Field Stability of Some Compounds Against *Tetranychus Urticae* Koch and *Pectinophora Gossypiella* (Saunders) on Cotton Plants

Abd El-Salam, A. Farag[1], El-Shamy, E. A[2] and Abd El-Rahman, H. A.[1]

1.Plant Protection Research Institute,Agricultural Research Center,Giza,Egypt.
2.Dept. of Agric. Zoology and Nematology, Fac. of Agric., Al-Azhar Univ., Assiut, Egypt.
abdelsalamfarag045@gmail.com,emadelshamy2021@gmail.com Hamdyaboshams2021@gmail.com

DOI: 10.21608/JALEXU.2023.193130.1118

Article Information

Received: February 11st 2023

Revised: March 7th 2023

Accepted: February 19th 2023

Published:March 31th 2023

ABSTRACT: The spider mite and pink bollworm are considered two of the most important pests attacking cotton plants and causing serious damage to leaves, flowers and bolls. Thus, the experiments were carried out at Sakha Agric. Research Station, Kafr El-Sheikh governorate during the seasons 2020 and 2021. However, the field experiments used compounds were one insecticide, beta cyfluthrin; three biocides, emamectin benzoate, *Bacillus thuringiensis* and *Beauveria bassiana* and one plant oil, jasmine oil which were tested against the two spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) and *Pectinophora gossypiella* (Saunders) (Lep: Noctuidae) using standardized method for assay. The highest effective compounds on *T. urticae* and *P. gossypiella* were emamectin benzoate (95.59 and 96.65 % reduction during the two seasons, respectively on *T. urticae* and 70.45 and 71.60 % reduction on *P. gossypiella* during the 1st and 2nd seasons, respectively). Beta cyfluthrin and *B. bassiana* had a moderate activity on the two pests followed by *B. thuringiensis*. Jasmine oil had the least activity on the treated *T. urticae* and *P. gossypiella* (33.89 and 33.79 % reduction during the first season, respectively) and there were not significant differences between each compound and others during the two seasons. In laboratory trails, beta cyfluthrin was the most effective with LC_{50} 2.61 and 1.45 mg / L 0n both adult and eggs of *T. urticae*, respectively followed by emamectin benzoate.While *B. bassiana* was of a moderate toxic with LC_{50} 63300 and 44200 using dipping method. Beta cyfluthrin was the most toxic to *P. gossypiella* with LC_{50} 2.99 mg / L. While *B. bassiana* was the low effective on *P. gossypiella* with LC_{50} 64100 mg / L using the artificial diet treatment method. The obtained data indicated that biocides caused significant against the two pests and could be used as alternatives to pesticides in IPM.

Keywords: Biocides, *Tetranychus urticae, Pectinophora gossypiella***.**

INTRODUCTION

The Pink bollworm, *Pectinophora gossypiella* and the two-spotted spider, *Tetranychus urticae* are two most important cotton pests that causes direct damage to cotton plant such as squares, flower buds, flowers and cotton boll which decrease cotton production of seed and oil Khan *et al*.(2007). Many cotton growers rely on the use of pesticides to the pest control. These compounds are harmful to the environment and accordingly, many researcher used some chemicals in agriculture to control pests that originally derived from microbial metabolites (Horikoshi *et al*. 2017). These kinds play very important role in suppressing populations of phytophagous mites and must be safeguarded. Many efforts have been undertaken to manage *T. urticae* problems in agricultural crops such as the application of new acaricides with the lower concentrations (Arbabi, 2007). These results can be supported with those obtained by several investigators. Ismail *et al.* (2006) indicated that abamectin was the most toxic compound against the egg stage of *T.urticae* with LC_{50} value of 2.88 ppm. Also, they indicated that cypermethrin was one of the most effective compounds on eggs of *T.urticae*. Moreover, Ismail (2009) found that cyhalothrin and abamectin have a special effect on eggs of *T.urticae* and considered the best compounds that have a special importance in integrated mite management, while the mineral oil Nat-1 was more toxic to egg stage of *T.urticae* than black cumin extract. Abamectin had the greatest effect on the adults (LC50 = 5.39mg) followed by chlorfenapyr (LC50= 106.51mg) after 1 day of application (Badawy, *et al*. 2022). Researchers thought that fungi use their products as well as mycotoxins as chemical defenses against different targets including insects and mites. For instance, mycotoxins such as aflatoxin and trichothecenes exhibited toxicity to many insect pests (Srivastava *et al*., 2009) Fungi and fungal metabolites showed a high toxicity to insects and mite pests; however, they showed low toxicity to non-target organisms (Ragavendran and Natarajan 2015). Thus, Ratnakar and Veeranna (2022) found that the incidence of larvae on bolls of B. *thuringiensis* showed significantly higher income was obtained with *P. gossypiella*, though were seemed until harvest. These corroborate the results of Verma *et al*. (2017) and Muttappa and patill (2019). The fungal isolate *B. bassiana* affected the mortality of *Galleria mellonella* larvae and achieved the high mortality as a biological control against larvae (Fathy *et al*., 2018). Boiassyed, *B. bassiana* as efficacy biocides against *G. mellonella* in the laboratory (Abdel-Raheem *et al.*, 2016). Consequently, microbial metabolites may be promising resources in a novel pesticide development. Thus, the present investigations were performed to determine susceptibility of *T. urticae* and *P. gossypiella* to certain treatment under laboratory and field conditions. Thus, we had taken some points in the development of IPM, especially of some treatments in biological control program.

