGENS AND FIELD TEST ON RED DUST MITE (*Tetranychius urticae* KOCH.) ON EGGPLANT AND PEPPER

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ABSTRACT

The study used some biological control components and evaluated them against the two-spotted mite *Tetranychius urticae* Koch. on eggplant and pepper crops in the spring season in Salah al-Din Government, Iraq. The laboratory study included a compatibility study between the biopesticide Vertimec and the two fungi Metarhizium and Beauveria, as well as alcoholic and aqueous oleander leaf extracts. The results were positive and caused an increase in the colony area of the two fungi at concentrations below the recommended levels; the Beauveria fungus is activated by the aqueous extract of the oleander plant at a rate of 0.5 ml/l. The colony area was 29.5 cm^2, while the colony area for comparison was 24.64 cm^2. The sub-mixtures recommended from the compatibility results were adopted to combat eggplant and pepper fields infected with economically essential pests. The compatibility between the biopesticide Vertimec and two biopesticides, Metarism and Beauveria, showed the highest killing value, as it gave the eggplant plants treated with (Metarism+Vertimec pesticide) at a concentration of 1 ml/1 ml for the two periods after one and three days. Tthe highest corrected percentage for killing, it reached (92.33 and, 96.77) mites. As for pepper plants, the combination between (Metarrhizm+Vertemic pesticide) succeeded in sub-lethal rates (ml/1 ml/liter), which after three days were subjected to the highest kill rates of (100) % of mites. The study's findings are an effective way to combat this pest and the field of integrated management to combat it and implement sustainable agriculture using environmentally friendly pesticides.

INTRODUCTION

Eggplant (*Solanum melongena* L.), which belongs to the Solanaceae family, is one of the widespread vegetable plants in many countries around the world and one of the most important sources of food for humans. It is cultivated in Iraq in open farms and greenhouses and, its cultivation area has increased especially in reserves due to the constant need for it in season and out of season. Eggplant production in Iraq was estimated at approximately 207.2 tons during 2020, which is a rise of 51.6% above previous year's production. It was predicted at around 136.7 thousand tons. (Central Statistical Organization, 2020). Eggplant fruits are used in cooking and pickling. They greatly benefit the liver and facilitate the intestine's

known functions; they also work to purify the blood. Scientific studies and recent research have also confirmed that they help prevent or treat obesity, as they are the main food (Mustafa, 2010). Pepper (*Capsicum annuum* L.), which is a member of the Solanaceae family, is also an essential crop in Iraq due to its nutritional value and potential medicinal benefits. Bell peppers contain a wide range of nutritional components and pharmacologically active receptors, which contribute to their pharmacological activities (Islam *et al*., 2021). Eggplant and pepper crops are susceptible to many pests, including the two-spotted spider mite *T. urticae* Koch. (Meck *et al*.,2009). The Spider mite causes critical economic losses on many fruit trees, vegetables and ornamental plants in protected and field crops, as it has been recorded on more than 1,200 plant families. It has been described as a worldwide pest. The two-spotted pest is a problem farmers face when cultivating eggplant and pepper. This pest is considered one of the most important pests that affect plants, leading to the deterioration of their condition and reduced productivity. Infection caused by this pest causes black spots on eggplant leaves, affecting the plant's photosynthesis and reducing its ability to obtain necessary nutrients. A black spot on the two-spotted fruit also deteriorates the quality of the fruit and its ability to thrive. Infected eggplants and peppers deteriorate through the appearance of deformities in shape and shortening in size, which affects their commercial value and causes economic losses to farmers (Attia *et al*., 2013). The two-spotted mite T. *urticae* is a severe insect that damages pepper and eggplant production (Pirithiraj and Soundararajan, 2020; Musa Kirişik *et al*., 2021). It is also one of Turkey's most significant and devastating agricultural pests, affecting field crops, fruits, and vegetables (Heba, 2021). Furthermore, using regular pesticides can often be essential to controlling this pest. However, inadvertent use of chemical pesticides has resulted in residue formation in food grains and the environment, as well as the growth of insect and mite resistance (Kumar *et al*., 2013). Integrated approaches to pest control also involve the use of a variety of pesticides on resistant plant species. There are pretty several ways known to defeat them, the key of which is the chemical pesticides (Liburd *et al*., 2007; Waleed F. Abobatta, 2023). Chemical pesticides, like others, are readily available and affordable and possess a short duration of action (Monteiro *et al*., 2015). The use of chemical pesticides has been and still is recognized as an effective mechanism for controlling the two-spotted mites. On the other hand, despite having a short-term life cycle, which includes various generations each year, and the undisputed volume of individuals produced through reproduction, it becomes resistant to these compounds so quickly that it becomes one of the most common. Pests can develop resistance during every pesticide application, making control globally difficult (Van Leeuwen *et al*., 2010). Again, control programs for chemical control were minimized due to the passage of pesticide problems (Al-Dahwi, 2008). The new development has propelled the use of safe chemicals and some time ago the aim was the utilization of pesticides in a suitable and single process. Biopesticides, contrasted with organisms including bacteria, fungi, and viruses, can be safely used to control this particular pest (Geroh *et al*., 2014; Mustafa and Al-Mallah, 2021; Abdel-Raheem *et al*., 2023; Ismail A. Ismail *et al*., 2023). Suffice it to say, the future is shining a bright light on this field of research due to their performance in higher yielding plants alongside pollution purification. In this regard, they have been used

