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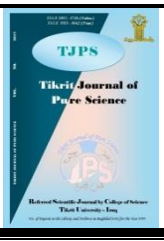

Laboratory evaluation of the effectiveness of some chemical pesticide and biopesticides and their combinations in the control of tomato leafminer *Liriomyza bryoniae*

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ABSTRACT

A laboratory study was carried out to evaluate the effectiveness of the chemical pesticides Actara, Abamectin, Oxymatrim, and two bioformulation Varanestra (*V. lecanii*) and Almite (*H. thompsonii*) and their combination on adults and pupae of the *Liriomyza bryoniae*. The results showed that the most compatibility pesticide with *V.lecanii* and *H.thompsonii* were Actara, while Abamectin and Oxymatrine did not showed compatibility with these fungi.

The treatment of Abamectin was superior in adult mortality 55.56% at the half-field concentration (FC-50%), followed by Actara was 46.67%, while the lowest mortality percentage of Oxymatrine treatment was 38.89%. The treatment of Varunestra was significantly higher in mortality percentage of adults was 55.60%, while the lowest mortality percentage for Almite treatment was 42.20%. There was no significant difference in adults mortality percentage for both the mixture (Actara + Varunestra) and the mixture (Actara + Almite), which reached 56.66% and 52.22%, respectively.

The treatment of the mixture (Actara + Varunestra) was superior In reducing adults emergence percentage from pupae of 8.88%, which did not differ significantly from the treatment of the mixture (Actara + Almite), which reached to 12.22%.Results showed that Actara was compatibility with two bioformulation Varanestra (*V.lecanii*) and Almite (*H. thompsonii*) to control adults and pupae of the *Liriomyza bryoniae*.

Introduction

Tomato leafminer *Liriomyza bryoniae* was one of the most important insect pests that attacked various vegetable crops such as tomatoes, beans, eggplants, potatoes, coriander, bacillus and ornamental plants, causing significant losses in quantity and quality of production in tropical and subtropical regions of the world[1]. *L. bryoniae* caused losses in tomato production of up to 17% and losses in marketing value of up to 20% on tomatoes crop that cultivated in greenhouses[2; 3]. Larvae feed on the mesophilic tissue between the upper and lower of the leaf forming zigzag mines, and causing a reduction in photosynthesis, dryness of leaves and poor growth of modern leaves, adults caused severe damage to leaves by feeding and oviposition eggs in the leaf tissue as well as transmitting viral diseases [4,5].

In Iraq [6] found that the highest density of the tomato leafminer *L.bryoniae* was 29 larvae / plants on the tomato crop on 15 th January 2014, and the *Liriomyza* spp was multivoltine, reached 12-15 generation per year.

The problem of control leafminers that was belonging to *Liriomyza* was evolution of genetic resistance against insecticides, although chemical control was still one of the main ways to control them. [7].

Previous studies have indicated the effectiveness of Actara, which belongs to the Neonicotinoid group against insects [8]. The rapid effect of the pesticide is concerned with nicotinic acetylcholine receptors in the nerve fibers of the central nervous system of the insect. [9]. Several studies have indicated that Abamectin was very effective in controlling of leafminer *L.trifolii*. [10]. The Oxymatrine pesticide of

Quinolizidine alkaloids, a plant derived from the roots of wild plants belonging to the legume family, is *Sophra japonica* [11].

[12] demonstrated the efficacy of *H. thompsonii* as biopesticide in insect control. The *V.lecanii* was one of the most fungus to control Diptera , Homopera and Lepidoptera insects [13,14].

The aim of this research to study the compatibility of biological control agents (Varanestra (*V.lecanii*) and Almite (*H. thompsonii*)) and modern chemical pesticides (Actara, Abamectin, Oxymatrim), and Evaluation of their effectiveness and their combination on the pupae and adults of *L.bryoniae*.