MATERIALS AND METHODS

Tested compounds:

- Beta cyfluthrin (Blend-extra EW 10%) at 60ml / fed. obtained from Starchem Chemical, Egypt (Cuangdong Liwei Chemical CO., Itd. China, Exporter CO. of Tc).
- Avermectin derivative insecticide, Emamectin benzoate (Kor WG 5.7%) obtained from syngenta Co. and was applied at 60g/ fed
- Jasmine oil (95%) was provided by Central Agricultural Pesticides Laboratory-Natural oil was applied at 1L / fed.
- *Bacillus thuringiensis* Kurstaki, (protecto 9.4 % WP Contains 32000 IU/mg) as biocide, at the rate of 300mg/ fed, obtained from Plant Protection Research Institute.
- *Beauveria bassiana* biocides, Biossiana, 2.5 % WP (1×10^8 CFU^1 /g). obtained from Production Unit, Plant Protection Research Institute (ARC), used as the rate of 250mg/ fed.

Field experiments:

Two experiments were performed at the farm of Sakha Agric. Research station, Kafr El-Sheikh, Egypt, during the successive seasons 2020 and 2021 in an area of $2100m^2$ which was divided into plots. Four replicates were designed for each compound. Each replicate with$100m^2$ in completely randomized blocks design was used. All tested compounds were applied to evaluate their efficiency on spider mite, *T. urticae* larva and *P gossypiella* infesting cotton plants.. All tested compounds were applied at recommended rates using a knapsack sprayer with one nozzle. The volume of water used for diluting compounds was 200 liter/Fadden. Samples of 10 cotton leaves were randomly collected from each replicate before and after treatment at intervals of 2, 7 and 15 days for mites and transferred to laboratory for examination. While pink bollworm, *P* gossypiella, samples consisting of 20 green bolls were randomly collected from each replicate before and after treatment at intervals of one and two weeks after spray. The green bolls were brought to the laboratory for examination.

Laboratory trails

1-Mass rearing and toxicity of tested compounds to adult females and eggs of *T. urticae*.

Adults of the two-spotted spider mite, *T. urticae* field strain were obtained from unsprayed cotton fields at the farm of Sakha Agricultural Research Station and brought to the laboratory for feeding on cotton plants planted in plastic pots. After two days, the females wandered over the cotton leaves and started eggs oviposit. Eggs, newly hatched nymphs and adults were used in the laboratory experiments as described by Dittrich (1962). All compounds were evaluated by the leaf disc dip technique with four concentrations of each treatment on discs of cotton plants (2cm diameter). Discs were dipped in the different concentrations for 20 seconds and left to dry. The leaf discs kept fresh by placing it on moisturized filter paper on a piece of wet cotton in Petri dish. Ten adults of *T. urticae* were transferred by means of a fine soft brush to each disc. Mortality counts were made 24 hours after treatment, according to the method by Sekeroglu, (1997). Red spider mite eggs were obtained by placing 10 adult females *T. urticae* on a cotton leaf disc placed upper side upon a water soaked cotton wool pad in Petri dish. Sufficient discs were set up to provide enough eggs for the following day's experiments. Eggs were never longer than 24 hours old at the start of an experiment. The discs attached with eggs were immersed in each chemical dilution on the test liquid for 20 seconds with gentle agitation. Untreated discs were immersed in distilled water. The tested eggs were kept together with untreated controls. To assay the residual effect of each tested chemical at LC_{50} level on adult mites, Egg deposition, egg-hatching, the method which was adopted by Farag (2011).

2- Mass rearing and toxicity of tested compounds against *P. gossypiella* larvae:

Active and healthy full grown larvae pink bollworm *P. gossypiella* were collected from infested cotton bolls at the end of cotton growing season**.** Five pairs of moths (male +female) were placed in wire capes with a piece of cotton wool saturated with a 10 % sugar solution to feed moths. Twisted paper oviposit eggs. The eggs were collected and placed in clean glass jars until hatching. The newly hatched larvae until reached to three instar larval (10 larvae) were brought to Petri dishes containing the artificial diet (5g) treated with the used compounds by adding recommended rates of each concentration as described by Abd El- Hafez *et al.* (1982). The Petri dishes were covered with fine and soft toilet paper below the glass cover to prevent larvae from escape, and that represent three replicates for every concentration as well as control (treated with water only) were reared in electrical incubation at constant conditions of 26± 1ºC and 70 ± 5% RH, on artificial diet according to the method by Deshpande and Joseph (1988).

