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# Direct toxicity effect of *Beauveria bassiana* and emamectin benzoate on *Pectinophora gossypiella* eggs (Lepidoptera: Gelechiidae) and *Tetranychus urticae* and their indirect effect on *Euseius scutalis* (Acari: Tetranychidae: Phytoseiidae)

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**Abstract:**

Two experiments were carried out to study the toxicity of the entomopathogenic fungus, *Beauveria bassiana* (10%) and the bioinsecticide, emamectin benzoate (2.15% EC) on eggs of the cotton pink bollworm, *Pectinophora gossypiella* (Saund.) (PBW) and two spotted spider mites *Tetranychus urticae* (Koch) (Acari: Tetranychidae) and their indirect effect on some biological parameters in addition to the feeding capacity of the predacious phytoseiid mite, *Euseius scutalis* (El-Badry) (Athisa-Henriot) (Acari: Phytoseiidae), under the laboratory conditions of 26 ±1°C and 65±5% RH. The results revealed that the two pests were highly susceptible to Emamectin benzoate than *Beauveria bassiana* as the $LC_{50s}$values were 0.484 and 0.179 ppm on PBW eggs and *T. urticae*, respectively, when treated with emamectin benzoate, while they were 43.3 and 11.07 ppm with *Beauveria*. The incubation period of *P. gossypiella* eggs prolonged to (4.66 days), when treated with *B. bassiana* and increased to (6.7 days), with emamectin, compared with (3.3 days) in the untreated (control). Feeding predacious mite, *E. scutalis* on *P. gossypiella* eggs and moving stages of *T. urticae* treated with emamectin benzoate and *B. bassiana***,** showed a considerable prolongation in total immature stages to (6.1 and 7.4 days) on PBW than (5.4 days) in the control and (7.2 and 8.8 days) than (6.0 days) for control, when fed on *T. urticae* treated with Emamectin benzoateand *B. bassiana*, respectively. Treatment with emamectin benzoate caused a higher reduction in the total food consumption of the predatory mite than that with *B. bassiana*.

## Introduction

The pink bollworm (PBW), *Pectinophora gossypiella* (Saund.)(Lepidoptera: Gelechiidae), is a significant pest of cotton plants in Egypt (Abd El-Mageed *et al*., 2007). It lays its eggs on different parts of the cotton plant; squares, flowers and green bolls. The eggs hatch in 3-4 days and larvae penetrate flower orthe squares or the green bolls to complete their development (Amer, 2006). The two spotted spider mite, *Tetranychus urticae* Koch. (Acari: Tetranychidae), is a polyphagous mite and a serious pest world-wide (Nauwen *et al*., 2001). The importance of this mite pest is not only cussed the direct damage to the plants but also it decreases the photosynthesis and transpiration of the plant leaves causing low yields (Golam, 2002). Many trials all over the world have succeeded using bio-pesticides in controlling mite pests in different orchards and field crops, such as the studies by Aucejio *et al*. (2003) and Aimee and Oscar (2007).

Insect pests and/or spider mites problems usually increase, when their natural enemies are destroyed by applications of broad spectrum pesticides (Mainul *et al*., 2010). Spider mites are rapidly developed resistance to a series of acaricides (Van Leeuwen *et al.,* 2004) and have recently assumed a new aspect of multiple resistances ( Kim *et al.,* 2006). A large numbers of commercial pesticides have a negative impact on the environment as well as natural enemies. Therefore, it is necessary to minimize the dependence on using chemical control and encouraging the use of biocides (El-Saiedy *et al*., 2015).The development of microbial control technology can help in developing its application in control programs; on other hand the laboratory evaluations of the effectiveness of the potential microbial control agents are necessary (Wraight *et al.* ,1998) ,the bio-pesticides; emamectin benzoate is a derivative of the natural Avermectin family produced by fermentation of soil microorganism *Streptomyces avermitilis* (Schallman *et al.*, 1987).