Materials and methods of work

Preparation of medium Potato dextrose agar (PDA)

Potato Dextros Agar (PDA) was prepared by dissolving 39 g of powder in 1000 ml distilled water by using Magnetic Stirrer to homogenized the medium well, the medium was distributed into flasks (capcity 500 ml), put 250 ml in each of the flasks, the slots were closed with cotton and aluminum foil, the flasks were Placed into the autoclave at 121ºC and press 1.5 kg/cm² for 15 minutes for sterilization. After sterilization, the vial should be cooled slightly, before solidification, 250 ml/L of Ampiclox antibiotic and pesticide, pour in 9 cm diameter Petri dishes and leave to solidify by Laboratory temperature.

Evaluation of the compatibility of pesticides Actara 25 WG, Avirmec 1.8 EC and Levo 2.4 SL with fungus *Verticillium lecanii* and *Hirsutilla thompsonii* at Laboratory:

Table (1) Insecticides and bioformulations used in the laboratory:

N	Insecticides or bioformulations	Active ingredient	Chemical Group
1	Actara 25 WG	Thiamethoxam	Neonicotinoids
2	Avirmec 1.8 EC	Abamectine	Avermectin
3	Levo 2.4 SL	Oxymatrine	Botanical insecticide
4	Varunestra 2% A.S.(2×10^8 CFU/ml)	*Verticillium lecanii*	Bioformulation
5	Almite 2% A.S. (2×108 CFU/ml)	*Hirsutilla thompsonii*	Bioformulation

METHODS: After preparing the medium and adding the antibiotic, add the chemical pesticide according to the recommended dose. Then add the mushrooms from the fifth concentration. Paste the dishes with Petri for hardening and place in the incubator at 25 ± 2°C after colony growth.

Laboratory Evaluation of Chemical and Biological Pesticides:

Laboratory insect rearing:

A glass basin with dimensions of (80 × 54 × 60 cm) with two openings on the large sides 20 cm in diameter and Pasted it Muslin cloth 50 cm long to control the process of drawing the leaves containing the larvae were prepared. The bottom of the basin was sand-washed and sterilized with an electric oven (depth 5 cm) for the purpose of providing the necessary moisture for the development of the stages of insect, the delivery of water to the sand was through two holes diameter of 20 cm and between 5 cm as in (Figure 1), was transferred 10 seedlings of tomatoes planted in Plastic bowls diameter of 12 cm to the basin, The basin was covered with Muslin cloth and was glued with adhesive silicon, and after the preparation of the basin, the aduts were collected from the infected Plastic house at the faculty of Agriculture, University of Tikrit, was collected by Aspirator and transferred to the basin [15].

Figure (1) The glass basin for the rearing of leafminer *L.bryoniae* at laboratory

Evaluation of the effectiveness of bio-chemical pesticides and bioformulations and their mixtures on the adults and pupae of the both tomato leafminer and climbing beans leafminer:

The experiment was carried out in the insect laboratory / faculty of Agriculture, University of Tikrit. The experiment was carried out with its replicates per treatment, by placing 10 adults or pupae in each plastic box (repeat) As well as control treatment (water only), Exposure of adults to pesticide residues on walls of boxes by the fine spray method was used with a 1/2 liter hand spray, then a piece of cotton saturated with a 5% sugar solution was placed in a glass tube (5×1) cm to feed the adults. The plastic boxes were covered with muslin cloth and rubber band and the result wrer taken after (1,3 and 7) days of treatment for chemical insecticides and (3,5 and 7) days for bioformulation. The death rates were extracted and corrected according to the [16]. The pupae were collected from the rearing basing and placed in boxes and treated by spraying them with a

1/2 liter hand spray, and the results were taken after (5,10 and 15) days of treatment for chemical insecticiedes and bioformiolation, and after (3.5 and 7) days of treatment for mixers of (chemical insecticiedes + bioformiolation).