Statistical analysis

The mortality Results were corrected using Abbott's formula (1925), and plotted on log dosage probit papers and according to Finney 1970. Failure of 95% confidence limits to overlap at a particular lethal concentration inducted a significant difference. The percentage reduction of infestation was calculated for each treatment according to Henderson and Tilton (1955).

$$\text{Egg mortality} = \frac{\text{Unhitched eggs}}{\text{N. of eggs in treatment}} \times 100$$

$$\text{Relative potency} = \frac{LC_{50}\text{ of least effect compound}}{LC_{50}\text{ of tested compound}}$$

$$\text{Toxicity index} = \frac{LC_{50}\text{ of standard compound}}{LC_{50}\text{ of tested compound}} \times 100$$

RESULTS AND DISCUSSION

Field experiments

Efficiency of tested compounds against *T. urticae* and *P. gossypiella*

Results obtained in Table (1and 2) indicated that the activity of the recommended rates of beta cyfluthrin, emamectin benzoate, *Bacillus thuringiensis*, *Beauveria bassiana* and plant oil (jasmine oil) were assessed during field application for suppressing *T. urticae* and *P. gossypiella* larvae in cotton fields. The populations and the reduction % of *T. urticae* and *P. gossypiella* were calculated. The results obtained clarified the reduction % of *T. urticae* number in the cotton field after application with the used treatments during the two successive seasons. In the first season, it was observed that beta cyfluthrin activity against of the mite number after one day in initial application, one week and two weeks after treatment compared to control causing approximately 93.65, 94.97 and 96.69 %, respectively.

Emamectin benzoate indicated a gradual reduction in the number by 96.26 % post one week of treatment. After two weeks post application, increased reduction was 97.33 %. The other treatments resulted in decreased reduction % as; *B. thuringiensis* (27.94 %), *B. bassiana* (45, 39 %) and Jasmine oil (26.63 %) through the initial effect. One week after spraying *B. bassiana* showed a moderate reduction (67.45 %) followed, nearly, by *B. thuringiensis* (42.01 %) and jasmine oil (39.59 %).

However, in the second week after spraying, the reduction percentage decreased in *B. thuringiensis* (39.67 %) and Jasmine oil (35.47 %), but reduction % increases with *B. bassiana* (82.75 %). In the second season, there was no difference in the impact of treatment on *T. urticae* number, the present study illustrated that beta cyfluthrin achieved about (94.01 %), (96.27 %) and (97.82) reduction% after initial effect, one week and two week, respectively. Emamectin observed a 94.41 % reduction after initial effect post application. While the reduction % of 10.22 % was showed by *B. thuringiensis* after two weeks post used and *B. bassiana* gave 72.42 % reduction compared to the control. Mite was affected with the five compounds as their reduction % after 2 weeks were highest, and there were significant differences between the five treatments.

The present data were on line with that of Zandi-Sohani and Ramezani (2015) when evaluated the chemical composition of five lamiacase plant essential oils and their acaricidal activity against *Tetranychus sp* (Acari: Tetranychidae). they demonstrated that all the tested essential oils have the ability to control *T.turkestani* and could be useful in the development of new agents for mite control (Tarikul 2019). All the pesticides showed the toxic effect on red spider mite in Tea and significantly reduced mite population in both laboratory and field conditions (Mamun *et al.*, 2015). After 5 days post treatment culture filtrates of KF23, KF9, KF40, and KF45 results in 53.69, 73.83, 50.34, and 67.11% mortality, respectively. Similarly, the culture filtrates of *B. bassiana* and *M. anisoplae* highly reduced mite population (Yun *et al.* 2017). The obtained results were relatively higher than mortality rates of HTCRMB isolated from *Hirsutella thompsonii* Fisher that only exhibited 55.90 %

aganist *T. urticae* and citrus rust mite, *Phyllocoptruta oleivora* Ashmead, 9 days after application (Aghajanzadeh *et al*. 2006). The obtained results in Table 2 demonstrated that, the pink bollworm appeared the susceptibility to post treatment with recommended rate of some treatment during complete compounds used. Thus, treatments on these pest larvae after the first applications (initial kill, 7 days after spray) reduction % in the 1st season were 62.52, 43.43, 31.22, 28.58 and 26.46 % for emamectin benzoate, beta cyfluthrin, *B. thuringiensis*, *B. bassiana,* and Jasmine oil, respectively. While, in the 2nd season, were 72.92, 51.05, 46.95, 35.20 and 11.79 % reduction with emamectin benzoate, *B. thuringiensis*, beta cyfluthrin, *B. bassiana* and jasmine oil after applecation compared for untreated plot, respectively. There were significant differences between the five treatments. While the spray gave 74.89, 76.12, 60.54, 48.80 and 31.64 % reduction for beta cyfluthrin, emamectin, *B. thuringiensis B. bassiana* and Jasmine, respevtivly. These results agreed with Somaa (2021), the biocide caused reduction 25.87 % in level infestation after treatment of *P. gossypiella* while, cypermethrin resulted in 83.58 % reduction. Amer *et al*. (2020) found that *B. thuringiensis* was considered the best compound and caused a reduction in the infestation of *P. gossypiella*, but less then emamectin benzoate activity. There were significant differences between the compounds after use of the interaction pink bollworm in both two seasons, which led to increase reduction % especially after the third spray.

