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Empact of Entomopathogenic fungi on White fly, *Bemisia tabaci* in Tomato Crop in Egypt

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Abstract : Empact of entomopathogenic fungi, *Metarhizium anisopliae, Beauveria bassiana*, and *Verticillium lecanii* to *Bemisia tabaci* under laboratory conditions and in the field in tomato crop were studied during two successive tomato seasons (2016 and 2017). Three concentrations were used (2 x10^3, 2 x 10^4 and 2 x 10^5 Conidia/ ml.). Under laboratory conditions the results showed that *V. lecanii, B. bassiana* and *M. anisopliae* mortalities were occurred after the two days from treatment. The third concentration (2 x 10^5 Conidia / ml.) was the highly toxic in *V. lecanii*, *B. bassiana* and *M. anisopliae* to the adult of *B. tabaci* compared with the other two concentrations. Under field conditions the third concentration (2 x 10^5) also, was the best concentration on whitefly after the third application in *V. lecanii*, *B. bassiana* and *M. anisopliae*.
Keywords: Entomopathogenic Fungi, *Bemisia tabaci*, Tomato Crop.

1. Introduction

White fly**,** *Bemisia tabaci* is a serious threat to crop production due to direct damage[1]. *Bemisia tabaci* is considered a cryptic species complex and was recently split into 11 groups encompassing 24 species[2]. The biotype B of *B. tabaci* (also known as Middle East-Asia Minor 1) is widely distributed throughout Brazil and it can cause economic losses estimated in 714 million US$/year in crops such as beans, soybeans, cotton, tomatoes, and leafy vegetables[3,4].

Moreover, they play a role in the natural mortality of whitefly populations[5]. The most promising mitosporic fungi include *Metarhizium anisopliae, Verticillium lecanii, and Beauveria bassiana* [6-14].

Metarhizium anisopliae, Verticillium lecanii, and Beauveria bassiana species have been used to control whiteflies and related insects in greenhouses in Europe, Canada and Egypt. These applications have been successful in cases where environmental conditions of high relative humidity and moderate temperatures are appropriate [15-17].

Empact can be indirectly measured with the activities of enzymes related to infection pathways, such as subtilis in- like (Pr1) and trypsin-like (Pr2) enzymes and chitinases [18-20].

The widespread distribution of *B. tabaci* is attributed to their exceptionally wide host rang and short generation time [21].

The entomopathogenic fungi *Beauveria bassiana* (Balsamo) Vuillemin has high activity against whitefly [22]. Blastospores and conidia can infect the host directly; mycelium needs to grow and from infectious propagates first. Conidia can be produced easily and are more stable in challenging environmental conditions than blastospores [23, 24].

The present study aims to use of entomopathogenic fungi to control such this pest to avoid using of insecticides to reduce pollution in tomato and the as well as reduce the costs of control.

Materials and Methods

Preparing of the concentrations

The concentrations were used (2 x10^3, 2 x 10^4 and 2 x 10^5 Conidia/ ml.) and add 0.5 % Tween 80. The spores were counted in the suspension using a Haemocytometer (0.1 mm x 0.0025 mm2).

Laboratory inoculation

Adults whitefly, *B. tabaci* were transferred to the laboratory from the Field and put in Petri-dishes with tomato leaf disk and incubated in 23±1°C and 75 ±5 % RH. (Five adults / replicate) were used in all treatments. The entomopathogenic fungi were sprayed using a manual sprayer in a suspension containing 2 x 10^3, 2 x 10^4 and 2 x 10^5 Conidia/ ml; while sterilized water was sprayed to the leaves disks as blank control. The mortality of whitefly was observed daily for seven day.

Field application

An area of 4200 m ^{2} in Nubaria, El-Behira Governorate was divided into four parts; each part was divided into three plots were treated with three concentrations from *V. lecanii*, *M. anisopliae* and *B. bassiana* and the other one as control treated by water. Every plot divided into three replicates. The suspensions were sprayed early in the morning. The suspensions were sprayed three times. The live insects of *B. tabaci* per leaf/ replicate were counted after all treatment.