Results and discussion:

Compatibility of biological control agents with chemical pesticides:

Compatibility of *Verticillium lecanii* with chemical pesticides:

The results(Table2) show that the Actara pesticide is the most tested insecticide in comparison with *V.lecanii* at field concentration (0.125 g / 0.5 L) The number of colonies of fungi (23) colony and the percentage increase +331.51. The pesticides Abamectin and Oxymatrim showed their compatibility with the fungus *V.lecanii* at field concentration (0.05, 0.031) ml / 0.5 l, respectively, where the number of colonies (0.2) colony and by Reduction-96.24 for both pesticides.

Table 2: Compatibility of *Verticillium lecanii* with chemical pesticides

pesticides	Concentration (0.5 L)	Number of colonies	Increase and reduction
Actara	**0.125 g**	**23a**	**+331.51**
Abamectin	**0.05 ml**	**0.2c**	**-96.24**
Oxymatrine	**0.031 ml**	**0.2c**	**-96.24**
Control	**Without pesticide**	**5.33b**	**-**

* Numbers with similar letters in the same column are not significant differences according to the Duncan Multiplicity test at the 5% prfobability level.

Compatibility *Hirsutilla thompsonii* with chemical pesticides

Table (3) showed the Compatibility of the *H. thompsonii* with Oxymatrine, Abamectin, Actara, as all pesticides caused inhibition of growth of the fungus at concentration (FC-50) except Actara, which was Compatible with *H.thompsonii*. The number of colonies (5.8) colony and increase rate of +249 at the concentration (FC-50) (0.125 g/0.5L). Abamectin and Oxymatrine inhibitors showed the growth of the fungus completely with a reduction of (-100) for both pesticides, they did not comply with *H.thompsonii*.

Table 3: Compatibility of *Verticillium lecanii* with chemical pesticides

Pesticides	Concentrations (0.5L)	Number of colonies	Increase and reduction
Actara	**0.125 g**	**5.8a**	**+249**
Abamectin	**0.05 ml**	**0.00c**	**-100**
Oxymatrine	**0.031 ml**	**0.00c**	**-100**
Control	**Without pesticide**	**1.66b**	**-**

* Numbers with similar letters in the same column are not significant differences according to the Duncan Multiplicity test at the 5% prfobability level.

The results showed that all tested pesticides were not compatible with *V.lecanii* and *H. thompsonii* except Actara, which was compatible with both fungi. The cause of the incompatibility of Abamectin and Oxymatrin and the decrease in fungi growth may be due to the toxic substance Active Ingredient Chemical pesticides have a inhibition effect on the growth of fungi when its concentration increases in the its growth medium because the high concentration of the chemical pesticide may inhibit some important enzymes in the completion of the metabolic activities of the fungus, which inhibits their growth [17; 18; 19], The reason for the compatibility of the pesticide Actara with the fungus may be due to the fact that these chemical pesticides have mechanisms of influence in the various organs of the insect and have no direct effect on the growth of fungi and their reproduction of the different physiological structure of the bodies of insects in addition to the difference metabolic pathways in each of these fungi may have some enzymes that metabolize and decompose these pesticides to secondary metabolites which are used as fungus as an important food source for their growth and propagation though a process known as Mycoremediation, as well as additives to the modern pesticides products such as some of the dispersal materials and bonding and fumes, which is a polysaccharides (Xanthan gum and Natural gum) and propylene glycol containing carbohydrates, which is a source of food ready for direct nutrition by fungi, which increases their vegetative growth and the production of conidies, many researchers pointed to the effect of some of the types of chemical pesticides in the growth and propagation of fungi *B.bassiana* and *M. isopliae* [20; 21; 22].

Effect of Chemical and Botanical insecticides on leafminer adults of *L.bryoniae* at half field Concentration (FC - 50%):

The results of the study showed in Table (4) that there were significant differences in pesticide interferences and exposure duration. The interaction of the pesticide Abamectin and after 7 days of the treatment achieved the highest mortality percentage of adults of leafminer *L. bryoniae*, with the mortality percentage reaching 63.33% while the lowest precentage of Oxymatrine on the first day of treatment was 33.33%. The results showed that the general mean of mortality percentage of adults for treatments was superiority of

the treatment of Abamectin by mortality percentage of 55.56% followed by the treatment of Actara with 46.67%, while mortality percentage of Oxymatrine treatment was 38.89%.