Table 1. Efficacy of different treatments on *Tetranychus urticae* infestad cotton plants

Treatment	Rates	N. pre treatment	Days after application						Average	Overall average R. %
			Initial effect 1 day		1week		2 week			
			N	R%	N	R%	N	R%		
2020										
Beta cyfluthrin	60m/fed	182.53	12.50	93.65a	13.34 f	94.97b	9.21 f	96.69 a	11.68	95.10 a
E. benzoate	60g/100L	212.25	15.61	93.19a	11.52	96.26 a	8.64	97.33 a	11.92	95.59 a
B. thuringiensis	250g/100L	215.11	167.42	27.94 c	181.41	42.01 d	198.11	39.67 c	182.31	36.54 c
B. bassiana	250g/100L	190.40	112.31	45.39 b	90.1 1	67.45 c	50.12	82.75 b	84.18	65.19 b
Jasmine oil	1L/100L	214.65	170.11	26.63 cd	188.56	39.59 e	211.45	35.47 d	190.04	33.89 d
Untreated	-	216.28	233.61	-	314.50	-	330.15	-	315.75	-
2021										
Beta cyfluthrin	60m/fed	191.87	14.53	94.01 a	10.56	96.27 a	4.21	97.82 a	9.73	96.03 a
E. benzoate	60g/100L	150.51	10.64	94.41 a	6.14 f	97.24 a	2.56	98.31 a	6.44	96.65 a
B. thuringiensis	250g/100L	210.45	187.11	29.70 c	175.65	43.65 c	191.01	10.22 c	184.59	33.95 c
B. bassiana	250g/100L	201.61	132.62	47.99 b	98.01	67.13 b	56.13	72.42 b	98.58	62.51 b
Jasmine oil	1L/100L	214.60	198.11	27.01 d	191.67	39.62 d	215.12	9.94 cd	201.66	25.52 d
Untreated	-	211.53	267.75	-	312.67	-	213.54	-	264.65	-

Table 2. Efficacy of different treatments on *Pectinophora gossypiella* infestad cotton bolls.

Treatment	Rates	N*. before treatment	Days after application						Averag e	Overall average R. %
			First spray		Second** spray		Third spray			
			N	R	N	R	N	R		
2020										
Beta cyfluthrin	60m/fed	11.50	7.42	43.43 b	4.25	69.64 b	2.11	86.38 a	4.59	66.48 b
E. benzoate	60g/100L	14.62	6.25	62.52 a	4.99	71.74 a	4.01	77.10 b	5.08	70.45 a
B.thuringiensis	250g/100L	12.25	9.61	31.22 c	7.11	51.94 c	5.50	66.67 d	7.40	49.94 c
B. bassiana	250g/100L	14.30	11.65	28.58 d	8.91	48.40 d	5.00	74.04 c	8.52	50.34 c
Jasmine oil	1L/100L	13.65	11.45	26.46 e	11.64	29.38 e	10.01	45.55 e	11.03	33.79 d
Untreated	-	14.50	16.54	-	17.51	-	19.53		17.89	-
2021										
Beta cyfluthrin	60m/fed	10.23	5.90	46.94 c	3.41	74.89 b	1.00	92.78 b	3.43	71.54 a
E. benzoate	60g/100L	12.65	6.73	72.92 a	4.01	76.12 a	2.12	87.62 c	4.28	71.60 a
B.thuringiensis	250g/100L	10.50	7.20	51.05 b	5.50	60.54 c	3.10	78.19 d	5.26	57.04 c
B. bassiana	250g/100L	9.30	6.55	35.20 d	6.32	48.80 d	4.11	97.37 a	5.66	60.45 b
Jasmine oil	1L/100L	10.43	10.00	11.79 d	9.32	31.64 e	9.32	34.33 e	9.54	25.92 d
Untreated	-	14.26	15.50	-	18.63	-	19.31	-	17.81	-

*Mean N. two examinations (7days and 15 days)- ** 15 days between each spray and another

Salama *et al*. (2013), found that *B. thuringiensis* gave the highest reduction % of *P. gossypiella* after three sprays. Also, the pathological effect of the *B. thuringiensis* was high efficacy on the second instar larvae. Amer, (2022), demonstrated that, pepper oil with gamma dose increases of the activity of *B. thuringiensis* against 1st instar larvae and egg (old 1 day) of *p. gossypiel*la. Salah El-din *et al. (*2020) showed that jojoba oil was the most toxic compound on *p. gossypiella*. Also, application jojoba oil had higher increase in reduction % compared with the untreated Use of essential oil having insect effects and their importance them pesticides usage in pest suggested and save beneficial natural enemies and save environment. Therefore, using botanical insecticides in IPM program (Hikal *et al*., 2017) is recommended. Mirmoayedi *et al*., (2010) *B. thuringiensis* is most effective and powerful compound for controlling of the cotton bollworm.