in the production various commercial preparations against igolonid mites (Butt *et al*., 2001). The eggplant crop accounts for a considerable share of agricultural production. Moreover, T. *urticae*, the two-spotted spider mite, usually attacks eggplant and pepper crops. The researcher has not encountered many studies addressing these problems despite their significance. As a result, the study was designed to assess integrated management for the red mite T. *urticae* on eggs. The plant (oleander) with both aquatic and alcoholic types, the fungi Beauveria and Metarism, and the pesticide Vertemic are essential in the integrated control of the two-spotted pests in eggplant and pepper farms and studying their compatibility. The best low concentration contributes to suppressing the pest at the lowest economic cost. It helps control it by preventing the spread of this pest through natural and environmentally friendly methods.

MATERIALS AND METHODS

The laboratory analysis was done in the Plant Protection Dept.- Agriculture College of -Tikrit University, -Iraq. The field study was carried out in the Makishifa district's fields.

Materials used in the experiment

1- Vertemic pesticide

Commercial name	Name of the active ingredient and type of preparation	Chemical group	manufacture company	Recommended concentration	Mechanism of action and properties of the pesticide
VERTIMEC	ABMCTIN (18g/L) EC	Vermectin	Syngenta	50-100ml/100L of water 3 days	It is a pesticide of biological origin that is produced from the fermentation of microorganisms in the soil called Streptomyces avermitilis it works by contact and has a transient effect it is slow in its effect and requires3-5days to obtain highest killing rate

2- Preparation of the Beauveria fungus / from the Fungi laboratory in the Plant Protection Department (local isolate).
3- Preparation of the Metarism fungus / from the Fungi laboratory in the Plant Protection Department (local isolate).

Laboratory study

Preparation of aqueous and alcoholic oleander leaf extract

Nerium oleander L. oleander leaves were collected from the gardens of the College of Agriculture/Tikrit University and identified in the Department of Horticulture and Gardens. The extraction processes of the raw materials were carried out in the laboratories of the Plant Protection Department, and method (Harborne, 1984) was adopted to separate the aqueous extract from dried oleander leaves, and the following steps were performed:

1- Washed the leaves well with water to remove dust from them.
2- The leaves were then dried by exposing them to sunlight, stirring them continuously from time to time, to prevent them from rotting.

3- The leaf samples were crushed with a mortar and then ground using an electric blender.
4- Take 50 grams of oleander leaf powder and put it in a 100 ml beaker, add 5 ml of boiled distilled water to it, then mix the contents with a magnetic stirrer for a quarter of an hour, then leave the mixture for 24 hours, then filter it using gauze several times. The filtrate was then evaporated on an electric heating device at a temperature of 50°C for 4 hours in order to reduce the excess amount of water in the filtrate and obtain a condensed extract, which was then preserved until this extract was used in the experiment. To prepare the alcoholic extract, the water was replaced with 96% ethyl alcohol, following the previous steps above.

Preparing concentrations of the pesticide Vertimec 1.8% (active ingredient abamectin 1.8%)

Prepare the concentrations of the pesticide Vertemac by taking 1 ml of it and adding it to 1 liter of distilled water so that the first dilution becomes (the recommended concentration). Then 100 ml of the first concentration is taken and 100 ml of water is added to it so that the second concentration becomes (the recommended half concentration), and then 100 ml are taken. From the second concentration, 100 ml of distilled water was added to it to become the third concentration, which is (the concentration is less than half the recommended).

Testing the vitality of the fungi Beauveria and Metarhizium

The nutrient medium was prepared by dissolving 20 g of PDA powder in 500 ml of distilled water, which was placed in a beaker and shaken slightly. After homogeneity, the beaker was closed with cotton plugs and aluminum foil and sterilized with an autoclave device at a temperature of 121°C for 15 minutes. After completing that, the beaker was left to cool slightly. Next, the medium was carried in Petri dishes of 2 mm. Then, the disinsagent Ampiblox was added in a volume of 0.3 ml. The dishes were allowed to be formed and solidified in the medium.