Table (4) Effect of Chemical and Botanical insecticides on adults of *L. bryoniae* at half Field Concentration (FC - 50%)

Treatments	Mortality percentages% Exposure time (day)			The general mean of treatment
	1	3	7	
Actara	36.67ef	46.67c	56.67b	46.67b
Abamectin	46.67c	56.67b	63.33a	55.56a
Oxymatrin	33.33f	40.00de	43.33cd	38.89c
The general mean of exposure duration	38.89c	47.78b	54.44a	-

* Numbers with similar letters in the same column are not significant differences according to the Dunkin Multipliers test at the 5% probability level.

Effect of Chemical and BioPesticide on leafminer adults of *L.bryoniae* at Field Concentration (FC):

The results of the study showed in Table (5) that there were significant differences in pesticide interferences and exposure duration. The effect of Actara and Abamectin achieved higher mortality percentage of leafminer adults *L. bryoniae* after (7 days) 80.00% and 83.33% respectively. The least mortality percentage of Abamectin and Oxymatrine on the first day of the treatment was 53.33% for both of them and there were no significant differences between them.

The results of the general mean percentage of adult mortality in field concentration showed no significant differences between the three pesticides with 68.89% of Actara and Abamectin, while the lowest mortality rate of Oxymatrine was 61.11%. The results showed an increase in the mortality rates for adults with an increase in the exposure time, reaching a high of 76.67 years after 7 days of treatment. The lowest percentage of deaths for adults on the first day of the treatment was 55.55%.

Table (5) Effect of Chemical and Botanical insecticides on adults of *L. bryoniae* at Field Concentration (FC)

Treatments	Mortality percentage% Exposure time (day)			The general mean of treatment
	1	3	7	
Actara	60.00c	66.67bc	80.00a	68.89a
Abamectin	53.33d	70.00b	83.33a	68.89a
Oxymatrine	53.33d	63.33c	66.67bc	61.11a
The general mean of exposure duration	55.55c	66.67b	76.67a	-

*Numbers with similar letters in one column or in one row are not significant differences according to the Dunkin Multipliers test at the probability level 5%.

The results of the tables (4,5) showed that the best effective insecticides on adults at the field and field half concentrations were Abamectin and Actara, while Oxymatrine was the least effective pesticide in adults because the Abamectin inhibitor affects the neural-musculoskeletal areas of the insects as it interferes with the neurotransmitter and neuromuscular transmission and stimulates the release of gamma-amino butric acid (GABA) and adhesion in receptor sites on the muscle neurons in the lesion, which increases the permeability of chlorine ions and occurs persistent polarization, stress, paralysis, and stop of feeding and dies starvation [23; 24; 25], this is consistent with [26] where they stated that the pesticide Abamectin was more effective in controlling *L. trifolii* in the concentration of 1.4 ml / L, which is consistent with [27] when treating *L. trifolii* with Abamectin with the highest kill rate of 58%.

The effect of the Actara pesticide is due to the toxic effect of the active substance Thiamethoxa, which is associated with the neurotransmitter (Ach) receptor and inhibits its breakdown and therefore accumulated at synap gap for nerve endings leading to stress, paralysis and rapid death [28], actara had systemic movement a nd its slow degradation within plant tissue [29], as noted by [30] reported that the mortality percentage of larvae of *L. trifolii* treated with the Actara pesticide was 70%.

The low mortality rate of adults with Oxymatrine may be due to its antifeedant and repellent effect of adults that have antenna capable of sensor-sensing genes [31] or possibly to adults with an enzyme-specific enzymatic system capable of analyzing the pesticide into compounds Non-toxic.

