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The Effectiveness of the Integration among *Beauveriabassiana*Vuill., Isaria fumosorosea(Wize) and Insecticides Against Bemisiatabaci(Genn.)

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Abstract

This research was carried out to determine the compatibility of different components of integrated pest management (the entomopathogenic fungi: Isariafumosorosea ,Beauveriabassiana Bbk, the pesticide Imidacloprid and Mineral oil) and their efficiency to control the white fly Bemisiatabaci on tomato. The results showed a weak effect of the two pesticides at a field dose and a half field dose on the vegetative growth and spores production of B.bassianaBbk and I. fumosorosea, this reflects the compatibility between the two pesticides and these fungi . Using of their combinations against whitefly nymphs showed that the Imidacloprid + I. fumosorosea gave the highest mortality rate after three days of treatment (79.6%), followed by the Mineral oil with B. bassiana Bbk (78.6%). After seven days the superiority of the Imidacloprid + I.fumosorosea continued (91.7 %) without significant difference from other combinations, but with significant difference from the agents used alone.

Key words: Isaria fumosorosea, Beauveriabassiana, Imidacloprid, compatibility, Bemisiatabaci.

Introduction

Bemisiatabaci(Genn.) (Hemiptera: Aleyrodidae) is one of the most damaging and common insect pests of greenhouse and field crops around the world. Due to direct damage and the spread of many plant viruses, it poses a significant danger to crop production [(1)]. Chemical insecticides are used mainly to combat this insect, but this process has run into issues due to the selection of resistant individuals. Furthermore, their adverse side effects on non-target species, as well as their environmental risks, have caused the use of alternate monitoring measures. As a result, the search for more environmentally friendly and long-lasting alternate management approaches opens up new ways to study microbial agents with biological control capacity. As a consequence, entomopathogenic fungi refer to a category of microorganisms

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that spontaneously infect and thereby control whitefly populations. Agents of biological regulationScientists, society, and private businesses are all interested in microbial pathogens of arthropods because they provide an environmentally safe alternative to conventional pesticides for use in advanced pest management programs (IPM) [(2)].Beauveriabassiana (Bals-Criv.) Vuill., Isariafumosorosea (Wize) (formerly Paecilomycesfumosoroseus), Lecanicillium spp. (formerly Verticillium spp.), and Aschersonia spp. are among the most promising fungal candidates for whitefly biological control. [(3)]. The aim of this analysis was to see how successful Isariafumosorosea, Beauveriabassiana, Imidacloprid, and Mineral oil were at controlling the whitefly Bemisiatabaci.

Methodology

The whitefly *Bemisiatabaci*, which used in the study, was obtained by infecting tomato plants (Super queen variety) by using infected tomato's leaves collected from the fields. They were planted in 10 cm diameter pots with a mixture of soil and peat moss (1:1) and were maintained under a green house condition. Furthermore, wo local isolates (*Beauveriabassiana*(*Bbk*) and *Isariafumosorosea*.) are used in this study, Obtained from the Ministry of Science and Technology', Directorate of Agricultural Research. The following chemical pesticides were used:

1- Bright 25% (wp), the active ingredient is Imidacloprid, the field dose rate is 1 g / liter of water

2- Mineral oil Nautilus 70% EW , the field rate is 20 ml / liter of water.

Pathogenic activity of *B. bassianaBbk* and *I. fumosorosea*was measured at concentrations of 10^5, 10^7 and 10^9 spores / ml + 0.01% Tween 20 on whitefly nymphs by spraying three plants for each concentration (treatment), the control treatment was sprayed with water +0.01% Tween 20. The chemical pesticides were used with the concentration of field and half field doses. The mortality rate of the nymphs was counted after 3, 5 and 7 days of treatment with fungi and three days for chemical pesticides that corrected using Abbott's formula [(4)].

The tests for fungal vegetative growth, and conidia production were done. Insecticides used in this study were imidacloprid and Nautilus mineral oil, with two doses, field and half field doses. Vegetative growth was measured by poisoned food technique [(5).] The formula suggested by(6) was used to identify chemical products based on mycelia growth (VG) and sporulation (SP) in addition to the regulation in in vitro experiments with entomopathogenic fungi (100 percent). The index is less than 30 in T= 20 (VG) + 80 (SP) / 100: Toxic.