*Beauveria bassiana* is a virulent, entomopathogenic fungus with a very wide range of insect pests and it is a resident of soil (Klingen *et al.,* 2002) and has semelparous life history with a single reproductive episode. This entomopathogenic fungus considerable a novel foliar insecticides of lepidopteron and other groups biological control agent against insect pests or mites (Lacey and Gottel, 1995).

Several laboratory methods are designed to evaluate the effects of pathogens by exposing predatory mites to pathogen (Zhang *et al.,* 2015 and Dogan *et al.,* 2017). The predatory mite *Euseius scutalis* (El-Badry) (Athisa-Henriot) (Acari: Phytoseiidae) is considered the most common predator on cotton and other economic crops in Egypt (Fouly *et al*., 2013). Other studies reported that the predatory mite *E.scutalis* attacks many species of preys such as *T. urticae* (Osman *et al*., 2013), whitefly (Mainul *et al.*, 2010) and reared under laboratory condition on *T. urticae* and PBW eggs (Sholla *et al.,* 2017).

The objective of the present study was to evaluate under laboratory conditions the direct effects of *B. bassiana* and emamectin benzoateon pink bollworm eggs and moving stages of *T. urticae* and their indirect effects on some biological aspects, when the predacious mite, *E.scutalis* was allowed to feed on pink bollworm eggs and moving stages of *T. urticae*.

## Materials and methods

### 1.Biopesticides used:

Two bio-pesticides were evaluated:

**1.1.**Common name: Emamectin benzoate Trade name: (Emacte 2.15 %EC). Rate of application: 150 $cm^3$ / 100 L.

**1.2.**Common name: *Beauveria bassiana* Trade name: Biover 10%Rate of application: 200 g / 100 L

**2.Tested insect:**

Laboratory strain of the pink bollworm (PBW), *P. gossypiella*, reared for several generations at Bollworms Research Department, Plant Protection Research Institute, Agricultural Research Center, Giza, Egypt under the laboratory conditions of 26±1°C and 65±5 RH% on an artificial diet previously described by Rashad and Ammar (1985).

**2.1. *Tetranychus urticae:***

Castor bean leaves, infested with the two spotted spider mite *T. urticae* was collected from Giza Governorate, Egypt; and transferred to the laboratory for mass rearing of the mite. Adult females of *T. urticae* were left to lay eggs on leaf discs of *Acalypha marginares* and kept on a moist cotton pad in a petri dish (15 cm in diameter), where suitable moisture was supplied daily to keep the leaf discs fresh for longer time and for collecting the deposited eggs easily.

**2.2. Collection and rearing of *Euseius scutalis* predator:**

The predacious mite *E. scutalis* (different immature stages) were collected from the leaves and flowers of Egypt cultivated cotton (during 2017) at Qaluobia Governorate and then transferred to the laboratory. The adult females of *E. scutalis* were provided by *T. urticae* and/or eggs of *P. gossypiella* as food sources and incubated at 26±1°C and 65±5% RH. The newly deposited eggs were singly transferred from the culture to the leaf discs, kept on moist cotton pads in (15 cm petri dishes) to estimate the incubation periodand hatchability of *E. scutalis* for used in the experiment..

**3.Preparation the pesticides used:**

Two preparations (*B. bassiana* and *E. benzoate*) for tested against PBW eggs and moving stages of *T. urti*cae. Five concentrations / eachcompound were prepared as follow: (1.98, 0.99, 0.495, 0.242 and 0.0.121 ppm) for emamectin and (200,100, 50, 25, 12.5 and 6.25 ppm) for *B. bassiana*.