Effect of Almite and Varunestrs on leafminer adults of *L. bryoniae*:

The results of the study showed in Table (6) that there were significant differences in pesticide interferences and exposure times, Varunestra was the highest mortality rate of the *L.bryoniae* adults after 7 days of treatment with 73.33%, while the least mortality

percentage of Almite and Varunestra on the third day of the treatment amounted to 20.00% for each them and there were no significant differences between them.

The results of the general mean of mortality percentage of adult by treatment showed that Varunestra had a mortality rate of 55.60%, while Almite was the lowest killing rate of 42.20%.

The results showed an increase in the mortality rates of adults with an increase in exposure duration, reaching a high of 60.00% and 66.67% after 7 days of treatment, respectively. The lowest mortality rate for adults on the third day of treatment was 20.00%.

Table (6): Effect of Almite and Varunestrs in adults of leafminer *L.bryoniae*:

Treatments	Mortality percentage% Exposure time (day)			The general mean of treatments
	3	5	7	
Almite	**20.00d**	**46.66c**	**60.00b**	**42.20b**
Varunestra	**20.00d**	**73.33a**	**73.33a**	**55.60a**
The general mean of exposure duration	**20.00b**	**60.00a**	**66.67a**	**-**

*Numbers with similar letters in the same column are not significant differences according to the Dunkin Multipliers test at the probability level 5%.

The results of Table (6) showed that the best effective bioformulation on adults was the Varunestra, while the Almite was less effective on adults. This is due to the fact that Varunestra, which is the *Verticillium lecanii*, was a pathogenic fungus that affects a wide range of insects through external cuticle and openings in the body of the insect [32; 33]. The increase in the mortality rate was due to the nature of the fungus in the production of enzymes necessary to penetrate the insect's cuticle. Enzymes and Mycotoxins affect the vital functions of organisms, they may disrupt or kill some tissues or may effect on the growth and development of the insect [34]. This agreed with the findings of [35], where *Verticillium lecanii* was found to be more effective in controlling the oriental red mit *Eutetranychus orientalis*, the mortality percentage 89.38%. [36] noted that the many research indicated the efficacy of same entomopathogens fungi *Verticillium lecanii*, *Paecilomyces fumosoroseus*, *Paecilomyces lilacinus* and *Metarhizium anisopliae* in control leafminers of *Liriomyza* spp.

The efficacy of *H.thompsonii* is due to its production of a toxic protein called Hirtsutellin, many researchers report that the *Hirsutilla* species produce metabolic substances, which are protein and organic compounds that are toxic to insects and mites, the effectiveness of *H. thompsonii* was due to its production of a toxic protein called Hirsutellin, many researchers reported that the Hirsutilla species produce metabolic substances, which are protein and organic compounds that are toxic to insects and mites [37; 38; 39]. [40] mentioned that *H.thompsonii* produced a protein called Hirsutellin (HTA) was used as a toxic insecticide for various insect and mites species, and [41] demonstrated the efficacy of *H.thompsonii* as insecticide, mortality percentage of *Periplaneta americana* adults ranged from 63.45-54.98 in different treatments with *H. thompsonii* fungus, including topical treatment, mixing with food, and injection.

The results of the study showed that the fungi of *V. lecanii* and *H. thompsonii* have started to effect the fungal infection on the third day of the treatment and continued to increase steadily over time. This may be due to the fact that the germination of the fungus and the process of penetrating the hyphae through the larval body wall, reproduction and excretion of toxins need time to kill, the post-treatment period had a very important role in biological control as it is directly proportional to larval killing rates when appropriate conditions are available [42]. This is consistent with many researchers who used entomopathogens, including *B. bassiana* [43] said that prolonging Duration of exposure of the insect to the fungus spores leads to an increase in the percentage of mortality of insects and may be attributed to the increase in the number of fungal spores, which increases the chances of germination and penetration and occurring infection and thus the inability of the insect to repel the fungus attack, thus increasing the chances of her inevitable death, as well as that the increase in the duration of exposure increases the amount of enzymes analyzed for the wall of the body of the insect, which is produced by the fungus, which facilitates the process of penetration and invasion of the cavity of the body of the insect and the depletion of its contents and killing [44].