Further, three days later, as depicted in Figure (1), a 1 ml. bottle of the Beauvera fungus was added to dishes prepared by the instrumentalists (nutrient medium and antibiotic Ampiblox). This experiment was repeated to propagate the Metarhizium fungus. The nutrient medium was prepared by dissolving 20 g of PDA powder in 500 ml of distilled water, which was placed in a beaker, shaken slightly, and after homogeneity, the beaker was then closed with cotton plugs and aluminum foil and sterilized in an autoclave at a temperature of 121°C for 15 minutes. After finishing, the flask was left to cool slightly, and then (0.3) ml of the antibiotic Ampiblox was added. The medium was then poured into Petri dishes at 2 mm. The dishes were left for the medium to solidify. After three days, a 1 ml isolate of the Metarhizium fungus was transferred to the dishes containing the nutrient medium and the antibiotic Ampiblox, as shown in Figure (2).

Compatibility test of Metarhizium and Beauveria fungi with aqueous and alcoholic oleander leaf extracts

The PDA medium was prepared as in the previous paragraphs by taking three 250 ml beakers and taking the concentration of the aqueous oleander leaf extract (0.5 ml), (1 ml), and (2 ml) that were taken from the previously prepared extract. A concentration of the concentrations was placed in each beaker. Then, the beakers were

closed well with cotton and silicone and placed in the autoclave at 121°C under a pressure of 50 bar for 15 minutes. Then, it was removed from the autoclave, and the beakers were left until they cooled slightly and transferred to the hood. Then (0.3) ml of the antibiotic Ampiblox was added to the beakers and poured into the dishes. Each flask was poured into two dishes, and the dishes were left until they solidified. Then, a 1 ml isolate of the Beauveria fungus was transferred to the dishes that had been poured before. After that, a flask containing 250 ml of PDA nutrient medium was prepared, and (0.3) ml of the antibiotic Ampiblox was added, then it was poured into dishes. They were left until they solidified, and 1 ml of Beauveria mushrooms were transferred. This represents the control treatment, then the dishes were transferred and placed in the incubator at room temperature. 27°C for seven days, and then readings were taken seven days after being placed in the incubator. Then he took three other beakers and put the concentrations of the extract of oleander leaves (0.5 ml) (1 ml) (2 ml) in them. Each beaker contained a concentration of these and was added to each of the three beakers containing the prepared nutritional medium. Then, the beakers were closed tightly with cotton.

The cellophane was mixed well and placed in an autoclave at a temperature of 121°C and a pressure of 50 bar for 15 minutes. After that, it was removed from the device, and the beakers were left to cool slightly. They were transferred to the hood, and three (0.3) ml of the antibiotic Ampiblox were placed in each beaker, which was then poured into Petri dishes. Each flask was poured into two petri dishes, and the dishes were left to solidify. Then, an isolate of the fungus Metarhizium was transferred using a loop to the dishes that had been poured before and contained the extract's concentration. A flask containing 250 ml of the nutrient medium was prepared, and (0.3) ml of antibiotic was added. The isolate from the fungus represented the control treatment, which was poured into two dishes and left until they hardened. Then, all the dishes were transferred and placed in the incubator at 27°C for seven days, and readings were taken from them.

The same experiment was repeated by replacing the aqueous leaf extract with the alcoholic oleander extract.

Figure (1): Beauveria fungus

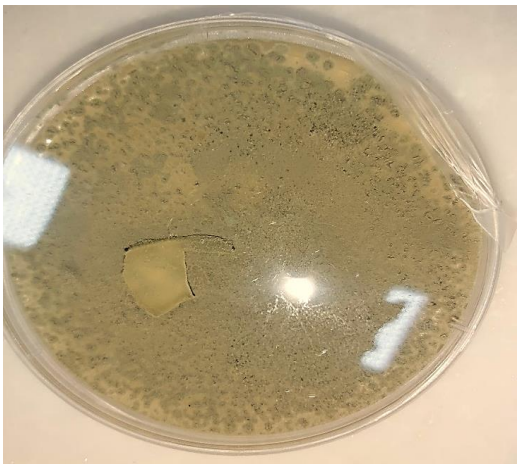

Figure (2): Metarhizium fungus

Compatibility test between the two fungi Beauveria and Metarhizium with the pesticide Vertimec 1.8%