**4. Experimental techniques:**

**4.1.Toxicity of tested compounds to *Pectinophora gossypiella* eggs and *Tetranychus urticae*:**

**4.1.1.Toxicity on *Pectinophora gossypiella* eggs**:

The toxic of two tested bio-chemicals; against the *P. gossypiella* eggs, were evaluated by the dipping technique; Three replicates from *P.gossypiella* eggs for each concentration for *B. Bassiana* and *E. benzoate* were used, each replicate contained 150-200 eggs (0-2 day old), deposited on piece of paper. The strips with attached eggs were dipped in each tested concentration (*B. bassiana* or *E. benzoate*) for 10 sec., and then left to dry. Another three replicates (100-150 eggs, deposited on a piece of paper), were dipped in water as check. Treated eggs were placed in a clean tube (3x10 cm.) until hatching under the previous conditions. Afterwards the hatched and unhatched eggs were recorded for each treatment; also the incubation periods were estimated.

**4.1.2.Toxicity on *Tetranychus urticae*:**

The toxic of two tested bio-chemicals; against the two spotted spider mite *T. urticae*, were evaluated by thespray technique; 150 individuals of moving stage (immature of the spotted spider mites) were divided into two groups, each group75 individuals and each group was divided into three (replicates), each replicate (25 individuals), placed on discs of *Acalypha marginares* and kept on a moist cotton pad in a Petri dish (15 cm in Diameter). The first group was sprayedby *B. bassiana* and the 2$^{nd}$ group was sprayed by Emamectin. The mortality rate after 24h to 3 days was estimated. Data were corrected according to Abbott's formula (1925), the $LC_{20}$, $LC_{50}$ and

$LC_{90}$ valuesfor each compound were calculated, using the LDP line program. The potency levels and the toxicity index were also calculated, according to (Sun, 1950).

**Toxicity index =** LC50 or LC90 of the most toxic compound/ LC50 or LC90 of the tested compounds x 100.

**Relative Potency** = LC50 of the least toxic compound/ LC50 of the tested compounds.

### 4.2. Some biological aspects and food consumption of *Euseius scutalis* when fed on treated *Tetranychus urticae* and *Pectinophora gossypiella*:

Newly hatched larvae of *E. scutalis* were divided into six groups; each group replicates three times, each replicate (20 individuals). The everyone from each group, concluded the predator of *E. scutalis* were confined singly on the strip with *P. gossypiella* eggs were dipped in each $LC_{50}$ values for *B. bassiana* or emamectin tested compounds as following:

-The first group fed on *P. gossypiella* eggs (from 0-2 days eggs age) dipping in $LC_{50}$values of *B. bassiana.*

-The second group fed on *P. gossypiella* eggs (from 0-2 days age) dipping in $LC_{50}$values of Emamectin.

- The third group fed on eggs of *P. gossypiella* untreated as a control.

-The fourth group, predator of *E. scutalis* was confined singly on the leaf discs after spring the moving stages of *T. urticae*, after spraying by $LC_{50}$ of *B. bassiana* for food

-The fifth group, predator of *E. scutalis* were confined singly on the leaf discs after spraying the moving stages of *T. urticae*, by $LC_{50}$ of emamectin. At the same time and the $6^{th}$group was fed on untreated immature stages of *T. urticae*.

The treated or untreated of *T. urticae* (immature stages) or *P. gossypiella* eggs were provided every day as a food source for predatory mites, the numbers of introduced prays increased (20 individuals) daily until thepredacious mite*E. scutalis* completing different immature stages. All experiments observed daily to recorded some biological parameters of *E. scutalis* such as; developmental time of different immature stages, food consumption /day, percent of mortality, life cycle and life span of the predator, data were daily recorded.

### 5. Statistical analysis :

All biological parameters of the predatory mite, *E. scutalis* were analyzed by Costat statistical program software, 1990 and Duncan's multiple range test (Duncan, 1955) at 5% probability level to compare the differences among time means.

## Results and discussion

### 1.Toxicity effects of emamectin benzoate and *Beauveria bassiana* on *Tetranychus urticae* and *Pectinophora gossypiella.*

Based on all LC values data in Table (1) showed that, the effect of emamectin benzoate was greater than that of *B. bassiana* on both *P. gossypiella* eggs and moving stages of *T. urticae.* The $LC_{50}$ values for emamectin treatments were 0.484 and 0.179 ppm for PBW eggs and moving stages of *T. urticae*, respectively, while for *B. bassiana* $LC_{50}$ values were 43.35 and 11.07 ppm for PBW eggs and moving stages of *T. urticae*, respectively.