An experiment of integration between fungi and chemical pesticides was carried out on tomato plants (Super queen variety) grown in pots, the pesticide was sprayed and the next day the spore suspension was sprayed with fungi. The experiment was designed according to

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randomized complete block design with three blocks, each with one plant for each treatment under greenhouse conditions. The treatments included in the study are shown in Table (1).

Table (1): Treatments

Treatments	Dose rate
Imidocloprid (Im)	**half field dose**
Im + *Isaria*	**half field dose +10^7**
Im + *Bbk*	**half field dose +10^7**
mineral oil	**half field dose**
Mineral oil +*Isaria*	**half field dose +10^7**
Mineral Oil + *Bbk*	**half field dose +10^7**
Isaria	**10^7**
Bbk	**10^7**

Results and Discussion

The tests were planned using a randomized full block method (RCBD), and the data was evaluated using the SPSS software and the Duncan multiple range test (DMRT) to compare the means at the 0.05 likelihood stage.Standardprobit analysis was used to obtain LC50 and LT50 values.

The impact of *B. bassianaBbk* and *I. fumosorosea*fungal suspensions on whitefly nymphs was related to isolate and concentrations. The highest mortality rate was achieved after seven days of treatment for a concentration of 10^9 spores / ml, 65.6% of isolate *Bbk* and 69%. for isolate *I. fumosorosea*, the correlation coefficient between concentration and mortality rate was 0.93 and 0.95 for the two isolates, respectively, and by linear equation was $y = 4.6x + 29.767$ for *I. Fumosoros* and $y = 3x + 39.833$ for *B. bassiana* (Fig. 1, 2).

The pathogenecity of the fungal isolates on the basis of the LC50 were the highest ability of infection by the isolate *Bbk*, as the value of LC50 was 9.7×10^3 spores / ml after seven days of treatment, while the isolate *I.fumosorosea* recorded 2.7×10^4 spores / ml . The virulence

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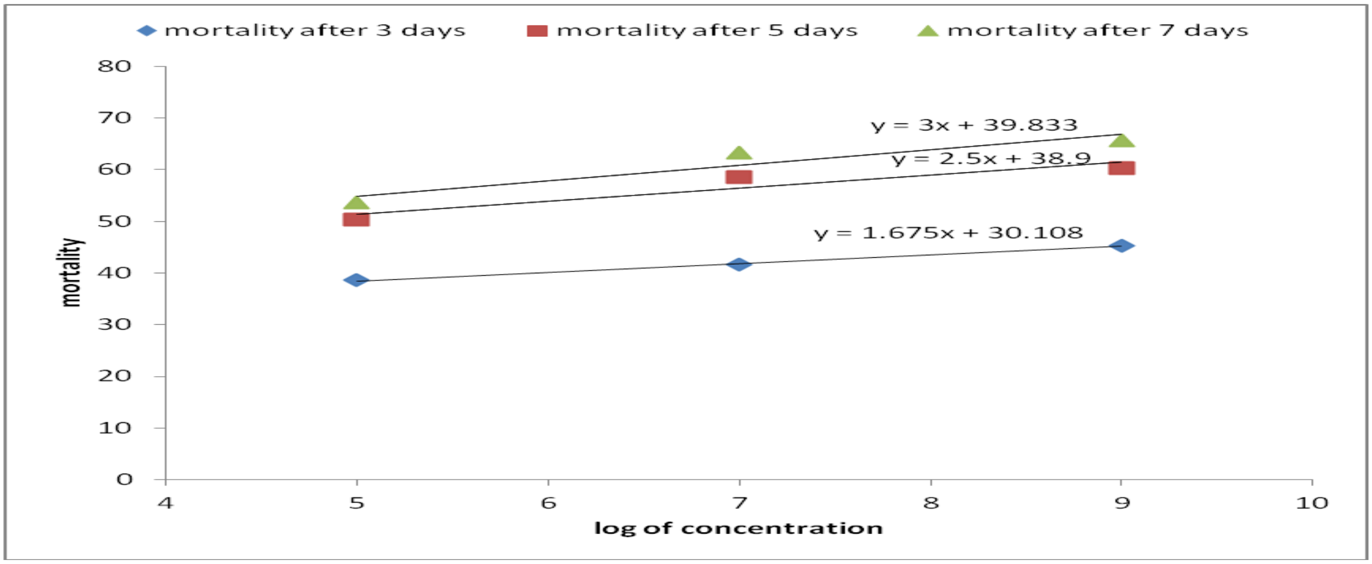
of isolates represented by (LT50), was inversely related to the concentration, the concentration 10^9 spores / ml given the shortest time. The isolation *Bbk* was the most virulent with the shortest time (3.23 days), followed by isolation *I. fumosorosea* (3.8 days) at the same concentration as it is clear in Figure (1) and Figure (2).