Laboratory experiments

1- activity of tested compounds against *T. urticae* and *P. gossypiella*

The results presented in Table (3) reveal the relation between the percentage of reduction and concentrations of different compounds on adult female and eggs of *T. urticae*. The different treatments tested were of most variable in their efficacy. The data in this study showed that the efficacy of the used treatment against *T. urticae* using leaf dipping method. Beta cyfluthrin proved to be the most toxic insecticide (LC_{50} value = 2.61) against the adult of mite with Relative potency and Toxicity index of 24252.8 and 100.0, respectively. Emamectin benaoate, *B. thuringiensis* and Jasmine oil allustrated insignificant differences among them, estimated LC_{50} value of 13.54, 6.25 and 718.78, respectively. Based on the confidence limits at 95 % overlap the LC_{50} value of *B. bassiana* (63300) was the least effective. It was also cleared after 48 h post treatment 1st instar larval with spores of *B. bassiana* fungus, which led to a high death rate and the observed of spores on the larvae (Fig. 1). El-Mesallamy *et al*. (2015) found that pepper oil has a highest efficacy against *T. urticae* and the low effect recorded with 1st instar larval of *P. gossypiella*. Results in Table (3) reported that the susceptibility of the eggs of *T. urticae* to the used treatment was varied. The LC_{50} value of beta cyfluthrin, emamectin benzoate, *B. thuringiensis* and jasmine oil was 1.45, 9.23, 4.23 and 312.65, respectively. *B. bassiana* inducted LC_{50} value of 44200. Hosny *et al*, (2010) indicated that cyhalothrin is the most effective compound tested on egg deposition, while black cumin extract has the least effect on egg deposition. Chlorfenapyr and Nat-1 are the best compounds that have a moderate effect on egg deposition of spider mite which give these compounds special importance in integrated mite management. Fungi and fungal metabolites exhibit a high toxicity to insects and mite pests. However, they show low toxicity to non-target organisms (Ragavendran and Natarajan 2015). Derbalah *et al.* (2013) evaluated the side effect of sublethal doses of

Table 3: Toxicity of different compounds to adult females and eggs of two- spotted spider mite *T.urticae* Koch

Treatments	LC_{50}	95% CL	Slope ± SD	TI	RP (fold)
			Adult		
Beta cyfluthrin	2.61	1.90-2.99	1.54±0.76	100	24252.8
E. benzoate	13.54	12.52-17.45	0.98±1.02	19.27	4675.0
B. thuringiensis	6.25	5.87-8.65	1.53±0.99	41.76	10128
B. bassiana	63300	61990-64125	0.89±0.79	412.30	1.00
Jasmine oil	718.78	666.77-878.07	1.08±1.69	363.11	88.06
			Eggs		
Beta cyfluthrin	1.45	1.2 3-1.89	0.89±1.26	100	30482.7
E. benzoate	9.23	6.78-9.68	1.22±0.99	15.70	4788.7
B. thuringiensis	4.23	2.89-5.65	1.65±1.08	34.27	10449.1
B. bassiana	44200	38400 - 48100	1.09 ± 1.22	328.o5	1.00
Jasmine oil	312.65	289.45 - 411.67	0.95 ± 1.18	463.77	141.3

R.p. (Relative potency), T.i. Toxicity index

the tested treatments; cyhalothrin was the most effective compound against *T. urticae* with respect to egg deposition while black cumin extract was the least effective one. Also, Nasr and El-Kasser (2013) found that the pyrethroid compound cyhalothrin was the most effective compound on egg deposition against *T. urticae*, while Jojoba extract has the least effect.

Data in Table (4) showed that the average values of the most important experiments that were applicated and examined to suppress pink bollworm, *P. gossypiella*. These experiments indicated that the treatment; beta cyfluthrin and emamectin may have ability to burn the stems of cotton leaves by dipping, which leads to their increase effective, compared to other than the used compounds. LC_{50} value was the beta cyfluthrin was 2.99 ppm which falls within a larger space when taking confidence limits into consideration and Relative potency and Toxicity index were 21438.12 and 100.0, respectively. *B. thuringiensis*, emamectin and jasmine oil showed insignificant differences from each other, calculated the LC_{50} value of 6.76, 11,23 and 523.11, respectively.

Table 4: Susceptibility of *Pectinophora gossypiella* larvae to some compounds in corporated into artificial diet.