**Table (1): Effect of *Beauveria bassiana* and emamectin benzoate on *Tetranychus urticae* moving stages and *Pectinophora gossypiella* eggs under laboratory conditions.**

| Treatment | | PBW eggs | | | | Susceptibility index based on | | Potency levels based on | |
|---|---|---|---|---|---|---|---|---|---|
| | | $LC_{25}$ | $LC_{50}$ | $LC_{90}$ | Slop | $LC_{50}$ | $LC_{90}$ | $LC_{50}$ | $LC_{90}$ |
| ***P .gossypiella*** | ***Beauveria*** | 18.47 | 43.35 | 219.17 | 1.82 | 1.12 | 1.11 | 1 | 1 |
| | **Emamectin** | 0.207 | 0.484 | 2.435 | 1.83 | 100 | 100 | 89.57 | 90.01 |
| **Treatment** | | **Moving stages** | | | | **Susceptibility index based on** | | **Potency levels based on** | |
| | | $LC_{25}$ | $LC_{50}$ | $LC_{90}$ | Slop | $LC_{50}$ | $LC_{90}$ | $LC_{50}$ | $LC_{90}$ |
| ***T. urticae*** | ***Beauveria*** | 3.04 | 11.07 | 121.17 | 1.19 | 1.62 | 1.08 | 1 | 1 |
| | **Emamectin** | 0.0628 | 0.179 | 1.31 | 1.48 | 100 | 100 | 61.8 | 92.51 |

## 2.Susceptibility index and potency levels:

The data revealed that the PBW eggs and *T. urticae* moving stages were highly susceptible to emamectin benzoate treatment than *B. bassiana* with high potency of emamectin compound which is declared by (Sun, 1950) formulas of susceptibility index and potency level. At the level of $LC_{50}$ Susceptibility index for *B. Bassiana* recorded 1.12 and 1.62 compared to 100 for emamectin benzoate for PBW eggs and *T. urticae* moving stages treatments, respectively.

These data indicated that the *T. urticae* moving stages high toxicity and high susceptibility to two compounds than *P. gossypiella* eggs. Amer (2004) found that spintor (natural compound) was potent against *P. gossypiella* ($LC_{50}$ was 0.131 ppm). Al-Shannaf and Kandil (2005) recorded that the $LC_{50}$ of spinosad for one and two day's old eggs of *Helicoverpa armigera* (Hb.) were 2.56 and 1.31 ppm, respectively. Sahab and Sabbour (2011) recorded that the $LC_{50}$ values of *B. bassiana* was ($179\times10^4$spores/ml) for PBW treated.

## 3.Effect two compounds on hatchability and incubation period of *Pectinophora gossypiella* eggs:

*B. bassiana* and emamectin benzoate, at $LC_{50}$ level, reduced the percent of hatchability of PBW eggs to (56.0 and 49.6%), respectively, compared to (94%) in the control (Table, 2). In *B. bassiana* treatment, most of the egg hatchability percent (69.6%) occurred after 3-4 days post treatment, while in Emamectin benzoate treatment the most hatchability percent (71.0%) occurred after 4to 8 days post treatment. This different in hatchability may be due to the mode of action and penetration of these compounds into the eggs. However, the eggs were the most sensitive to emamectin benzoate than *B. bassiana*. Also, the percentages of egg hatchability recorded in Table (2) indicated that eggs were more sensitive to Emamectin benzoate treatment than *B. bassiana*. The incubation period of pink bollworm eggs was high affected by $LC_{50}$ treatment of Beauveria and emamectin (Table, 2).