- The percent of reduction were calculated according to Handerson and Tilton formula.
- Statistical analysis

Data were analyzed by analysis of variance (one ways classification ANOVA) and followed by a least significant difference (L.S.D at 5%) (SAS Institute Inc., 2003).

Results

Three concentrations of entomopathogenic Fungi, *V. lecanii*, *M. anisopliae* and *B. bassiana* were evaluated on *B. tabaci* under laboratory and the field.

1- Effect of *V. lecanii*, *M. anisopliae* and *B. bassiana* on *B. tabaci* under laboratory conditions.

As Show in Table (1) there are no effect for *V. lecanii*, *M. anisopliae* and *B. bassiana* to *B. tabaci* after three day from treatment.

Table (1): % Mortality of *V. lecanii*, *M. anisopliae* and *B. bassiana* on *B. tabaci* under laboratory conditions at 23±1°C and 75 ±5 % RH.

Days	% of mortalities									
	Con.	*V. lecanii*			*B. bassiana*			*M. anisopliae*		
		2 x 10^3	2 x 10^4	2 x 10^5	2 x 10^3	2 x 10^4	2 x 10^5	2 x 10^3	2 x 10^4	2 x 10^5
2nd	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3rd	0.0	10	11	12	8	9	10	7	8	10
4th	0.0	13	25	30	11	23	25	12	20	23
5th	0.0	33	45	55	30	35	53	25	27	35
6th	0.0	55	75	95	37	45	65	30	41	55
7th	0.0	80	85	100	45	65	75	45	58	70

Mortalities are occurred in the third day. The percent of mortalities are increased gradually and reached to the maximum in the 7th day from treatment. With the all concentrations, the percent of mortalities are increased with increase of concentrations. The percent of mortalities ranged between 80 to 100, 45 to 75 and 45 to 70 % with *V. lecanii*, *B. bassiana* and *M. anisopliae*, respectively, in the 7th day after treatment. Table (1) shows that there are slight differences between effect of *V. lecanii*, *M. anisopliae* and *B. bassiana* isolation to *B. tabaci*. This mean that *V. lecanii* isolation is more effective than *B. bassiana* and *M. anisopliae*. The percent of mortalities with all concentrations 2×10^3, 2×10^4 and 2×10^5 Conidia/ ml of *V. lecanii* isolation were 80, 85.4and 100%, respectively.

2- Effect of *V. lecanii, B. bassiana* and *M. anisopliae* on *B. tabaci* in season 2016.

Table 2; show that after the second application the number *B. tabaci* leave were decreased compared with control. That the percent of reduction by *V. lecanii M. anisopliae* and *B. bassiana* after the third treatment were 50.7, 79.3 & 100, 50.2, 63.0 & 73.5 and 45.5, 50.5 & 63 %, respectively.

The statistical analysis shows that there are no significant differences between the concentrations and control after the first application all plots. After the second application there are significant differences between all concentrations and control. After the third treatment there are highly significant differences among all concentrations. The L.S.D was 2.1 after the third treatment. The statistical analysis confirmed that the third concentration (2×10^5) was the highly toxic compared the first and the second concentrations in all treatment.

Table (2): Effect of *V. lecanii, B. bassiana* and *M. anisopliae* on *B. tabaci* during season 2016.

Treatments	The percent of infestation by *B. tabaci*/ leave										L.S.D
	Control	*V. lecanii*			*B. bassiana*			*M. anisopliae*			
		2×10^3	2×10^4	2×10^5	2×10^3	2×10^4	2×10^5	2×10^3	2×10^4	2×10^5	
1st	7 ± 1.3^{a}	8 ± 2.3^{a}	8 ± 1^{a}	9 ± 3^{a}	9 ± 1.3^{a}	10 ± 2.2^{a}	10 ± 0.2^{a}	9 ± 1^{a}	9 ± 1.5^{a}	8 ± 2.3^{a}	3.1
2nd	8 ± 1.2^{a}	5 ± 1^{bc}	4 ± 1^{bc}	3 ± 2^{c}	7 ± 1^{bc}	6 ± 2^{bc}	5 ± 1.5^{bc}	8 ± 1^{b}	7 ± 1.7	4 ± 2^{bc}	2.8
3rd	9 ± 1^{a}	4 ± 1.5^{bc}	2^{bc}	0.0^{c}	4 ± 2^{bc}	3 ± 0.2^{bc}	2 ± 1.3^{bc}	5 ± 1^{b}	4 ± 1.7^{bc}	3^{bc}	2.1
Percent of reduction %	------	50.7	79.3	100	50.2	63.0	73.5	45.5	50.5	63.0	----

