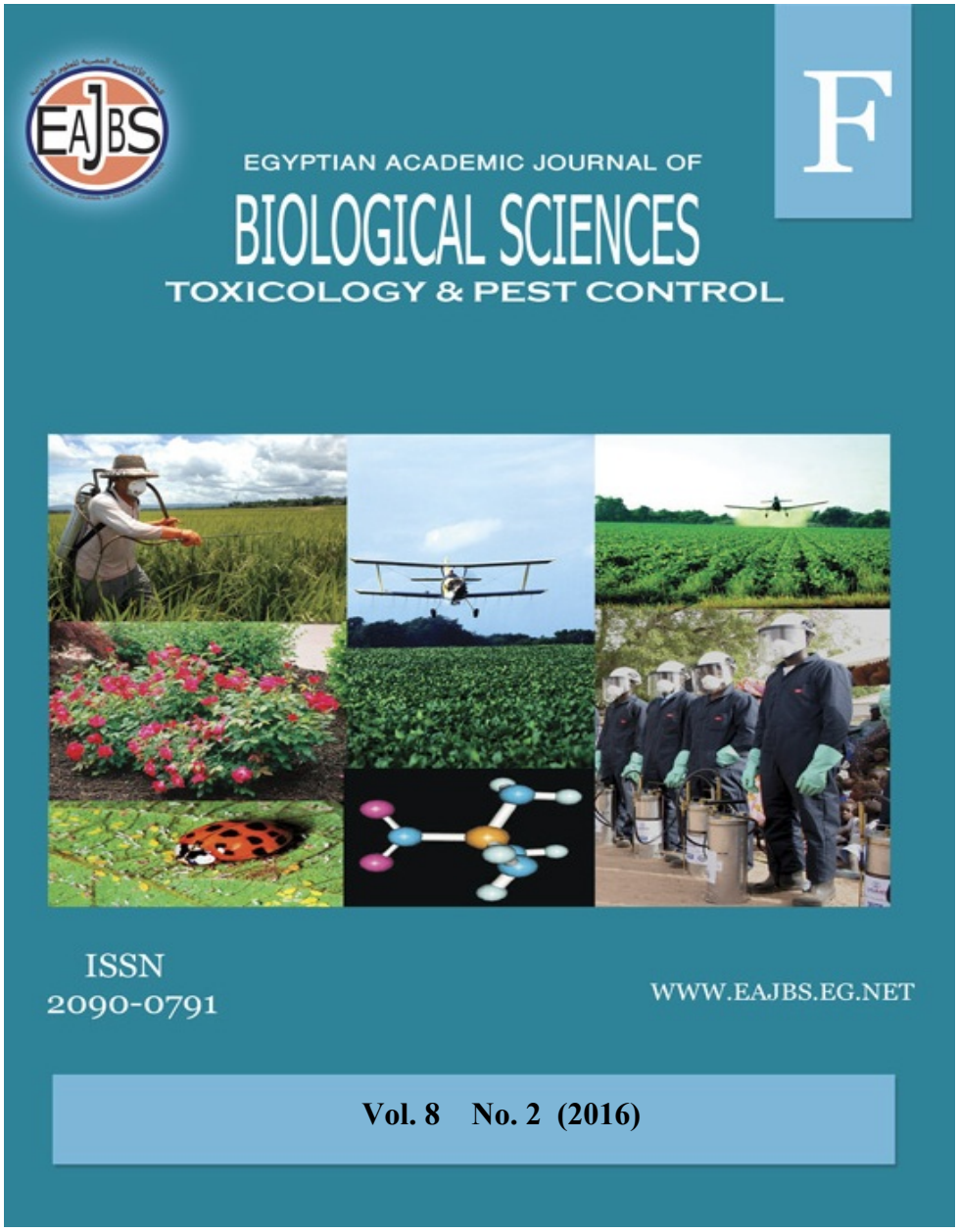

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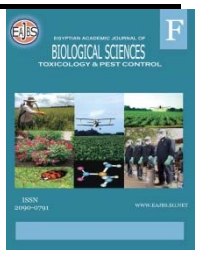

Monitoring Effects of Pheromone with Some Bio and Chemical Insecticides in Controlling *Heliothis armigera* on Tomato Plant

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ABSTRACT

The field experiment was carried out for the control of tomato fruit borer (*Heliothis armigera*) during the period from March 2013 (spring season) to June 2013 (summer season) to evaluate effectiveness of some bio-chemical insecticides with pheromone and Egg parasitoid of *Trichogramma* against mal moth of *H. armigera* to pest management practice in tomato. Also, in this study was evaluated the efficacy spinosad treatment on the same insect in two varieties from tomato plant (Supper strean and Casle rock) through the period of (29/6/2014 to 16/9/2014). Data were taken as number of fruit borer larvae (mal moths/trap/week). The results indicated the treatments (Neem + *Trichogramma* + pheromone) was more efficient than all treatments which was given mean number 3.64/trap, but (Mineral oil + *Trichogramma* + pheromone) was lowest efficient recorded mean number 12/trap, compassion with control 14.5/trap in spring plantation 2013. But in summer season the treatment (Mineral oil + *Trichogramma* + pheromone) was more efficient which recorded 4.00/trap and (Chemical + pheromone) was less efficient recorded 22.82/trap. In this study the efficacy of Spinosad treatment on supper streann was higher than casle rock. Which given numbers mean 2.00 comparing 2.5 for casle rock. Finally the use botanical neem and mineral oil with *Trichogrammma* and pheromone showed high efficiency on (*Heliothis armigera*). Also, the results indicate that it can recommend use spinosad treatment on supper streann