**Table (2): Effect of *Beauveria bassiana* and emamectin benzoate on some parameters of *Pectinophora gossypiella* eggs.**

| Treatments ($LC_{50}$) | Eggs hatchability % (after ---days) | | | Mean of Incubation period (Days±SE.) |
|---|---|---|---|---|
| | % | 3-4 days post treatment | 4-7 days post treatment | |
| ***B. bassiana*** | 56.0 | 69.6 | 30.4 | 4.66±0.40 |
| ***E.benzoate*** | 49.6 | 29.0 | 71.0 | 6.7±0.54 |
| **Untreated** | 94.0 | 90.0 | 10.0 | 3.3±0.33 |
| **LSD** | | | | |

The time required for incubation period estimated by 4.66 days/eggs when eggs treated with *B. bassiana* and highly increased to 6.7 days when treated with emamectin benzoate compared with 3.3 days with control with (approximately1 to 2 times).Other researchers have also reported ovicidal activities are due to fungal species as well as host species (Erler *et al*., 2013 and Dogan *et al*., 2017).

**4. Developmental periods of *Euseius scutalis*:**

As shown in Tables (3 and 4), the incubation periods of eggs were (2.3 and 2.7 days), when *E. scutalis* was reared on *P. gossypiella* and *T. urticae*, respectively.

The total developmental period of the immature stages of *E. scutalis* was high significant affected by different food sources, treated with *B. Bassiana* or emamectin. The two tested compounds prolonged the duration of all immature stages than the control.5.4 and 6 days were required from larvae to develop to deutonymphal stages of *E. scutalis*, when fed on untreated *P. gossypiella* eggs and *T. urticae*, respectively. It was longer (6.1 days and 7.4 days), when fed on *P. gossypiella* eggs, and increased to 7.2 and 8.8 days when provided with *T. urticae* spryied by *B. bassiana* and emamectin, respectively (Tables, 3 and 4). Sholla *et al*. (2017) reported that the total developmental period of immature stages of *E. scutalis* were 6.6 days /♀ and 5.03 days /♂ on *P. gossypiella* eggs, prolonged to 6.68 days/♀ and 5.92 days/♂ on *T. urticae*. Osman *et al.* (2013) stated that the larval stage of *E. scutalis* lasted (2.31 days), when fed on nymphs of *T. urticae*, the proto-nymphal period was (2.56 days), deuto-nymph lasted (2.31 days) and total immature stages (7.06 days), when fed on nymphs of *T. urticae*, respectively.

**5.Percent mortality of predator when reared on *Pectinophora gossypiella* eggs and *Tetranychus urticae* treated:**

Data recorded in Tables (3 and 4) indicated that high significant difference ($P < 0.05$) between the predator mortality rates when the predator reared on *P. gossypiella* eggs or *T. urticae* treated with *B. bassiana* and emamectin; it were (17 and 33%mortality), when *E. scutalis* was fed on PBW eggs treated with *B. bassiana* and emamectin, respectively, compared to (4%) in untreated (control). While the respective, rates increased (23 and 39%, mortality) when fed on *T. urticae*, compared to (5%) in the control (Table, 4).

**Table (3): Developmental time of the predatory mite *Euseius scutalis* when fed on *Pectinophora gossypiella* eggs treated with $LC_{50}$ values of *Beauveria bassiana* and emamectin benzoate under laboratory conditions.**

| Treatments | | Egg stage | Immature stages (days ± SE) | | | | Life span days ± SE | Increase in duration | Mortality% |
|---|---|---|---|---|---|---|---|---|---|
| | | Incubation period | Larvae | Prto-Nymph | Deuto-nymph | Total immature stages | | | |
| *P .gossypiella* | *B. bassiana* | 2.3 ±0.1 | 1.6 ±0.1 | 2.1 ±0.2 | 2.4 ±0.3 | 6.1 ±0.5 | 8.4 ±0.5 | 1.1 | 17 |
| | E. benzoate | | 1.9 ±0.1 | 2.6 ±0.1 | 2.9 ±0.2 | 7.4 ±0.6 | 9.7 ±0.61 | 1.26 | 33 |
| | Untreated | | 1.3 ±0.2 | 1.8 ±0.1 | 2.30 ±0.3 | 5.4 ±0.2 | 7.7 ±0.3 | ------ | 4 |
| LSD | | | 0.114 | 0.133 | 0.027 | 0.103 | 0.99 | - | - |
| P | | | ** | ** | ** | *** | *** | - | - |