The PDA nutrient medium was prepared as in the paragraphs above (3) by taking nine 250 ml beakers and taking different concentrations of each dilution of Vertimec pesticide (0.5 ml) (1 ml) (2 ml) and placing them in each beaker separately. The beakers were closed tightly with cotton and cellophane and mixed. It was placed in an Autoclave device at a temperature of 121°C and a pressure of 50 bar for 15 minutes. Then, it was taken out of the device, and the beakers were left to cool slightly and transferred to the hood. A concentration of (0.3) ml of the antibiotic Ampiblox was placed in each beaker. Then, it was poured into Petri dishes, and the dishes were left to solidify. After that, an isolate of the Metarhizium fungus was transferred using a loop to the previously poured dishes containing the pesticide concentrations. Then, a beaker containing 250 ml of nutrient medium was prepared, and (0.3) ml of the antibiotic was added, poured into two dishes, and left until it solidified. An isolate of the fungus was transferred. Metarhizium was transferred to the incubator at a temperature of 27°C for seven days, and this treatment represents the control.

Field study

The land was prepared by plowing, hoeing, smoothing, and mowing. Drip irrigation was used to irrigate the field. The hybrid variety (Al-Jawhara) of the eggplant plant and the (Sayhoud) variety of the pepper plant were planted in the form of lines of 20 m each line length, half a meter between one line and another, and 60 cm between one seedling and another. These commercial varieties were chosen for their cultivation in protected agriculture during the fall and spring periods, in addition to their wide spread in the country. The treatments were distributed to the plants in detail using a compatibility program. According to the following transactions:

1- Vertemic pesticide, the active ingredient is (abamectin 1.8%)
   1 ml/L (at the under recommended concentration).
   2 ml/liter (at the recommended concentration).
2- Aqueous extract of oleander plant: active ingredient (glycosides)
   1 ml/L (at the under recommended concentration).
   2 ml/L (at the recommended concentration).
3- Alcoholic extract of oleander plant:
   1 ml/L (at the under recommended concentration).
   2 ml/L (at the recommended concentration).
4- Beauveria fungus and aqueous extract of oleander plant:
   (0.5 ml - 0.5 ml) / liter, respectively.
5- Metarism fungus and the alcoholic extract of the oleander plant:
   (1 ml - 1 ml) / liter, respectively.
6- Metarism fungus and Vertemic pesticide:
   (1 ml - 1 ml) / liter, respectively.

The effectiveness of the experimental pesticides to combat immature stages and adult mites was evaluated in the field. The readings were taken one day before the control to determine the density of the mites, and after the control one, three and seven days to determine the effectiveness of the pesticides on the adult mites. A 16-liter backpack sprayer was used to conduct the procedures. The numbers of dead

larvae were recorded and the percentages of kills were extracted and corrected according to equation (Abbott, 1925). The equations were used. Modified using the Abbott equation and the Metcalf method (Metcalf, 1972) developed by (Al-Jubouri and Al-Mallah, 2013) to calculate the following:

1. Average kill percentage for the mixture.
2. Calculating the killing percentage of the pesticide (the percentage of toxic effect of the pesticide only).
3. Calculate the killing percentage for the activating additive alone.
4. Calculate the synergism ratio and strengthening ratio of the activated additive.

$$\%\ kill\ corrected = \frac{\%\ killing\ in\ treatment\ -\ \%\ killing\ in\ comparison}{100\ -\ \%\ killing\ in\ comparison} \times 100$$

*Equation (1) (Abbott, 1925)

Statistical Analysis

The laboratory experiment was carried out using a complete randomized design (C.R.D.) and the field experiment was carried out by adopting a complete randomized block design (R.C.B.D.). The data were analyzed using the ready-made program SAS, and the means of each trait were compared using the least significant difference (L.S.D.) to ensure the significance of the differences between the coefficients at a probability level of 5% (Ahnter, 2010).

RESULTS AND DISCUSSION

Compatibility between the two biocide fungi *B. bassiana* and the fungus *M. anisopliae* with alcoholic and aqueous extracts of oleander and Vertimec 1.8%. It is noted from Table (1) that the total growth area of the two biocidal fungi, *B. bassiana* and *M. anisopliae*, grew well when mixed with alcoholic and aqueous extracts of the oleander plant. It varied depending on the type of concentration, the type of extract, and the pesticide Vertemic, as it gave the best compatibility between them (the fungus *B. bassiana* concentration 0.5 ml + aqueous extract of oleander, as the average area for fungus growth, was 29.5 cm2, while the comparison was smaller, amounting to 24.64 cm2. Then came the highest concentration of 1 ml for the same fungus and the pesticide Vertemic, with the lowest concentration of the fungus being 0.5, as the agreement between them gave the same significance, reaching (14.17, 13.83). cm2. As for the fungus *M. anisopliae*, it gave the alcoholic extract at a concentration of 0.5 ml the highest growth area corresponding to it, amounting to 18.51 cm2, followed by the pesticide Vertemic with the fungus at concentrations of 1 ml and 0.5 ml, reaching (13.75, 13.33) cm2, respectively, while the comparison treatment was average growth is 15.50 cm2. The statistical analysis in Table (1) shows a difference in the general average agreement between the fungus and the treatments. The highest overall average value in agreement with all factors included in the study was given to the Beauveria fungus, amounting to 14.507 cm2.