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) belongs to the family *Solanaceae* is one of the most popular and important vegetable crop. Tomato is susceptible to insect attack from seedling to fruiting stage. All parts of the plant including leaves, stems, flowers and fruits are subjected to attack. Tomato is attacked by a number of pests including Tomato fruit worm *Helicoverpa* (= *Heliothis*) *armigera*) larvae of fruit worm are polyphagus it can attack tomato fruit at any stage of growth decreasing its market value (Gajete *et al*. 2004). The production and productivity of the tomato crop is greatly hampered by the fruit borer, *H. armigera* which causes damage to developing fruits and results in yield loss ranging from 20 to 60% (Tewari and Krishnamoorthy, 1984; Lal and Lal, 1996).

Due to wider host range, multiple generations, migratory behavior, high fecundity and existing insecticide resistance this insect became a difficult pest to tackle (Hussain *et al*., 1991 and Ahmed *et al.,* 2000). Tomato fruit borer *Heliothis armigera* (Hub.) has been identified as a major pest of tomato in many countries of the world and cause damage to the extent of about 50-60 per cent fruits (Singh and Singh, 1977). Tomato fruit borer is a versatile and widely distributed polyphagous insect, belonging to the family Noctuidae of the order Lepidoptera. Parasitoids, *Trichogramma chilonis* are well known due to efficiency and multiplication (Parra and Zucchi, 2004). The success behind the *Trichogrammma* is their dispersal. They rapidly dispersed in the field and attack the target organism (Jeffrey *et al.*, 2012). Insecticides used for the management of insect pests of different crops, caused the resistance and resurgence development in insects as well as environmental and health hazards. Due to that, integrated pest management (IPM) trends replaced insecticidal management. Similarly, *H. armigera* populations were managed through host plant resistance along with other methods such as botanicals and insecticides application (Lukefahr, 1981). The indiscriminate use of synthetic chemical pesticides to control this pest resulted in development of resistance and harmful pesticide residues in fruits (Armes *et al.,* 1992, 1994). Management of *Helicoverpa armigera* relies heavily on insecticides, often to the exclusion of other methods of management. A number of insecticides have been found reported to be effective for controlling *H. armigera* on pigeonpea (Ujagir, 2000). Organophosphates and pyrethroids insecticides are still used for *H. armigera* control, but their use may be eliminated with the introduction of several new insecticides (e.g. spinosad, abamectin, Pyriproxyfen, indoxacarb) (Razaq *et al*., 2007). Insecticides are currently the key of *H. armigera* management in almost all cropping systems around the worldwide (Yang *et al*. 2005). Natural pesticides are good alternative to synthetic pesticides because they are safe to environment, natural enemies, humans and other animals, e.g. most botanical pesticides have low to moderate mammalian toxicity (Hassan, 1992). The main objective of study is the determination of the efficacy of four bio-insecticides and one chemical insecticide with pheromone and *Trichogramma* were evaluated for their effectiveness in the control of *Heliothis armigera* infesting tomato plant in the field.

MATERIALS AND METHODS

This experiment was conducted in the field of Etay-El-baroud Agriculture Research station, Beheira Governorate, during the period from March 201٣ (spring season) to June 2013 (summer season) to evaluate some bio-chemical insecticides against mal moth of (*Heliothis armigera*) to pest management practice in tomato. But the experiment of evaluate the efficacy the spinosad treatment on the same insect in two varieties from tomato plant (supper strean and casle rock) through the period of (29/6/2014 to 16/9/2014). The materials and methods used for conducting the experiment were presented in this paper under the following headings:-

Chemical insecticides

Chlorantraniliprole 20% E.C. a.i (trade name: Coragen) rate of application (60ml/feddan) were obtained from Dow Agro Science Company Cairo Egypt.

Bio-insecticides

(*B.t*) *Bacillus thuringiensis* var. *kurstaki*, 33 × 106 C.F.U/1ml, rate of application (4800 ml/ feddan); Azadirachtin 4.5% E.C. a.i (trade name Neemix) rate of application (75 ml

a.i/100ml water; Petroleum derivative (trade name Mineral oil) rate of application (120 ml/ feddan) were obtained from Plant Protection Research Institute, Agriculture Research Center, Cairo, Egypt; Spinosad 24% SC a.i and 25% WG a.i (trade name Tracer) rate of application (35 ml/feddan) was obtained from Dow Agro Science Company Cairo Egypt.

Pheromone used (3E, 8E, 11Z –14 AC (C16 H26 O2), (E, Z, Z) –3, 8, 11– Tetradecatrienyl acetate was obtained from Plant Protection Research Institute, Agriculture Research Center, Cairo, Egypt.