**Values are mean ± SE of three replicates.**
**Values within the same column having the same letters are not significant different (ANOVA, Duncan's multiple range tests, P < 0.05).**

**Table (4): Developmental time of the predatory mite *Euseius scutalis* when fed on *Tetranychus urticae* treated with $LC_{50}$ values of *Beauveria bassiana* and emamectin benzoate under laboratory conditions .**

| Treatments | | Egg stage | Immature stages (days ± SE) | | | | Life span days ± SE | Increase in duration | Mortality% |
|---|---|---|---|---|---|---|---|---|---|
| | | Incub-ation period | Larvae | Prto-Nymph | Deuto-nymph | Total immature stages | | | |
| *T. urticae* | *B. bassiana* | 2.70 ±0.2 | 1.8 ±0.1 | 2.3 ±0.1 | 3.1 ±0.2 | 7.2 ±0.4 | 9.9 ±0.5 | 1.2 | 23 |
| | E. benzoate | | 2.1 ±0.1 | 2.9±0.3 | 3.8 ±0.4 | 8.8 ±0.5 | 11.5 ±0.7 | 1.5 | 39 |
| | Untreated | | 1.5 ±0.2 | 2.10 ±0.1 | 2.4 ±0.1 | 6.0 ±0.4 | 8.7 ±0.6 | ----- | 5 |
| | LSD | - | 0.247 | 0.35 | 0.114 | 0.348 | 0.133 | - | - |
| | P | - | ** | ** | *** | ** | ** | - | - |

**Values are mean ± SE of three replicates.**
**Values within the same column having the same letters are not significant different (ANOVA, Duncan's multiple range tests, P < 0.05).**

The increase in mortality percent when *E. scutalis* was fed on *T. urticae* can be explained as a high susceptibility of the moving stages of the prey towards the two compounds than PBW eggs.

**6.Effect of preys treated on food consumption of *Euseius scutalis* immature stages:**

The data recorded in Tables (5 and 6) showed that there was a high significant difference (P < 0.05) between the all immature stages of *E. scutalis* consumption when fed on treated preys than the untreated; because the low consumption recorded when fed on treated preys. They consumed an average of (18.0, 20.9 and 23.6) from PBW eggs; and (15.6, 18.3 and 20.0) from *T. urticae* in control for larvae, protonymph and deutonymphs of *E. scutalis*, respectively. On the other hand, it decreased to (14.3, 15.9 and 20.3), when fed on PBW eggs treated with *B. bassiana* and to (11.6, 13.3 and 18.6) prey/mite, respectively, when fed on PBW eggs treated with emamectin. These values gradually decreased to (8.8, 11.5 and 14.9 prey/ mite/ day) for larvae, protonymph and deutonymphs, respectively, when fed on *T. urticae* treated with emamectin and (9.0, 14.3 and 17.0 prey/mite), respectively, when they were consumed *T. urticae* treated with *B. bassiana* as tabulated in Table (6). The total food consumption of the predator was (69.5 preys) from untreated PBW eggs and (50.9 preys) from untreated *T. urticae*. At the same time, the total consumption of mite decreased to (43.5 and 50.5 preys) by fed on treated PBW eggs and to (35.2 and 40.3 preys) from *T. urticae* treated, respectively. The results agree with Sholla *et al*. (2017) who found that the total food consumption of the female and male predator were (66.43 and 54.33 preys) from PBW eggs, respectively, and (48.5 7 and 41.6 prey/mite)female and male, respectively, when fed on *T. urticae*.