Figure(1): Linear equation of the effect of *B. bassiana*

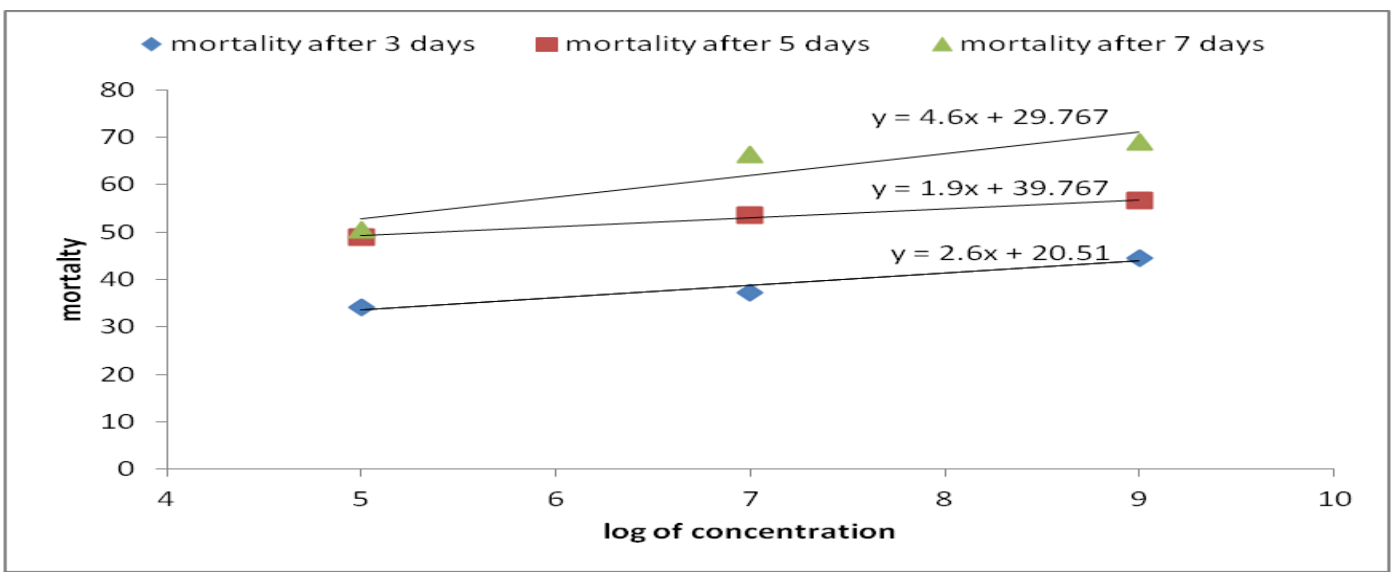


Figure (2): Linear equation for the effect of *Isariafumosorosea*

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Table (2): LC50 and LT50 of B. Bassiana and I. Fumosorosea Against Whitefly Nymphs

Isolate	Concentrations	LT50(day)
Bbk	10^5	5.55
	10^7	4.0
	10^9	3.23
LC_{50}	$10^3$9.7 x	
Isf	10^5	6.05
	10^7	4.33
	10^9	3.8
LC_{50}	2.7×10^4	