Egg parasitoid of *Trichogramma*

(70 to 75 adult/ m^2) were implemented according to **(Gaffar, 2013 &Cabello *et al*., 2009)**. The rate of release of each treatment was (136000 individuals/release/182 m^2, divided into 5 paper cards; each card contained almost 3000 individual) use 3 replicates and the distance between the cards 6 meters was obtained from Plant Protection Research Institute, Agriculture Research Center (ARC), Cairo, Egypt.

Pheromone trap

For conducting the present study, water trap (YWPT) was used. It consists of rectangle plastic frame each side measuring 35 x 25 cm long and 6 cm deep. Every trap baited with one capsule containing 2mg of mixture of *Heliothis* pheromones. Traps were positioned at 20 cm above the crop. Pheromone capsules were changed and replaced by new one every 7 days. The trap is filled with soapy water which acted as a catching where as the soap watering. Trap was renewed every week and increased some water to overcome the evaporation of water, every 7 days checked and the numbers of captured adult males were counted.

Tomato varieties

In this experiment the following tow tomato varieties were used in the present studies supper 55 and supper 550. These varieties are commonly cultivated in Egypt for local consumption.

Design and Layout of the Experiment:

In this respect area of about 700 m^2 was chosen to be cultivated by two varieties of tomato, supper 55 and supper 550. All area was divided into 12 plots. The plots were arranged in completely randomized blocks design with two varieties and each variety was replicated three times. The layout of the experiment was prepared for distributing the treatment combinations in each plot of each block. The samples were kept in a tightly closed paper bags and transferred to the laboratory in the same day for inspection by the binocular microscope. All plots received normal agriculture practices and were kept free of any insecticides treatments.

Treatments:

Six treatments (A, B, C, D, E and F) were used for tested five integrated programs for controlling *Heliothis armigera*: (1) *bacillus thuringiensis* + Trichogramma + pheromone, (2) Neem + Trichogramma + pheromone, (3) Spinosad + Trichogramma + pheromone, (4) Mineral oil + *Trichogramma* + pheromone, (5) Chemical + pheromone and (6) control. Each treatment was planted with 750 tomato seedlings (= 10000 plants/feddan). Usage rates were 200g *B.T*/f + three Trichogramma cards *Trichogramma* + pheromone, 75ml Neem /100ml + three Trichogramma cards + pheromone, 120ml Mineral oil /f + three Trichogramma cards + pheromone, 60ml coragen 20% /f + three Trichogramma cards + pheromone and control.

Statistical analysis:

The data was subjected to analysis of variance (ANOVA) and the means were compared by L.S.D. test at 0.05 levels, using SAS program (SAS Institute, 1988).

RESULTS AND DISCUSSION

Effect of treatments in controlling *Heliothis armigera* on tomato plants.

The results in Tables (1, 2) and Figures (1, 2) indicated that there were significant differences in efficiency between treatments in the two plantations, spring and summer, 2013. The treatments C (Neem + *Trichogramma* + pheromone) was more efficient than all treatments, which was given mean number 3.64/trap, while treatments, (Spinosad + *Trichogramma* + pheromone), (*BT* + *Trichogramma* + pheromone), (Chemical + pheromone) and (Mineral oil + *Trichogramma* + pheromone) gave mean number 4.45, 5.00, 8.00 and 12.00 respectively in spring plantation 2013.

Table 1: Weekly number of *H. armigera* male moth on tomato plants after use sex pheromone trap catches during spring plantation, 2013.

Mean Number of mal moths/trap/week						
Inspection Date	**A**	**B**	**C**	**D**	**E**	**F**
15/3/2013	-	1	1	1	1	2
22/3	-	-	-	1	3	4
29/3	-	2	1	2	4	6
7/4/2013	-	1	1	2	4	6
14/4	2	3	2	2	5	7
21/4	2	3	2	3	8	10
28/4	4	2	1	4	10	13
5/5/2013	5	4	2	3	12	16
13/5	9	7	5	7	16	21
20/5	11	5	6	10	23	26
27/5	14	9	8	11	27	29
4/6/3013	17	12	11	14	31	34
Total	**64**	**49**	**40**	**60**	**144**	**174**
Mean	**8.00**	**4.45**	**3.64**	**5.00**	**12.00**	**14.50**
F.value	**177.70**					
L.S.D0.05	**0.698**					
S.E	**0.138**					

A = insecticide treated field (Chemical + pheromone), B = biological control field (spinosad + Trichogramma + pheromone), C = biological control field (Neem + Trichogramma + pheromone), D = biological control field (BT + Trichogramma + pheromone), E = biological control field (Oil+ Trichogramma + pheromone), F = Control

Table 2: Weekly number of *H. armigera* male moth on tomato plants after use sex pheromone trap catches during summer plantation, 2013.