In comparison, the percentage of the total area of the *M. anisopliae* fungus was Its compatibility with the tested parameters reached 11.274 cm2. The results indicate the validity of the compatibility between *B. bassiana* and M. *anisopliae* at concentrations of 0.5 and 1 ml with the aqueous extract of oleander and a smaller amount with the alcoholic extract. This agreed with what researchers did in a study (Jelly *et al.,* 2023) where they found that when mixing the alcoholic or aqueous

extract of oleander with the two fungi *B. bassiana* and *M. anisopliae* are not affected by fungi and have shown toxicity in their toxicological activity against the Spodoptera frugiperda insect. The outcome of these assays calls for medical compatibility between alcoholic and water-based oleandrin, which means that the combination is considered safe. It also draws attention to the need to reinforce environmental health and integrated pest management systems for sustainable agriculture. This might reveal, as (Yusuf Nikpeyma *et al.,* 2019) have observed. In their experiments, without noticeable effects, they most successfully investigated the potential of fungal biocides, including B. bassiana and M. anisopliae. But they complemented it with both alcoholic and aqueous extracts of oleander. In the study of El-Akad *et al.* (2016), the two biological fungi, *B. bassiana* and *M. anisopliae*, have no visible growth difference (using aqueous or alcoholic oleander extract). This conforms to the results from the study of biocides′ compatibility with oleander extracts and, by extension, supports the use of oleander extracts in integrated control programs against mites and insect pests.

Table (1): Compatibility among the two probiotic fungi, *M. anisopliae* and *B. bassiana*, with oleander plant's alcoholic and aqueous extracts and the pesticide Vertimec 1.8%

Treatments		Average growth area (cm^2)				Average
Beauveria fungi	Concentration	Alcoholic extract	Aqueous extract	Vertmic	Control	
	2 ml	6.50 e-f	6.42 e-f	9.00 d-g	24.64 a	
	1 ml	4.00 f	14.17 b-d	7.67 e-f	24.64 a	
	0.5 ml	9.08 c-e	29.50 a	13.83 b-d	24.64 a	
Average						14.507 A
Metarism fungi	2 ml	4.50 f	7.00 e-f	5.26 e-f	15.50 b	
	1 ml	5.80 e-f	9.81 c-e	13.33 b-d	15.50 b	
	0.5 ml	18.50 b	10.50 c-e	13.75 b-d	15.50 b	
Average						11.247 B
General average						12.877
LSD 5 %		Interaction between concentrations & treatments		Treatments effect		Concentration effect
		5.435		1.569		3.843

*The numbers followed by similar letters in the same column or row do not have significant differences according to the least significant difference (LSD) test performed at the 5% significance level.

The effect of the period and the pesticide Vertemic and their compatibility with the two biocides *B. bassiana* and *M. anisopliae* on the killing rate of the red two-spotted spider T. *urticae* Koch. On eggplant in the field:

Table (2) shows a variation in the killing rate of the two-spotted red mite T. *urticae* Koch. depending on the type of fungus and pesticide, their compatibility, and the duration of exposure, the treatment (Metarism+Vertemic pest.) at a concentration of 1 ml/1 ml for the two periods after three and seven days gave the highest percentage corrected for killing, as it reached (92.59, 96.77) mites, respectively, followed by the

treatment (Metarism+alcoholic oleander extract). At the concentration of 1 ml/liter, after seven days, the corrected kill percentage reached (86.73) mites. The effect on the kill rates decreased and was lower in the readings on the first day of exposure to the treatments (Metarism+Vertemic) at the sub-lethal concentration, giving the lowest corrected kill percentage amounting to (12.26) mites. Statistical analysis shows differences between exposure duration levels, which is expected because pesticide toxicity increases directly with the length of pesticide exposure (Al-Adel, 2006), as the duration after seven days gave the highest value. The general average of the effect of the total treatments, the corrected percentage of kills was (65.867) followed by the two general averages after three days, and then after a day, it reached (50.704 and 39.251) mites, respectively. It is noted from the same table that compatible treatment with sub-lethal concentrations of the biocide, the pesticide, and the extracts gave successful results in combating the mite on the eggplant crop and that modern trends in treating pest problems tend to use low concentrations of pesticides to reduce their residues in environmental elements, in addition to the nature of the botanical pesticides and their extracts, which are known to deteriorate significantly it spreads rapidly in the environment through various environmental factors that directly affect it. Therefore, this result is an essential and promising source for managing mite pests. This may be because the main compound in the oleander extract is the alkaloid oleandrin, which has a percentage in the plant tissues of 0.08%, which makes the reproduction medium of the fungi essential and suitable for their growth and reproduction, in addition to the extract containing glycosides, glucose, vitamin C, oils, and the Quercetin compound, which is a flavonoid (Shaw) (Reynolds, 1989) These compounds may be used by fungi as food for their growth and reproduction.