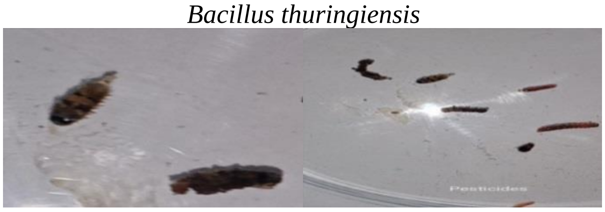
Treatments	LC_{50}	95% CL	Slope ± SD	TI	RP (fold)
Beta cyfluthrin	2.99	2.45 - 3.81	1.22 ± 0.89	100	21438.12
E. benzoate	11.23	9.34 - 13.67	1.09 ± 1.12	26.62	5707.92
B.thuringiensis	6.76	4.90 - 7.90	1.26.± 0.79	44.23	9610.19
B. bassiana	64100	50200 - 75548	1.79 ± 1.05	466.45	1.00
Jasmine oil	523. 11	400.01 - 622.11	1.43 ± 1.12	571.58	122.53

R.p. (Relative potency), T.i. Toxicity index

Biossiana (*B. bassiana*) was of decreased activity against *P. gossypiella* with LC_{50} value 64100ppm. It was also cleared after 48h post treatment 3rd instar larval with beta cyfluthrin, emamectin, *B. thuringiensis*, jasmine oil and spores of *B. bassiana* fungus, which led to a high death rate and the observed of spores on the larvae (Fig. 1). The present data are in similar with Alkhazraji and Majeed (2017) indicated that the eggs and 2nd instar larvae were more sensitive to the plant oil and the highest mortality percentage compared with 6th instar larvae, *S. littoralis.* Fergani and Refaei (2021) showed the *B. bassiana* isolated caused highest mortality % under laboratory conditions and could be recommended as effective biocontrol against *S. littoralis*, while Ullah *et al*.(2019) found that *B. bassiana* had insignificant effect against *S. littoralis*.

Beauveria bassiana

Bacillus thuringiensis



Beta cyfluthrin and emamectin benzoate

Oil

Fig.1. *Pectinophora gossypiella* larvae after treatment with compounds using larvae spray method

REFERENCES

Abbott, W. S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. of Eco. Entomol., 18(2): 265-267.

Abdel-Raheem, M. A, I. A. Ismail, N. A. Farag, R. S. Abdel-Rahman and H. H. Elbehery 2016. Isolates, Virulence of two Entomopathogenic Fungi as biological control agent on sugar beet fly, Pegomyia mixta in Egypt Der Pharma Chemica, 8(18): 132-138.

Abd El-Hafez, A., A. G. Metwally and M. R. A. Saleh 1982. Rearing pink bollworm *Pectinophora gossypiella* (Saunders)on kidney bean diet in Egypt (Lep.: Gelechiidae) Res. Bull. Fac. Agric. Zagazic Univ. 10pp.

Arbabi, S. 2007. Effect of a microbial-based acaricidal product on spotted and predatory spider mites. Afr. Crop Sci. J., 17: 169-143.

Aghajanzadeh, R. Y., N. Lftrc and W. Qurse. 2006. Mechanisms of Acaricide Resistance in the Two Spotted Spider Mite *Tetranychus urticae*. In. biorational control of arthropod pests: Application and Resistance Management, Ishaaya, I. and A.R. Horowitz (Eds.). Springer, the Netherlands, ISBN: 97690123162, pp: 347-393.

Alkhazraji, H. I. and E. H. Majeed 2017. Effect of black pepper (*piper nigrum* L.) oil extract on cotton leaf worm instars *Spodoptera. littoralis* (Boised) (Lepidoptera: Noctuidae). Al-Anbar. J. for Agric. Sce. 15(2): 598-608.

Amer, R. A., Sh. G. Omina, D. A. Abdel-Salam and A. Sh. Awad 2022. Cayenne oil, capsiccumannuum L. with Gamma- Ray for Enhancing Bacillus *thuringiensis* (kurs) efficacy *Pectinophora gossypiella* (Saunder) control. Egypt. Acad. J. Biolog. Sci. 14(1): 133-147.

Amer, R. A., M. S. Salem, R. A. Dar, N. N. Hassan and D. Abdel- Salam 2020. Compination effects between gamma radiation and spraying equipment for three cotton boll pests controlling. J. of Entomol. and Zoology studies. 8(2): 633-644.

Badawy, M. E. I., M. S. Mahmoud and M. M. Kattab 2022. Toxicity,joint action effect, and enzymatic assays of abamectin, chlorfenapyr and pyridaben against the two-spotted spider mite *Tetranychus urticae*.J. of Basic and Applied Zoology. 83(22): 4-20.

Derbalah, A. S., Y. A. Keratum, M. E. El-dewy and E. H. El-Shamy 2013. Efficacy of some insecticides and plant extracts against *Tetranychus urticae* under laboratory conditions. Egyption J. plant pro. Res. 1(3): 46-68.

Deshpande, S. G. and M. Joseph 1988. Insect growth and development inhibition properties of *Cathranthus roseus*. International Journal of Tropical Agriculture, 6: 287-290.

Dittrich, V. 1962. A comparative study of toxicological test methods on a population of the two-spotted spider mite (*T. urticae*). J. Econ. Entomol., 55(5): 644- 648.

El-Mesallamy, A. M., S. Raslan, M. El-Nagar and W. A. El-Medany 2015. Toxicity and latent effect of pepper plant essential oil (capsicum annuum) on some cotton pests. Middleeast. J. of Applied Sci., 5(4): 1184-1191.