Mean Number of mal moths/trap/week						
Inspection Date	**A**	**B**	**C**	**D**	**E**	**F**
15/3/2013	-	-	1	-	6	7
22/3	-	-	2	1	10	12
29/3	-	5	5	4	18	16
7/4/2013	3	5	5	٥	17	18
14/4	4	3	4	5	18	19
21/4	4	2	5	٤	20	17
28/4	3	3	6	4	21	23
5/5/2013	6	5	4	7	27	32
13/5	4	2	8	3	28	37
20/5	7	4	5	5	23	24
27/5	6	3	6	4	18	22
4/6/3013	5	4	5	6	18	23
Total	**42**	**36**	**56**	**48**	**224**	**250**
Mean	**22.82**	**20.36**	**4.80**	**5.09**	**4.00**	**5.25**
F.value	**163.66**					
L.S.D0.05	**0.581**					
S.E	**0.158**					

A = insecticide treated field (Chemical + pheromone), B = biological control field (spinosad + Trichogramma + pheromone), C = biological control field (Neem + Trichogramma + pheromone), D = biological control field (BT + Trichogramma + pheromone), E = biological control field (Oil+ Trichogramma + pheromone), F = Control

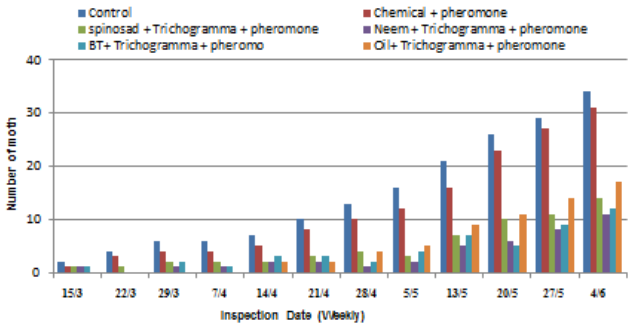

Fig. 1: Weekly number of *H. armigera* male moth on tomato plants after use sex pheromone trap catches during spring season plantation, 2013.

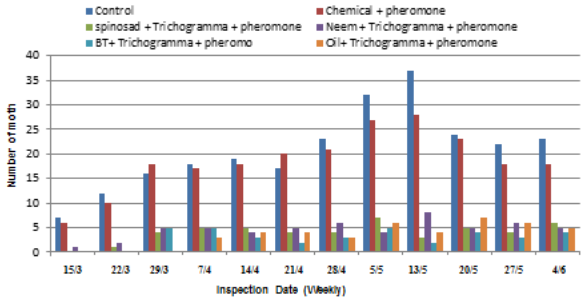

Fig. 2: Weekly number of *H. armigera* male moth on tomato plants after use sex pheromone trap catches during summer plantation, 2013.

The treatment (Mineral oil + *Trichogramma* + pheromone) was more efficient than all treatments, which recorded the average number 4.00/trap, while treatments (Neem + Trichogramma + pheromone), (BT + Trichogramma + pheromone), Control, (spinosad + Trichogramma + pheromone) and (Chemical + pheromone), gave 4.80, 5.09, 5.25, 20.36 and 22.82, respectively, in summer plantation 2013.

Data in Table (3) summarized the relative comparison between the treatments, for populations of *Heliothis armigera* male moth captured in sex attractant traps during spring and summer plantation, 2013.

Table 3: Comparisons with pheromone trap catches of *Heliothis armigera* moth on tomato plants during the spring and summer plantation, 2013

Treatment	Plantation, 2013			
	Spring		Summer	
	Total/ season	Mean/ one week	Total/ season	Mean/ one week
Chemical + pheromone	64	8.00	42	22.82
Spinosad + Trichogramma + pheromone	49	4.45	36	20.36
Neem + Trichogramma + pheromone	40	3.64	56	4.80
***BT*+ Trichogramma + pheromone**	60	5.00	48	5.09
Mineral Oil + Trichogramma + pheromone	144	12.00	224	4.00
Control	174	14.50	250	5.25

Our view has been supported by Mehta *et al* (2010), studied the role of Nimbicidine, Neemzal in the suppression of *H.armigera* larval population in the tomato field. Neem seed kernel extract (NSKE 5%) was found most effective in reducing the larval population and pod damage by Prasad and Roy (2011). Abbas and El-Dakroury (1988) and Ali & Young (1996) observed that the susceptibility of *Helicoverpa* to both conventional and biological insecticides