Table (2): Effect of the pesticide Vertemic, the two biocides *B. bassiana* and M. *anisopliae* and the alcoholic and aqueous extract on the corrected percentage of kill of the two-spotted red spider *T. urticae* Koch. on eggplant in the field.

Pesticides	Concentration	Corrected percentage of kills			
		After 1 day	After 3 days	After 7 days	Average
Metarism+Vertemic	1ml/1ml/L	12.26 i	92.59 a	96.77 a	67.21 A
Metarism+alcoholic extr.	1ml/1ml/L	39.75 f-g	62.32 b-f	86.73 a-b	62.93 A
Bioveria+aqueous extr.	0.5ml/0.5ml/L	45.60 e-g	58.55 c-g	75.29 a-d	59.82 AB
Alcoholic extract	2ml/L	40.87 f-g	53.77 d-h	56.11 c-g	50.25 BC
Alcoholic extract	1ml/L	40.34 f-g	57.89 c-g	69.83 a-e	56.02 A-C
Aqueous extract	2ml/L	32.38 g-i	41.85 e-g	50.59 d-h	41.61 DC
Aqueous extract	1ml/L	26.29 i-h	32.19 g-i	39.17 f-g	32.55 D
Vertemic	1ml/L	32.14 g-i	43.01 e-g	44.51 e-g	39.89 CD
Vertemic	2ml/L	46.43 e-g	53.72 d-h	82.52 a-c	70.75 A
Average		39.25 C	50.70 B	65.87 A	46.44674
LSD 5%	Av. Interactions	Av. Periods	Av. Pesticides		
	28.401	9.4669	16.359		

*The numbers followed by similar letters in the same column or row do not have significant differences according to the least significant difference (LSD) test performed at the 5% significance level.

The effect of the recommended sub-concentrations of mixing the Metarism fungus with Vertemic pesticide in the mite after three days on the eggplant plant:

Table (3) showed that the Metarism fungus had a stimulating effect of the pesticide Vertemic amounting to 52.26%. This activation included two types of effects, namely the potentiation effect (the toxic effect) and the toxic effect of the pesticide Vertemic, which amounted to 44.51%, so the total effect of both was 96.77%. The results showed that the highest effect was strengthening and activating the fungus Metarism, which amounted to 52.26%, compared to the effect of Vertemic, which did not exceed 44.51% of the total effect of 96.77%. A similar study reached the highest killing rate among individuals of the two-spotted mite with a killing rate of 100% when using Vertemic at a concentration of 1 ml/liter 7 days after spraying (Tulail And Mohammad, 2021). Study (Hamida, 2005) agreed with this study as Vertemic pesticide gave significant results in reducing the number of adults of the two-spotted mite, and the average number of adults reached about 3.22 adults/leaf compared to the control treatment, which amounted to 29.89 adults/leaf two weeks after spraying it on the cotton plant. Vertemic pesticides achieved significant results as the killing rate reached 70% for newly puberty females of two-spotted mites after a week of laboratory treatment (Suleiman, 2018). Vertemic pesticide helped reduce the number of two-spotted mites from 140 individuals/inch2 to 36.7 individuals /inch2 two weeks after being sprayed on cucumber plants in open fields (Mahdi *et al.*, 2017).

Table (3): Effect of the recommended sub-concentrations of mixing Metarism fungus with Vertemic pesticide in mites after three days on eggplant plants.

Status type	Type of Treatment	Corrected percentage of kills	Type of Effect
Average % kill of the mixture and its components out of the total treated mites 100%	Metarism fungus	52.26	Strengthening + revitalizing
	Vertemic	44.51	Pesticide effect
	Metarism + Vertemic	96.77	Overall effect

The effect of the exposure period of the pesticide Vertemic and their compatibility with the two biocides Metarhizium and Beauveria and the alcoholic and aqueous extract of the oleander plant on the killing rate of the red two-spotted spider *T. urticae* Koch. On-field pepper:

The results of Table (4) showed a variation in the killing rates of the two-spotted spider T. *urticae* Koch. depending on the type and concentration of the pesticide used, their compatibility, and the duration of exposure as the treatments that were exposed after three days gave the highest percentage of kills the compatibility between (Metarhizum+Vertemic pest.) succeeded in the sub-lethal ratios (1 ml/1 ml/liter) as well as (Metarizum + alcoholic extract) in the sub-lethal ratios (1 ml/1 ml/l) had the highest value of (100)% mites followed by the same value and duration of effect of the alcoholic extract at the concentration (2 ml/l) which reached (83.33) mites. Then, the corrected percentage of kills decreased in treating the pesticide Vertemic at the sub-recommended concentration (1ml/L) as it went (58.67) mites.