Farag, A. A. 2011. Studies on resistance of *Tetranychus urticae* Koch for acaricides. P.hd. Thesis, Fac. of Agric. Kafr El-Sheikh, Univ. 134pp.

Fathy, D. M., H. M., H. M. Mansour and A. R. Ziedan 2018.efficacy of local isolate of Beaveria bassiana and commercial product of B.bassiana mixed with metarhiziun anisopliae on the greater wax moth. J. Plant Prot. Mansoura Univ., 9(8): 479-482.

Fergani, A. Y. and E. A. Refaei 2021. Pathogenicity induced by indigenous *Beauveria bassiana* isolate in different life stage of the cotton leafworm, *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) under laboratory conditions. Egyption J. of bio. pest Con.: 31-64.

Finney, D. J. 1971. Probit analysis 3rd ed., Cambridge Univ. press, London UK.

Hosny, A. H., A. Y. Keratum and N. E. Hassan 2010. Comparative efficiency of pesticides and some predator to control spider mites. J. Plant Prot. and path., Mansoura Univ., 2(12): 1065-1085.

Horikoshi, T., U. Sandr and F. Wtres 2017. Determination of susceptibility and resistance of some greenhouse populations of *Tetranychus urticae* Koch to chlorpyrifos (Dursban 4) by the Petri dish-Potter tower method. J. Pest Sci., 78: 179-133.

Hikal, W. M., R. S. and H. A. Said-Alahl 2017. Botanical insecticides as simple extractive for pest control, cogent biology 3:1, 1404274, Dol:10. 1080/23312025. 2017-1404274.

Handerson, C. F. and E. W. Telton 1955. Test with acaricides against the brown wheat mite. J. Econ. Entomol., (48): 157-161.

Ismail, A. A. 2009. Integrated mite management evaluation of some compounds against the two spotted spider mite, *Tetranchyus urticae* and the two predators *Amblysieus fallacies* and *Phytoseiulus perimillis*. J. Agri. Res. Kafr El-Shiekh Univ., 35(4): 1082-1095.

Ismail, A. A., W. H. Hegaz, A. S. Derbalah, N. E. Hassan and S. A. Hamed 2006. Toxicological and biological studies of some compounds against the two-spotted spider mite, *Tetranychus urticae* and its predatory mite, *Amblyseius gossipi* on different host plants. J. Pest cont. & Environ. Sci., 14(2): 227- 256

Khan, R. R., S. Ahmed, M. W. Saleem and M. Nadeem 2007. Field evaluation of different insecticides against spotted bollworm Erias spp. At distract Sahiwal. Pakestan Entomol., 29(2):129-134.

Mamun, J. E., M. Gnjtf and K. Letcger 2015. Side-effects of three neem (*Azadirachta indica* A. Juss) products on the predator *Macrolophus caliginosus* Wagner (Het. Miridae). J. Applied Entomol., 145: 387-492.

Muttappa, Y. and S. B. patill 2019. Seasonal incidence of pink bollworm, *Pectinophora gossypiella* (Saunder) on Bt cotton. Intarnational J. of Current Miervobiology and Applied Sciences, 8(12):351-360.

Mirmoayedi, A., M. Maniee and A. Yaghutipoor 2010. Control of cotton spiny bollworm (Earies insulana). Boisd val. using three bioinsecticides Bt, spinosad and Neem-Azal, J. of Entomol., 7(2):89-94.

Nasr, M. Hoda and E. H. El-Kasser 2013. Toxicological studies on cotton mite *Tetranychus urticae*. Egy. J. plant pro. Res. 1(4), 107-136

Ragavendran and Natarajan 2015. Control of the carmine spider mite *Tetranychus cinnabarinus* boisduval by the predatory mite *Phytoseiulus persimilis* (Athias-Henriot) in protected strawberries in Aydın, Turkey. Turk. J. Agric. For., 29: 269-265.

Ratnakar, V. and G. Veeranna 2022. Management of pink bollworm, *Pectinophora gossypiella* (Saunder) in cotton. Indian J. of Entomol. 84(4):903-905.

Salah El- din, H., E. F. El-Khayat, A. M. Rashad, A. M. Shwams El-Dibn and T. R. Abdel- Zaher 2020. Toxicological and biological effects of jojopa and flaxseed oils agaist pink bollworm, *Pectinophora gossypiella* (Saunder) and spiny bollworm, *Earias insulana* (Boisd). J. of Plant Pro. and Path., Mansoura Univ., 11(9): 461-466.

Salama, M. A., M. A. A. Abdel-Baki, J. B. A. El-Naggar and E. Y. El-Nacar 2013. Efficiency of some insecticides sequence on cotton bollworms and histopathological effecta of some biocidis on pink bollworm larvae. Egypt. J. Agric. Res. 91(2): 429-448.