The normal death of whitefly species is highly affected by entomopathogenicfungi ,and are distinguished by their importance as biological control agents because they can infect insects directly through the body wall [(2)]. Screening of the entomopathogenic fungi to select the optimum is important in an integrated pest control strategy, The most widely used species in managing B. tabaci are Beauveriabassiana, Metarhiziumanisopliae, Isariafumosorosea, Ashersonia spp., and Verticilliumlecanii. [(3)]several studies confirmed the effectiveness of B. bassiana in controlling B.tabaci whiteflies [(6)]. Testing of twenty-five isolates of B. bassiana at a concentration of 10^7 spores/ml, commercial biocides of B. bassiana against B.tabaci nymph reported a mortality rate of 3-85%. The LC50 of the four most virulent isolates ranged from 1.1×10^5 to 6.2×10^6 spores / ml in the second set of biological experiments on 10 isolates chosen at a concentration of 105-108 spores / ml [(7)].

Numerous studies confirm the importance of Isariafumosorosea (Paecilomyces fumosoroseua) in controlling whitefliesIt is one of the pest's most powerful natural enemies. It can transmit B. tabaci epidemics in greenhouses and open fields [(8)].and infect a number of pests in agriculture and forest areas [(9)].

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Under laboratory conditions, the virulence of five isolates of B. Bassiana and I. fumosorosea and four isolates of Lecanicilliummuscarium on whiteflies on bean leaves showed that B. bassiana and I. fumosorosea were more successful, with a mortality rate of 71-86 percent within 8 days and a Lt50 of 3- 4 days with a concentration of 10^7 spores / ml (150 spores [2].

Imidacloprid recorded a significant effect on nymphs of whiteflies, as the mortality rate was 91.6% at field dose, with a significant difference from the field dose of mineral oil (82.6%), and the two treatments differed significantly from the results of the half field dose of the two pesticides(75.3 and 71.3%, respectively)

Chemical control with insecticides has been the most effective way to reduce whitefly damage to crop production. Imidacloprid is one of the neonectinoids pesticides used extensively to control pests, and it is a systemic chloronicotinyl pesticide that is used in the treatment of soil, seeds and leaves to control many pests, especially sucking insects [10], as found by[11] , Imidacloprid significantly reduced both adults and nymphs of whiteflies. Effect of Imidacloprid on whiteflies under laboratory and the greenhouse condition showed that the pesticide remains effective for 45 days [12]. The foliar application of Actara and Imidacloprid was substantially successful after one day of treatment on nymphs and whiteflies on eggplant, according to an assessment of the effectiveness of certain Neocontinoid pesticides on nymphs and whiteflies on eggplant.

The results showed a weak effect of the two pesticides Imidacloprid and Mineral oil at a field and half field doses on *Beauveriabassiana* vegetative development and sporulation, this reflects the compatibility between the two pesticides and the fungus by 73.46 and 82.75 for Imidaclopridand 87.12 and 94.36 for the Mineral oil at Field and half doses respectively.

The reduction effect of the two pesticides on the formation of spores at the recommended field dose was 33.3% for Imidacloprid and 13.79% for mineral oil, and the reduction ratio in the half dose was 19.5 and 5.8% respectively. See Table (3):

Table (3): Pesticide Effects on Beauveriabassiana Vegetative Development and Sporulation

Treatment	Dose rate	Radius of Vegetative growth (cm)	Reduction (%)	Sporulation (x 10^7)	Reduction (%)	Toxicity value	Compatibility
Imidacloprid 25%wp	**Imidacloprid 25%wp**	**3.83**	**4.25**	**58**	**33.3**	**73.46**	**Compatible**

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	0.5 g /l	3.86	3.5	70	19.5	82.75	Compatible
Mineral oil	20ml/l	3.63	9.25	75	13.79	87.12	Compatible
	10 ml/l	3.8	5.0	82	5.8	94.36	Compatible
Control	_	4.0	_	87			

Smaller than 30: very toxic; 31-45: toxic; 46-60: moderate toxicity; greater than 60 = compatible

The two pesticides were compatible with Isariafumosorosea at 66.37 and 61.37% for field and half field doses of imidacloprid respectively and by 70.26 and 76.58% for the mineral oil (Table 3), with a decrease of 29.25% and 28.25% in fungal growth and 34.48% and 40.22% for sporulation in the case of the pesticide Imidacloprid, and a decrease of 33.75% for fungal growth and 28.73 and 21.84% for sporulation in the case of mineral oil.