There is also a discrepancy between the corrected percentage killing rates in the treatments after exposure for seven days except for the one in which the killing percentage reached 100%, as it increased intuitively with the period of exposure to pesticides. The aqueous extract was given at a high concentration (2 ml/L) of water and had a corrected kill rate of 93.33 mites, followed by Vertemic pesticide at the recommended concentration (2 ml/L) of 88.67 mites. This may be attributed to the mechanism of the complete effect of the pesticide Vertemic and to the mechanism of action of abamectin, which is through its binding to the sensory receptors of nerve cells and then entering the chloride channels and increasing electrical transmission within the cell. As a result, tremors, agitation, and a collapse of the pest's nervous system occur (Wolstenholme and Rogers, 2005), and the pesticide works. It stops the process of reproduction and development of insects and spiders and thus contributes to controlling the spread of spider mites and reducing the damage resulting from them. The results of the statistical analysis in Table (4) showed that there were significant differences in the averages of the periods to which the lesion was exposed, as the period after seven days and after three days gave the highest value, reaching (87.963 and 82.593%) mites respectively, while the period after one day had a less significant moral impact reaching 53.815% of a mite. The results also showed a discrepancy between the effect of the total pesticide averages and the duration of exposure depending on the type and concentration of the pesticide and the compatibility. The compatibility of the treatment of (Metarrhizm + Vertemic) and (Metarrhizm + Alcohol) at the concentration below the recommended level gave the highest overall average of corrected percentage killing rates of 87.89 and 85.67%, respectively.

Table (4): The effect of the exposure period, the pesticide Vertemic, their compatibility with the two biocides B. bassiana and M. anisopliae, the alcoholic and aqueous extract of the oleander plant on the percentage of killing the two-spotted spider *T. urticae* Koch. on field pepper.

Pesticides	Concentration	Corrected percentage of kills			
		After 1 day	After 3 days	After 7 days	Average
Metarism+Vertemic	1ml/1ml/L	56.67 d-f	100.00 a	100.00 a	85.56 AB
Metarism+alcoholic extr.	1ml/1ml/L	63.67 b-e	100.00 a	100.00 a	87.89 AB
Beauveria +aqueous extr.	0.5ml/0.5ml/L	60.67 b-e	76.67 a-e	83.33 a-c	73.56 A-D
Alcoholic extract	2ml/L	30.00 f	100.00 a	100.00 a	76.67 A-D
Alcoholic extract	1ml/L	31.33 f	76.67 a-e	84.33 a-c	64.11 CD
Aqueous extract	2ml/L	63.00 b-e	83.33 a-c	93.33 a	79.89 A-C
Aqueous extract	1ml/L	50.00 e-f	73.33 a-e	83.33 a-c	68.89 B-D
Vertemic	1ml/L	53.33 e-f	58.67 d-f	72.00 a-e	61.33 D
Vertemic	2ml/L	57.00 d-f	80.00 a-d	88.67 a-b	75.22 A-D
Average		53.815 B	82.593 A	87.963 A	74.79
LSD 5%	Av. Interactions	Av. Periods	Av. Pesticides		
	29.111	9.704	16.808		

*The numbers followed by similar letters in the same column or row do not have significant differences according to the least significant difference (LSD) test performed at the 5% significance level.

The results in Table (5) also showed that the Metarism fungus stimulated the pesticide Vertemic, which amounted to 28.00%. This activation included two types of effects: the potentiation effect (the toxic effect) and the poisonous effect of the pesticide Vertemic, which amounted to 72.00%, so the total impact of both was 100%. Researchers from Pakistan (Muhammad Amjad *et al.*, 2012) found results that may be consistent with our study of mixing some modern pesticides with pathogenic fungi. When combining the fungus Metarhizium with the pesticide, another study evaluated the effect of different strains of insect-pathogenic fungi, including *M. anisopliae*, on the two-spotted spider mite. All fungal isolates tested were pathogenic to mites, killing adult females (Muhammad Amjad *et al.*, 2012). A study was conducted on pea and wheat crops in Beheira Governorate, Egypt, against *T. urticae* Koch. It agreed with our findings, as (Abou-Zaid, 2019) used the insect-pathogenic fungus *M. anisopliae* and recorded a significant decrease in pest density during the two successive seasons of 2017 and 2018. While another study in Egypt (Ghatwary, 2007) found that mixing biological fungi with the pesticides used was not used, and tests were conducted in the 2005-2006 season to determine the effectiveness of the two biological fungi *B. bassiana*, the fungus *M. anisopliae* mineral oils, and the insecticide carbosulfan.