3- Effect of *V. lecanii, B. bassiana* and *M. anisopliae* on *B. tabaci* in season 2017.

Table 3; show that after the second treatment the number *B. tabaci* leave were decreased compared with control. That the percent of reduction by *V. lecanii*, *B. bassiana* and *M. anisopliae* after the third treatment were 55.1, 72.2 & 100, 52.0, 60.0 & 75.2 and 45.9, 51.5 & 64 %, respectively.

The statistical analysis shows that there are no significant differences between the concentrations and control after the first treatment all plots. After the second treatment there are significant differences between all concentrations and control. After the third treatment there are highly significant differences among all concentrations. The L.S.D was 2.1 after the third application. The statistical analysis confirmed that the third concentration (2×10^5) was the highly toxic compared the first and the second concentrations in all treatment.

Table (3): Effect of *V. lecanii, B. bassiana* and *M. anisopliae* on *B. tabaci* during season 2017.

Treatments	The percent of infestation by *B. tabaci*/ leave										L.S.D
	Control	*V. lecanii*			*B. bassiana*			*M. anisopliae*			
		2×10^3	2×10^4	2×10^5	2×10^3	2×10^4	2×10^5	2×10^3	2×10^4	2×10^5	
1^{st}	7 ± 2.1^{a}	8 ± 2.1^{a}	8 ± 2^{a}	9 ± 1^{a}	9 ± 2^{a}	8 ± 21.1^{a}	10 ± 3.2^{a}	10 ± 1^{a}	9 ± 1.3^{a}	9 ± 2.2^{a}	3.2
2^{nd}	8 ± 2.2^{a}	7 ± 1^{bc}	6 ± 2^{bc}	3 ± 1^{c}	8 ± 1^{bc}	7 ± 1.2^{bc}	4 ± 1.2^{bc}	8 ± 1^{b}	7 ± 1.7	4 ± 2^{bc}	2.5
3^{rd}	9 ± 1^{a}	5 ± 2^{bc}	3 ± 1^{bc}	0.0^{c}	5 ± 1^{bc}	4 ± 2.3^{bc}	3 ± 1^{bc}	5 ± 1^{b}	4 ± 2.2^{bc}	3 ± 1^{bc}	2.3
Percent of reduction %	------	55.1	75.2	100	52.0	60.0	75.2	45.9	51.5	64.0	----

Discussion

These data showed that the entomopathogenic fungi *V. lecanii*, *B. bassiana* and *M. anisopliae* can be used as agent in pest control and integrated pest management programs.

The effect of *V. lecanii*, *B. bassiana* and *M. anisopliae* may be depending on the type of host plant. While the percent of mortality after 7^{th} day by *V. lecanii*, *B. bassiana* and *M. anisopliae* ranged between 100, 75.2 and 60%, respectively [25]. This result compatible with [26] who found that both of *B. bassiana* and *V. lecanii* caused mortalities of up to 97 and 100% in *Chilo partellus*, respectively. [27] reported that *B. bassiana* as an entomopathogenic fungi showed high effects on the aphid *Aphis craccivora* and the white fly *B. tabaci* infesting cucumber. [28] reported that *V. lecanii* caused higher virulence in the early stages of whitefly and reduced with older instars. [29] mentioned that entomopathogenic fungi caused good mortality to whitefly.

On the other hand, [30-33] described the control of the silver leaf whitefly *Bemisia argentifolii* on several plants (including cucurbits, broccoli, tomatoes, and cotton) using *B. bassiana*; they observed only a few fungus-killed adults on the plants did not exceed 1 %.

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