tends to decline with increasing age and size. Janardhan *et al* (1999) reported antifeedent and insecticidal properties of certain plant extracts against *H.armiger*a. Azadirachtin interaction with developpment of *H. armigera* was recorded growth inhibitory and antifeedent activity of extracts from *Melia dubia* by Koul *et al* (2000). The results of this study are in conformity with Ravi *et al*., (2008) found that application of microbial and neemazol were equally effective as that of the sequential application of synthetic chemical insecticides, e.g. Endosulfan, Quinolphos and Indoxacarb in reducing *H. armigera* larval population and fruit damage. Also, Ravi *et al*., (2008) who reported that indaxacarb when tested with some other biopesticides reduced the population of *H. armigera* (Hubner) from 10.75 to 0.75 after 1 spray and it was rapid in action. Chowdary *et al.* (2010) who reported that chlorantr-aniliprole 20 SC was effective against okra fruit borer, *H. armigera* at 30 g a.i. ha-1 and 20 g a.i. ha-1. Also, this results agreement with (Chari *et al.*, 1995) showed that some of the microbial were effective for the control of *H. armigera* which included bacteria, *B. thuringiensis.* Spinosad allowed natural parasitism by *Trichogramma* sp. Aspect of biological activities of Spinosad to larvae of *H. virescens* and other lepidopteran insects were described by Sparks *et al.* (1995). These results are in similarity with those of (Davies *et al.*, 2011) who reported the efficiency of *Trichogramma westwood* on *H. armegera* in cotton crop and suggested that *Trichogramma* alone can also give good result but if it combined with other control strategy so the efficiency will be ncreased, an integrated pest management (IPM) strategy was used. Cabello *et al.* (2012) used *Trichogramma* cards in green house for management of another lepidopterous borer (South American tomato pinworm) and found it very effective. Also, Alam *et al.* (2012) evaluated IPM package (weekly release of egg parasitoid *Trichogramma evanescens,* larval parasitoid *Bracon hebetor* and use of pheromone trap) against fruits borers of late winter tomato. They observed that IPM package resulting 74.5% reduction of fruit infestation over non-IPM package (spraying of Proclaim 5SG1g l^{-1}).

Effect of Spinosad treatment on *Heliothis armigera* in two varieties of tomato crop fruits:

Effect on number of *Heliothis armigera* male moths.

Data in tables (4, 5) and Figures (3, 4) showed the efficacy the Spinosad treatment on mal moth of *Heliothis armigera* on two Tomato varieties, supper strean and casle rock through the period of (29/6/2014 to 16/9/2014), on the basis of mean number of male moths /trap/week.

Table 4: Effect of Spinosad on number male moth of *H. armigera* in tomato plant of one varietie (supper strean) after infections.

Inspection Date	Mean number of male moths/trap/week (*H. armigera*)	
	Spinosad treatment	Control
29/6/2013	0	9
6/7	0	14
13/7	1	25
20/7	2	31
27/7	1	29
4/8	1	32
11/8	2	33
18/8	3	36
25/8	4	39
2/9	5	41
9/9	6	43
16/9	5	45

Table 5: Effect of Spinosad on number male moth of *H. armigera* in tomato plant of one varietie (casle rock) after infections.

Inspection Date	Mean number of male moths/trap/week (*H. armigera*)	
	Spinosad treatment	Control
29/6/2013	0	0
6/7	0	15
13/7	1	27
20/7	1	33
27/7	3	35
4/8	2	33
11/8	2	36
18/8	3	39
25/8	4	41
2/9	1	43
9/9	5	47
16/9	3	49

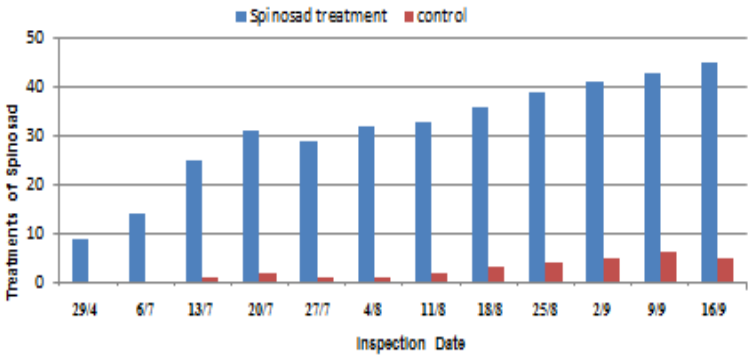

Fig. 3: Effect of Spinosad on number male moth of *H. armigera* in tomato plant of one variety (Supper strean) after infections.

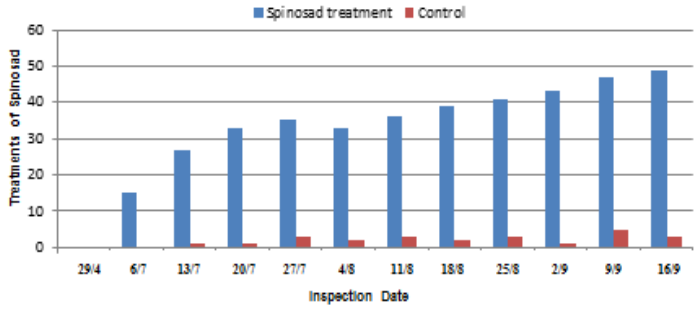

Fig. 4: Effect of Spinosad on number male moth of *H. armigera* in tomato plant of one varieties (Casle rock) after infections.

The results indicated the efficacy of the treatment on supper streann was higher than casle rock. Which given number means 2.00 comparing 2.5 for casle rock.

The results indicate also, that it can recommend use the treatment on supper streann. These results are in agreement with Ghosh *et al*., (2010) who reported that Spinosad 73 to 84 gm a.i. /ha was effective against *H. armigera* on tomato than Quinalphos, Lambda cyhalothrin and Cypermethrin. Similar results were also obtained by Reddy *et al*. (2007) who reported that Spinosad 45% SC 0.3 and 0.2ml was the best treatment against pod borers followed by Indoxacarb 14.5% SC 1.0 and 0.5ml. Our present findings on the efficacy of Spinosad are similar with the findings of Sidde Gowda *et al*. (2003). Nannini *et al*., (2011) found that

in all tests, Spinosad proved to be highly effective against tomato borer larvae.