Effect mixture of Actara and bioformulations Almite and Varunestra on leafminer adults of *L.bryoniae*:

The results of the study showed in Table (7) that there was a significant difference in the averages of pesticide interferometry and exposure duration. The mixture of Actara + Varunestra and the highest mortality rate of the bacteriologist L. bryoniae yielded 7 days with 83.33% Actara + Almite and Actara + Varunestra were killed on the first day of treatment with 33.33 and 36.67% respectively, with no significant differences between them.

The results of the general mean mortality rate for adults showed no significant differences between (Actara + Almite) and (Actara + Varunestra), the

adult mortality rate was 56.66 and 52.22, respectively.

The results showed an increase in mortality rates for adults with an increase in exposure duration, with the highest average of 78.33% after 7 days of treatment. The lowest percentage of adults on day 3 of the treatment was 35.00%.

Table (7) Effect of combinations of Actara and bioformulations Almite and Varunestra on adults of leafminer *L.bryoniae*:

Treatments	Percent murder rates Exposure time (day)			The general average of the effect of transactions
	3	5	7	
Actara+Almite	36.67e	46.67d	73.33b	52.22a
Actara+Varunestra	33.33e	53.33c	83.33a	56.66a
The general mean of exposure duration	35.00c	50.00b	78.33a	-

*Nunbers with similar letters in the same column are not significant differences according to the Dunkin Multipliers test at the probability level 5%.

The results of Table (7) show that the best effect of the combination of the pesticide and the bioformulations on the adults was the mixture of (Actara + Varunestra) because it achieved the highest mortality rate for adults and the lowest effect of the mixture (Actara + Almite), this was due to the fact that the Actara was more compatible with the *Verticillium lecanii*. The number of colonies increased by 331.51%, while the colonies of *Hirustilla thompsonii* increased by 249.%

The study results show that the Actara showed a significant effect with *V. lecanii* and *H. thompsonii* by increasing Mortality percentages, and this is consistent with what many researchers have pointed out to the synergism effects of chemical pesticides formulations (powdered powders, (WG) in the growth propagation of fungi in *B.bassiana* and *M.anisopliae* [20,21,22].

Effect of Chemical and Botanical insecticides on leafminer pupae of *L. bryoniae* at of half field concentration (FC-50%):

The results of the study showed in Table (8) that there were significant differences in the emergence percentages of adult for pesticide interference and exposure times at the half-field concentration, the effect of the Actara insecticide after 5 days of treatment was the lowest emergence percentage of adults from pupae treated, while the highest percentage for the oxymatrine and after 15 days of treatment was 66.67%.

The results of the general mean of emergence percentage of tomato leafminer adults by effect of the treatments on the superiority of Abamectin treatment with a least emergence percentage of 16.66%, which did not differ significantly from the treatment of the nicotine pesticide Actara by 20.00%, while Oxymatrine was the least influential the pupae had the highest adults emergence percentage of 42.22%, compared to control treatment had emergence percentages of adult of 100%.

Table (8) Effect of Chemical and Botanical insecticides on leafminer pupae of *L. bryoniae* at of half field concentration (FC-50%)

Treatments	Emergence percentage% Exposure time (day)			The general mean of treatments
	5	10	15	
Actara	6.67h	13.33fg	40.00c	20.00c
Abamectin	10.00gh	16.67f	23.33e	16.66c
Oxymatrine	23.33e	36.67d	66.67b	42.22b
Control	100.00a	100.00a	100.00a	100.00a
The general mean of exposure duration	25.00c	41.66b	57.50a	_

*Numbers with similar letters in the same column are not significant differences according to the Dunkin Multipliers test at the probability level 5%.