Table (5): Effect of the recommended sub-concentrations of mixing the Metarism fungus with Vertemic pesticide on the mite after three days on the pepper plant.

Status type	Type of Treatment	Corrected percentage of kills	Type of Effect
Average % kill of the mixture and its components out of the total treated mites 100%	Metarism fungus	28.00	Revitalizing
	Vertemic	72.00	Pesticide effect
	Metarism + Vertemic	100.00	Overall effect

CONCLUSIONS

1- Compatibility of the biologically resistant fungi Beauveria and Metarism with the pesticide Vertemic.
2- Compatibility of the bioresistant fungus Beauveria with Metarism with aqueous and alcoholic extracts at sub-low concentrations of the oleander plant.
3- The compatibility between (Metarism + Vertemic) at concentration (1 ml/1 ml/L) after three days of treatment gave the highest percentage of field kill on plants.
4- The treatment of the pesticide Vertemic at a concentration of 2 ml/L after a day of treatment also outperformed the eggplant in the field.

This is a result that achieves our desired goal in the study which is to use sub lethal concentrations and environmentally friendly materials to obtain a clean environment. At the same time, we achieve a reduction in the pest density which results in raising the level of production and increasing the profitability of the crop, in addition to not contaminating the fruits with toxic residues that harm human health. In this way, we have moved away from pollution with toxins. In the production of

economically important crops, we achieved an opportunity for important environmental factors to metabolize pesticides in the right direction.

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CONFLICT OF INTEREST

The authors state that there are no conflicts of interest with the publication of this work.

توافقية Vertemic 1.8% EC مع مستخلص الدفلى وبعض مسببات الأمراض الحشرية واختبار كفاءتها على الحلم الأحمر ذي البقعتين (Tetranychius *urticae* KOCK.) على الباذنجان والفلفل

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الخلاصة

أجريت الدراسة بهدف إستخدام بعض مقومات المكافحة الاحيائية وتقييمها حقليا ضد الحلم ذو البقعتين Tetranychius *urticae* koch على محصولي الباذنجان والفلفل في الموسم الربيعي في محافظة صلاح الدين, من الدراسة المختبرية التي شملت دراسة التوافقية بين المبيد الاحيائي Vertimec والفطرين Beauveria , Metarhizium ومستخلصي أوراق نبات الدفلى الكحولي والمائي حيث كانت النتائج إيجابية وسببت زيادة في مساحة المستعمرات للفطرين وبالتراكيز التحت الموصي بها وتنشط فطر البيوفيريا بفعل المستخلص المائي لنبات الدفلى في النسبة 0.5 مل/لتر وإذ بلغت مساحة المستعمرة 29.5 سم^2 في حين كانت مساحة المستعمرة للمقارنة 24.64 سم^2. إعتمدت الخلطات التحت الموصى بها من نتائج التوافقية في مكافحة حقلي الباذنجان والفلفل المصابان بالافة المهمة اقتصاديا والتي تعد من الآفات الرئيسة, اذ أظهرت التوافقية بين المبيد الاحيائي Vertimec مع المبيدين الإحيائيين ميتارايزم و بيوفيريا اعلى قيمة قتل اذ اعطت على نباتات الباذنجان معاملة (ميتارايزم+مبيد الفيرتمك) بالتركيز 1مل /1مل للمدتين بعد يومين وثلاثة أيام أعلى نسبة مئوية المصححة للقتل اذ بلغت (92.33 , 96.77) حلمه اما على نباتات الفلفل فقد نجحت التوافقية بين (ميتارايزم+مبيد فيرتمك) بالنسب تحت القاتلة (١مل/١مل لتر) والتي تعرضت بعد يومين أعلى نسب قتل بلغت (100) % حلم, إن ما توصلت له الدراسة تعد وسيلة فعالة لمكافحة هذه الافة وبالإمكان تطبيقها في مجال الادارة المتكاملة لمكافحتها وتطبيق الزراعة المستدامة باستعمال المبيدات الصديقة للبيئة.

الكلمات المفتاحية: مبيد الفيرتمك، مبيد ميتارايزم، مبيد بيوفيريا، الباذنجان والفلفل.

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