REFERENCES

Abbas, M.S. and El-Dakroury, M.S.I. (1988). Laboratory investigation on efficacy of polyhedrosis virus and a viral pesticide on different larval instars of *Heliothis armigera* HBN. Agricultural Rese. Review 66: 47-53.

Ahmed, K., A.S. Qureshi and F. Khalique, 2000. Effect of environmental factors on pheromone trap catches of chickpea pod borer, *Helicoverpa armigera* (Hub.) from 1983 to 1998. *Proc. Pakistan Acad. Sci.,* 37: 227-38.

Alam, S.N., N.K. Dutta, A.K.M.Z. Rahman, M. Mahmudunnabi and M.A. Rahman. (2012). Management of fruit borer pests attacking later winter tomato at panchagarh region. Annual Report 2011-2012, Entomology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701. 217.

Ali, A. and Young, S.Y. (1996). Activity of *Bacillus thurigiensis* Berliner against different ages and stages of *Helicoverpa zea* (Lepidoptera: Noctuidae) on cotton. J. Entomological Science, 31: 1-8.

Armes, N.J., D.R. Jadhav, G.S. Bond and A.B.S. King, (1992). Insecticide resistance in *Helicoverpa armigera* in South India. *Pesticide Sci.,* 34: 355-364.

Armes, N.J., S.K. Banerjee, K.R. DeSouza, D.R. Jadhav, A.B.S. King, K.R. Kranthi, A. Regupathy, T. Surulivelu and N. Venugopal Rao, (1994). Insecticide resistance in *Helicoverpa armigera* in India: Recent developments. In: Proceedings of the Brighton Crop Protection Conference - Pests and Diseases, Thronton Heath, UK, British Crop Protection Council Publications, pp: 437-442.

Cabello, T., Gallego, J.R., Fernandez, F.J., Gamez, M., Vila, E., Pino, M.D. and Hernandez, S.E. (2012). Biological control strategies for the South American tomato moth (Lepidoptera: Gelechiidae) in greenhouse tomatoes. *J. econ. Ent*., 105:2085-2096.

Chari, M.S., S.G. Rao and G. Raghupati. (1995). Relative efficacy of *Bacillus thuringiensis* formulation against gram pod borer *H. armigera* Hub. on chickpea. Paper presented at National Seminar on IPM in Agriculture held at Nagpur (India) in Dec. 29-30, 25.

Chowdary Rajesh L, Bheemanna M and Ranjith kumar L. 2010. Bioefficacy of rynaxypyr (Coragen) 20 SC against fruit borer *Helicoverpa armigera* (Hubner) in okra. International Journal of Plant Protection 3(2): 379-381.

Davies, A.P., Carr, C.M., Scholz, B.C. and Zalucki, M.P. (2011). Using *Trichogramma* Westwood (Hymenoptera: Trichogrammatidae) for insect pest biological control in cotton crops: an Australian perspective. *Aus. J. Ent.,* 50: 424-440.

Gaffar, S. (2013). Relative comparison between parasitization efficiency of three Trichogramma species versus eggs of tomato leafminer moth, *Tuta absoluta* (Meyrick) on tomato greenhouse in Egypt. The Eleventh of Agricultural Development Research 27-30 March, 2012. Ain Shams Univ., Faculty of Agriculture. 168 -169.

Gajete TD, Gajete LB, Irabagon JR, Tiburcio EB. (2004). Technoguide for tomato production. In: Technoguides for Agric. Production and Livelihood Projects. CLSU Res. Office, RET, Science City of Muñoz, Nueva Ecija, 58-65.

Ghosh, A., chatterjee, M. and roy, A. (2010). Bio-efficacy of spinosad against tomato fruit borer (*Helicoverpa armigera* Hub.) (Lepidoptera: Noctuidae) and its natural enemies. *J. Horti. Forestry*., 2(5): 108-111.

Hassan, S.A. (1992). Guideline of the side-effect of plant protection product on Trichogramma chilonis. In: Guideline for Testing the Effect of Pesticides on Beneficial Organism, (ED) Hassan, S.A. IOBC/ WPRS Bullet., 15(3):19-39.

Hussain, T., M.A. Talpur and G.D. Tunio, (1991). Relative toxicity of pyrethroid insecticides to gram pod borer. *Proc. 11th Pakistan Cong. Zool.,* 11: 119-22.

Janardhan, S., Chitra, K.C.,Kameswara, R.P. and Subramaniyam, R.K. (1999). Antifeedent and insecticidal properties of certain plant extracts against *H. armigera*. Journal of Insect Science 5:163-164.

Jeffrey, G., Wright, M.G., Thomas, P.K., Sylvie, A.P. and Michael, P. H. (2012). Dispersal of *Trichogramma ostriniae* in field corn. Biol. Sci. Tech., 22: 1221-1233.

Koul, O., Jain, M.P. and Sharma, V. K. (2000). Growth inhibitory and antifeedent activityof extracts from *Melia dubia* to *S.litura* and *H. armigera* larvae, Indian J. Experimental Biology, 38(1):63-68.