Table (4): Pesticide Effects on Isariafumosoroseavegetative Development and Sporulation

Treatment	Dose rate	Radius of Vegetative growth (cm)	Reduction (%)	Sporulation ($x 10^7$)	Reduction (%)	Toxicity value	Compatibility
Imidacloprid 25%wp	1 g /l	2.83	29.25	52	34.48	61.37	Compatible
	0.5 g /l	2.87	28.25	57	40.22	66.37	Compatible
Mineral oil	20ml/l	2.65	33.75	62	21.84	76.58	Compatible
	10 ml/l	2.65	33.75	68	28.73	70.26	Compatible
Control			_	87			

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Smaller than 30: very toxic; 31-45: toxic; 46-60: moderate toxicity; greater than 60 = compatible

The compatibility between entomopathogenic fungi and the pesticides is essential in integrated pest management programs [(13)].

Several studies were carried out to see how the pesticide influenced pathogenic fungi. [(14)]found that the pesticide imidacloprid gave the least inhibitory effect on the fungal growth (11.1%), followed by deltamethrin (36.7%). [(15)]indicated the compatibility between Beauveriabassiana and the pesticide Imidacloprid that enhanced the fungus's efficiency in controlling the whitefly Bemisiaargentifolii,.

The results of exposure of whitefly nymphs to various combinations of control agents (Table 4) showed that the combination of the pesticide Imidacloprid + Isariafumosorosea gave the highest mortality rate in the whitefly nymphs after three days of treatment (79.6%) with a significant difference from the mineral oil And the fungi alone, followed by that mineral oil with Beauveriabassiana (78.6%). After seven days of treatment, the superiority of the pesticide Imidacloprid + Isariafumosorosea continued (91.7 %) without significant difference from other combinations, but with significant difference from the agents used alone.

Table (5): The Percentage Mortality of Whitefly Nymphs Due to Exposure to Imidocloprid, Mineral oil, B. BassianaBbk and I. fumosorosea and Their Combinations

Treatment	**Dose rate**	**%Morality**	
		After 3 days	**After 7 days**
Imidocloprid	**Half field dose**	**71.8 ab**	**73.3 b**
Im+ *Isf*	**Half field dose+10^7**	**79.6 a**	**91.7 a**
Im + *Bbk*	**Half field dose+10^7**	**75.3 ab**	**87.6 a**
Mineral oil	**Half field dose**	**66.9 b**	**69.6 bc**
Mineral oil+ Isf	**Half field dose+10^7**	**73.0 ab**	**86.3 a**
Mineral oil+ *Bbk*	**Half field dose+10^7**	**78.6 ab**	**85.6 a**
Isf	**10^7**	**49.6 c**	**59.3 c**
Bbk	**10^7**	**54.6 c**	**62.3 c**

The same letter in column indicated to non significant differences

Combining pesticides with low doses and entomopathogenic fungi can act as a positive action. This is always beneficial as it reduces the doses of the pesticides and thus reduces environmental pollution as well as resistance of insect pests [(16),(17)] indicated the compatibility between Beauveriabassiana and the pesticide Imidacloprid and enhanced the fungus's efficiency in controlling the whitefly Bemisiaargentifolii,

The oil mixture enhances the adhesion of the spores to the insect, and later the infection, and the use of oil in compatible concentrations causes a high mortality.[(18)] On the basis of germination, fungal growth, and spore formation, researchers investigated the compatibility of eight vegetable oils with B. bassiana and M.anisopliae.

Conflict of Interest – **Nil**

Source of Funding- **Self**

Ethical Clearance – **Not required**

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