Sekeroglu, 1997. Toxicity of spirodiclofen to the predatory mite, *Amblyseius womersleyi* (Acari: Phytoseiidae) and its prey, *Tetranychus urticae* (Acari: Tetranychidae). J. Entomol. Sci., 42: 44-51.

Somaa, H. M. 2021. Evolution of sequences certain insecticides groups and biocide application on cotton bollworm, associated predators and cotton yield in cotton field Egypt. Annals of Agric. Sce. Moshtohor. 59(2):557-562.

Srivastava, D. F., H. Mrdne and S. Fesfw. 2009. A review of the major biological approaches to control the worldwide pest *Tetranychus urticae* (Acari: Tetranychidae) with special reference to natural pesticides: Biological approaches to control *Tetranychus urticae*. J. Pest Sci., 87: 351-336.

Tarikul, I. 2019. Comparative toxicities of novel and conventional acaricides against different stages of *Tetranychus urticae*Koch (Acarina: Tetranychidae). J. Saudi Soc. Agric. Sci., 46: 151-146.

Ullah, Ml, N. Altaf, M. Afzal, M. Arshad, N. Mehmood and M. Riaz 2019. Effect of entomopathogenic fungi on the biology of *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) and its Reduviid predator, Rhynocoris marginatys(Heteroptera:Reduviidae). Int. J. Insect Sci. 11:1-7.

Verma, S. K., D. R. S. Jeewesh, S. Saurabh and Y. Nirvaesh 2017. Population dynamics of pink bollworm, *P. gossypiella* (saunders) in cotton crop. Int.. J. of Pure and Applied Bioscience. 5(2):801-806.

Yun, Z. C., G. Dfect and F. Agrmn 2017 . Toxicity of pesticides to *Tetranychus urticae* Koch (Acari:Tetranychidae) and their side effects on *Neoseiulus californicus* (Acari:Phytoseiidae). Int. J. Acarol., 41: 688-693.

Zandi-Sohani and Ramezani 2015. Biological control of *Tetranychus cinnabarinus* by *Phytoseiulus persimilis* on greenhouse cultivars. IOBC/WPRS Bull., 20: 115-210.

الملخص العربي

الثبات الحقلي لبعض المركبات تجاة العنكبوت الاحمر ذو البقعتين ودودة اللوز القرنفلية علي نباتات القطن

[1]عبدالسلام عبدالسلام فرج ، [2]عماد عبدالغفار الشامي ،[1]حمدي عبدالرحيم عبدالرحمن
[1]معهد بحوث وقايه النباتات.مركز البحوث الزراعيه
[2]–كليه الزراعة. جامعه الازهر فرع اسيوط قسم الحيوان الزراعى والنيماتودا

يعتبر العنكبوت الاحمر ودودة اللوز القرنفليه من اهم الافات التي تصيب محصول القطن وتسبب اضرار بالغه للاوراق والازهار والثمار مما تؤدي الي خساره فادحة بالمحصول.ولذلك تم اجراء التجارب الحقليه والمعمليه بمحطه البحوث الزراعيه بسخا-كفر الشيخ خلال مسمي 2021-2022 لتقييم التاثير السام لخمسة مركبات (مركب حشري بيتا سفلوثرين) ثلاثه مركبات حيويه (ايمامكتين بنزوات-باسيلس ثورينجينسيس- بوفريا باسيانا) و زيت نباتي (زيت الياسمين) ضد العنكبوت الاحمر ودودة اللوز القرنفليه. أظهرت النتائج ان ايمامكتين بنزوات كان اعلي المركبات تاثيرا مما ادي الي نسبه انخفاض عاليه تمثل 95.59و96.69 % للعنكبوت خلال الموسمين علي التوالي و70.45 و71.60 % لدودة اللوز ايضا خلال الموسمين علي التوالي. يليه بيتا سفلوثرين وبوفاريا وبكتيريا باسيلسز بينما زيت الياسمين كان اقل تاثيرا بنسبه انخفاض 33.8 و33.79 % لملا من الاكاروس ودوده اللوز القرنفليه خلال الموسم الاول علي التوالي. اوضحت النتائج بعدم وجود فروق معنويه بين مختلف المركبات خلال موسمي الدراسه. بينما في التقيم المعملي للمركبات وجد ان بيتا سفلوثرين اكثر فعاليه بقيمه 2.61 و1.45 LC_{50} جزء في المليون علي الطور الكامل والبيض علي التوالي للاكاروس يليه ايمامكتين وبوفاريا باستخدام تكنيك غمر القطاعات النباتية وبينما وجد اعلي المركبات تاثيرا علي دوده اللوز القرنفليه بيتا سفلوثرين بمعدل تاثير 2.99 LC_{50} جزء في المليون واقل المركبات تاثيرا فطر بوفاريا 64100 LC_{50} جزء في المليون باستخدام طريقه معامله البيئه الصناعيه. وعلي ذلك اوضحت النتائج ان بدائل المبيدات تسببت في التاثير علي الاكاروس ودوده اللوزالقرنفليه مقارنه بالكنترول وممكن استخدام هذه البدائل في برامج المكافحه المتكامله.