Lal, O.P. and S.K. Lal (1996). Failure of control measures against *Heliothis armigera* infesting tomato in heavy pesticidal application areas in Delhi and satellite towns in Western UP and Haryana. *J. Entomol. Res.,* 20(4): 355-364.

Lukefahr, M. (1981). A review of the problems, progress, and prospects for host-plant resistance to *Heliothis* species. International Workshop on *Heliothis* Management. Icrisat, India. *Heliothis* Management, pp. 223-231.

Mehta, K.S; Patyal, S.K. ;Rana. R.S. and Sharma K.C. (2010). Ecofriendly techniques for the management of *H. armigera* (Hübner) in tomato. Journal of Biopesticides 3(1):296-303.

Nannini, M., F. Foddi, G. Murgia, R. Pisci and F. Sanna (2011). Insecticide efficacy trials for management of the tomato borer *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), a new tomato pest in Sardinia (Italy). *Acta Horticul.*, 917: 47-53.

Parra, J.R. and Zucchi, R.A. (2004). Trichogramma in Brazil: feasibility of use after twenty years of research. Neo. Ent., 33: 271-281.

Prasad, A and Roy. S.B (2011). Histoarchitrchural alteration in the mid gut tissue of fourth instar larvae of gram pod borer *Helicoverpa armigera*(Hub) Fed with leaf extract of plant Lantana camara (L). International *J. Pharma and Bio Sciences*, 2(1): 613-620.

Ravi, M., Santharam, G. and Sathiah, N. 2008. Ecofriendly Management of Tomato Fruit Borer *Helicoverpa armigera* (Hubner). Journal of Biopesticides, 1(2):134-138.

Razaq, M., A. Suhail, M.J. Arif, M. Aslam, and A.H. Sayyed, (2007). Effect of rational use of insecticides on pyrethroids resistance in *Helicoverpa armigera* (Lep. Noctuidae). J. Appl. Entomol., 131(7): 460-465.

Reddy, A. V., Sreehari, G. and Kumar, A. K., 2007, Efficacy of certain new insecticides against pest complex of chilli (*Capsicum annum* L.). *Asian J. Horti*., 2(2): 94-95.

SAS Institute, 1988. SAS/STAT Users Guide, ver. 6.30. SAS Institute Inc. CryNarolina.

Sidde Gowda DK, Yelshetty S. and Patil BV. (2003). Spinosad 45 SC: An effective insecticide against pigeonpea fruit borer, *Helicoverpa armigera* (Hubner). Pestology 27(11): 21-22.

Singh, H. and G. Singh (1977). Biological studies on Heliothis armigera Hubner in Punjab. Indian J. Entomology, 37(2): 154-164.

Sparks TC, Thompson GD, Larson LL, Kirst HA, Jantz OK, Worden TV, Hertlein MB. and Busacca, JD. (1995). Biological characteristics of the spinosyns: a new naturally derived insect control agents. Proceedings Beltwide Cotton Conferences, San Antonio, USA 2: 903-907.

Tewari, G.C. and P.N. Krishnamoorthy. (1984). Yield loss in tomato caused by fruit borer. Indian J. Agricult. *Sci.,* 54: 341-343.

Ujagir R. (2000). Field efficacy of insecticides against pod borer complex in early pigeonpea (*Cajanus cajan* (L.) Millsp. at Pantnagar, North India. Annals of Plant Protection Sciences 71: 19-25.

Yang E., Y. Yang, S. Wu and Y. Wu, (2005). Relative contribution of detoxifying enzymes to pyrethroid resistance in a resistant strain of *Helicoverpa armigera*. J. Appl. Entomol., 129: 521-525.

ARABIC SUMMERY

رصد تاثير الفرمون مع المبيدات الحيوية والكيماوية للتحكم فى دودة اللوز الامريكية على نباتات الطماطم

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٣- معهد بحوث وقاية النباتات- الدقي -مركز البحوث الزراعية بالقاهرة