Effect of Chemical and Botanical insecticides on r pupae of *L. bryoniae* at field concentration(FC)

The results of the study showed in Table (9) that there were significant differences in the emergence percentages of adults for pesticide interference and exposure time at the field concentration, the lowest percentage of adults for the treatment of Abamectin after 5 days of treatment was 3.33%, while the highest percentage of leafminer adults of *L.bryoniae* from pupae was treated with oxymatrine and after 15 days of treatment was 53.33% .

The results of the general mean of emergence percentage of adults were the treatment of Abamectin was superior by least emergence percentage was 8.88%, followed by Actara (23.33%), while the highest rate of Oxymatrine treatment was 34.44% compared to control treatment had emergence percentages of adults of 100%.

Table (9) Effect of chemical and biopesticides on pupae of *L. bryoniae* at field concentration (FC)

Treatments	Emergence percentage%			The general average treatments
	Exposure time (day)			
	5	10	15	
Actara	10.00f	16.67e	43.33c	23.33b
Abamectin	3.33g	10.00f	13.33ef	8.88c
Oxymatrine	16.67e	33.33d	53.33b	34.44b
Control	100.00a	100.00a	100.00a	100.00a
The general mean of exposure duration	32.50a	40.00a	52.49a	_

*Numbers with similar letters in the same column are not significant differences according to the Dunkin Multipliers test at the probability level 5%.

Tables (8,9) shows that the best pesticides were effective on pupae of leafminer *L. bryoniae* at the half field concentration and field concentration were the Abamectin, which achieved the lowest emergence percentage of adults, while the highest percentage of adults in the oxymatrine treatment was consistent with [45]. When treated pupae of leafminer of citrus Phyllocnistis citrella with abamectin, the mortality percentage was 2.68%.

Effect of Almite and Varunestra on leafminer pupae of *L. bryoniae*

The results of the study showed in Table (10) that there were significant differences in pesticide interferences and exposure times, Varunestra was the lowest emergence percentage of adults in the fifth day of the treatment, with 3.33%, while the highest emergence percentage was of *L. bryoniae* for Almite treatment after 15 days of treatment amounted to 33.33%.

The results of the general mean of adults emergence percentages showed that the e Varunestra treatment was superior by least emergence percentage of 13.33%, while the highest percentage of Almite treatment was 21.11%, compared to control treatment had emergence percentages of adults of 100%.

The results of Table (10) show that the best pesticide effective in the pupae was Varunestra because it achieved the lowest emergence percentage of adults, while the Almite was less effective because the adults emergence percentage from pupae was high, the reason for the death of pupae was that the infection of fungi led to the depletion of the internal tissues of the pupae body and therefore impossibility of the completion of the emergence and therefore could not complete the emergence or insect dead inside the envelope of the pupae, the results are consistent with the findings of [45]. When treated pupae of *spodoptera litura* with the fungus *Metarhizium anisopliae*, the percentage of pupae mortality percentage was 85.8%. [46] reported that the pupae of *chrysomya albiceps* treated with *M.anisopliae* fungi led emergence percentage of 3.33%, and. [47] reported that treatment the pupae of *Culex. quinquefaciatus* with *M.anisopliae* suspension caused mortality percentage of 65.47%.

Table (10) Effect of Almite and Varunestra on pupae of *L. bryoniae*

Treatments	Emergence percentages%			The general average of treatments
	Exposure time (day)			
	5	10	15	
Almite	6.67de	23.33c	33.33b	21.11b
Varunestra	3.33e	10.00d	26.67c	13.33c
Control	100.00a	100.00a	100.00a	100.00a
The general mean of exposure duration	36.66c	44.44b	53.33a	_

*Numbers with similar letters in the same column are not significant differences according to the Dunkin Multipliers test at the probability level 5%.