**7. Reduction in food consumption predator mite *Euseius scutalis*:**

The effect of food source treatment on reduction of preys' *E. scutalis* consumption was presented in Tables (5 and 6). The highest reduction, ranged from (21.2 to 36.4%) and (25.5 to 43.6%) was found, when the predacious mite was fed on PBW or *T. urticae* treated with emamectin, while the lowest reduction recording (3.9 to 23.9 and 15 to 29.5 %), was recorded when *E. scutalis* was fed on PBW or *T. urticae* treated with *B. bassiana*. From the previous results, it can be concluded that the *T. urticae* was high susceptibility to the two compounds than PBW eggs and the treated PBW eggs or *T. urticae* by emamectin caused a high reduction in consumption of the predator than *B. bassiana* treated.

**Table (5):Food consumptions of the predacious mite *Euseius scutalis* when fed on *Pectinophora gossypiella* eggs under laboratory conditions**

| Stages of predator\ | Average numbers of prays consumption in a day/ predator ± SE | | | | | | |
|---|---|---|---|---|---|---|---|
| | ***P. gossypiella* treated with** | | ***P. gossypiella* untreated** | | | **% Reduction in consumption due to fed on** | |
| | **E. benzoate** | ***B. bassiana*** | | **LSD** | **P** | **E. benzoate** | ***B. bassiana*** |
| **Larvae** | 11.6±1.6 | 14.3±1.2 | 18.0±0.59 | 2.571 | ** | 35.5 | 20.5 |
| **Prtonymphal** | 13.3±1.2 | 15.9±1.5 | 20.9±0.7 | 1.353 | ** | 36.4 | 23.9 |
| **Deutonymphals** | 18.6±1.9 | 20.3±1.8 | 23.6±1.4 | 1.988 | ** | 21.2 | 3.9 |
| **Total consumption** | 43.5±3.2 | 50.5±4.3 | 62.5±2.9 | 5.211 | *** | 30.4 | 27.3 |

**Values are mean ± SE of three replicates.**
**Values within the same column having the same letters are not significant different (ANOVA, Duncan's multiple range tests, P < 0.05).**

**Table (6):Food consumptions of the predacious mite *Euseius scutalis* when fed on *T. urticae* under laboratory conditions.**

| Stages of predator\ | Average numbers of prays consumption in a day/ predator ± SE | | | | | % Reduction in consumption due to fed on | |
|---|---|---|---|---|---|---|---|
| | *T. urticae* treated with | | Untreated | | | | |
| | E. benzoate | *B. bassiana* | | LSD | P | E. benzoate | *B. bassiana* |
| Larvae | 8.8±0.9 | 11.0±1.4 | 15.6±0.7 | 1.377 | ** | 43.6 | 29.5 |
| Prtonymphal | 11.5±1.4 | 14.3±1.8 | 18.3±1.2 | 2.322 | ** | 37.1 | 21.8 |
| Deutonymphals | 14.9±1.3 | 17.0±1.6 | 20.0±0.9 | 2.111 | ** | 25.5 | 15 |
| Total consumption | 35.2±0.5a | 40.3±3.3 | 50.9±0.9 | 6.217 | *** | 30.8 | 20.8 |

**Values are mean ± SE of three replicates.**
**Values within the same column having the same letters are not significant different (ANOVA, Duncan's multiple range tests, P < 0.05).**

From all the aforementioned results, we may concluded that can be used two bio chemicals' *B. bassiana* and Emamectin successfully in controlling the spider *T. urticae* because it was highly susceptibility to both compounds than PBW eggs.But; Emamectin caused a high reduction in consumption of the predator *E. scutalis* than that treated with *B. bassiana*. Biological control with *B. bassiana* is a promising alternative to bio-chemical control against PBW eggs or *T. urticae* that causes alittle damage to the predacious mite, *E. scutalis* with no damage to the environment. So it can be used *B. bassiana* products in the Integrated Pest Management Program of spider mites or PBW eggs with the predator, on cotton fields.

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