Effect mixtures of Actara and bioformulations Almite and Varunestra on pupae of *L. bryoniae*

The results of the study showed in Table (11) that there were significant differences in pesticide interferences and exposure times. The treatment of the mixture (Actara + Varunestra) on the third day achieved the lowest emergence percentage of adults of 3.33%, while the highest percentage of emergence on the seventh day of treatment in the mixture treatment(Actara + Almite) was 16.67%.

The results of the general mean of emergence percentage of adults with the effect of the treatments , the mixture (Actara + Varunestra)was superiority with the lowest percentage of 8.88%, which did not differ significantly from the treatment of the mixture (Actara + Almite), which reached the emergence percentage of adults of 12.22%.

The results showed an increase in the emergence percentage of adults with an increase in exposure duration, with the highest mean of 43.33% after 7 days of treatment, the lowest percentage of adults on day 3 of the treatment was 36.66%.

Table (11) Effect mixtures of Actara and bioformulations Almite and Varunestra on pupae of *L. bryoniae*

Treatments	Emergence percentage% Exposure time (day)			The general average of treatments
	3	5	7	
Actara+Almite	6.67de	13.33bc	16.67b	12.22b
Actara+Varunestra	3.33e	10.00cd	13.33bc	8.88b
Control	100.00a	100.00a	100.00a	100.00a
The general mean of exposure duration	36.66a	41.11a	43.33a	_

*Numbers with similar letters in the same column are not significant differences according to the Dunkin Multipliers test at the probability level 5%.

From the results of Table (11), it is found that the best combination was (Actara + Varunestra) because it achieved the lowest percentage of adults from pupae, while (Actara + Almite)was less effective because the emergence percentage from pupae was higher.

The results showed that the Actara pesticide was compatible with the two bioformulation Varanestra (*V.lecanii*) and Almite (*H. thompsonii*). The two mixtures(Actara + Varunestra) and (Actara + Almite) achieved the highest mortality percentage for larvae and the lowest adults emergence percentage from pupae. Therefore, we recommend the two mixtures for control tomato leafminer *Liriomyza bryoniae*.

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التقييم المختبري لفاعلية بعض المبيدات الكيميائية والحيوية وتوافيقها في مكافحة بالغات وعذارى صانعة انفاق أوراق الطماطة *Liriomyza bryoniae*

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الملخص

أجريت دراسة مختبرية لتقييم فاعلية المبيدات الكيمياوية Actara، Abamectin وOxymatrim والمستحضرين الحيويين Varunestra (*V.lecanii*) وAlmite (*H.thompsonii*) وتوافيقهما على بالغات وعذارى صانعة انفاق أوراق الطماطة *Liriomyza bryoniae* وقد أظهرت النتائج ان مبيد Actara اكثر المبيدات المختبرة توافقا مع الفطرين *V.lecanii* و*H.thompsonii* أما المبيدين Abamectin و Oxymatrine اظهرا عدم توافقيتهما مع الفطرين. تفوقت معاملة Abamectin بنسبة قتل للبالغات بلغت 55.56% عند التركيز نصف الحقلي (ت ح – 50%)، تلاها معاملة مبيد Actara بنسبة قتل بلغت 46.67%, بينما اقل نسبة قتل لمعاملة Oxymatrine بلغت 38.89%. تفوقت معاملة المستحضر الحيوي Varunestra (*V.lecanii*) بنسبة قتل للبالغات بلغت 55.60%، بينما كانت اقل نسبة قتل للمستحضر الحيوي Almite (*H.thompsonii*) بلغت 42.20%، وتبين عدم وجود فروق معنوية في نسبة القتل للبالغات لكلا التوافيقين Actara + Varunestra و Actara + Almite اذ بلغت 56.66 و 52.22% على التوالي. %. تفوقت معاملة الخليط Actara + Varunestra باقل نسبة بزوغ للبالغات بلغت 8.88%، والتي لم تختلف معنويا عن معاملة الخليط Actara+Almite التي بلغت فيها نسبة البزوغ 12.22%.