تعد الطماطم (*Lycopersicon esculentum*) من محاصيل الخضروات المهمة والرئسية فى العالم وفى مصر وشمال افريقيا والتى تعود الى العائلة الباذنجانية Solanaceous . وتسبب آفة حافرة الطماطم توتا ابسليوتا اضرارا بالغة لنباتات الطماطم كما تصيب ايضا العائلة الباذنجانية . يهدف هذ البحث الى اسنخدام طرق مختلفة باستخدام بدائل المبيدات الحشرية وتشمل الفرمونات الجنسية (مصائد فرمونية) ،طفيليات بيض التريكودرما ،المبيدات الميكروبية والمستخلصات النباتية والتى استخدمت بالتكامل فيما بينهما مع مصائد دلتا لاستكشاف مستوى التعداد الحشرية وتم استخدام ست مساحات لهذة المعاملات تابعة لمحطة بحوث ايتاى البارود – مركز البحوث الزراعية مساحة كل منها ١٧٥م٢ نفذت طرق المكافحة خلال فصل الصيف عام 2013 . تم تقييم فعالية طرق المكافحة على اساس نسبة خفض الاصابة فى يرقات الافة وذالك بعد فترات ٢ ، ٥ ، ٧ ، ١٠ يوم من كل معاملة . (١) اظهرت النتائج اختلاف في الكفاءة بين المعاملات للعروتين الربيعى والصيفى،٢٠١٣ وجاءت المعاملة (تراسر+ طفيل التريكوجراما + الفرمونات الجنسية) أكثر كفاءة من المعاملات الاخرى، حيث أعطى ٤.٥ فراشة/مصيدة يلية (دايبلx٢+ طفيل التريكوجراما + الفرمونات الجنسية) يلية (نيمكس + طفيل التريكوجراما + الفرمونات الجنسية) يلية (كوراجن ٢٠% + طفيل التريكوجراما+ الفرمونات الجنسية) يلية (الزيت المعدنى+ طفيل التريكوجراما+الفرمونات الجنسية) حيث اعطى ٥.٥٣، ٥.٨٤، ٩ و ٢٣.٧٦ فراشة/مصيدة على التوالى مقارنة بالكنترول ٢٩.٨٤ فراشة/مصيدة فى العروة الربيعى، وايضا (تراسر+ طفيل التريكوجراما + الفرمونات الجنسية) اكثر كفاءه فى العروة الربيعى 7.00 فراشة/مصيدة يلية (كوراجن ٢٠% + طفيل التريكوجراما+الفرمونات الجنسية) يلية (دايبلx٢ + طفيل التريكوجراما + الفرمونات الجنسية) يلية (نيمكس + طفيل التريكوجراما + الفرمونات الجنسية) يلية (الزيت المعدنى + طفيل التريكوجراما + الفرمونات الجنسية) حيث اعطى 7.70 ، ٨.٠٩ ، ٨.٩١ ، ٦٩.٧٣ لكل مصيدة مصيدة على التوالى للعروة الصيفى مقارنة بالكنترول ٨٩.٢٧ فراشة لكل مصيدة. (٢) اوضحت النتائج خفض الاصابة باليرقات فى العروة الصيفى مقارنة بالعروة الربيع، كما امكن ترتيب فعالية المعاملات تنازليا كما يلى (تراسر+ طفيل التريكوجراما + الفرمونات الجنسية)، (نيمكس + طفيل التريكوجراما + الفرمونات الجنسية)، (دايبلx٢ + طفيل التريكوجراما + الفرمونات الجنسية)، (كوراجن ٢٠% + الفرمونات الجنسية) يلية (الزيت المعدنى + طفيل التريكوجراما + الفرمونات الجنسية) وسجلت القيم المقابلة للخفض فى ٨٨.٣٢%، ٨٥.٧١%، ٨٤.٩١%، ٨٣.٠٠%، ٣٥.٨٠% على التوالى فى العروة الربيعى، بينما كانت فى العروة الصيفى (كوراجن ٢٠% + الفرمونات الجنسية)، (تراسر+ طفيل التريكوجراما + الفرمونات الجنسية) (نيمكس + طفيل التريكوجراما + الفرمونات الجنسية)، (دايبلx٢ + طفيل التريكوجراما + الفرمونات الجنسية)، (الزيت المعدنى + طفيل التريكوجراما + الفرمونات الجنسية). وسجلت القيم المقابلة للخفض فى التعداد كما يلى ٧٩.٨%، ٧٩.٧٢%، ٧٩.٤٣%، ٧٨.٨٠%، ٢٢.٩٢% على التوالى مقارنة بالكنترول. (٣) لم تظهر النتائج تأثر الاعداء الحيوية المتواجدة على نباتات الطماطم بالمبيدات الغير تقليدية، بينما تأثرت بالمركب الكيماوى التقليدى (كوراجن).(٤) وجد اعلى إنتاجية لمحصول الطماطم للثمار٢١.٣٢٠طن/فدان فى حالة المكافحة باستخدام تراسر+ طفيل التريكوجراما +الفرمونات الجنسية) يلية (كوراجن٢٠% + الفرمونات الجنسية) (١٩.٧) طن/فدان يلية (نيمكس + طفيل التريكوجراما + الفرمونات الجنسية) (١٧.٢) طن/فدان يلية(دايبلx٢ + طفيل التريكوجراما + الفرمونات الجنسية) (١٣.٠) طن/فدان يلية (الزيت المعدنى + طفيل التريكوجراما +ا لفرمونات الجنسية) (١٠.٩) طن/فدان. مقارنة بالكنترول (٥.٧) طن للعروة الربيعى. بينما العروة الصيفى أعلى انتاجية (١٩.٩ طن/فدان) لاستخدام (تراسر+ طفيل التريكوجراما + الفرمونات الجنسية) يلية (كوراجن ٢٠% + الفرمونات الجنسية) (١٧.٨ طن/فدان) يلية (دايبلx٢ + طفيل التريكوجراما + الفرمونات الجنسية)(١٦.٨ طن/فدان) يلية (نيمكس + طفيل التريكوجراما + الفرمونات الجنسية) ،(١٥.٩ طن/فدان) يلية (الزيت المعدنى + طفيل التريكوجراما + الفرمونات الجنسية)، (٩.٨ طن/فدان) مقارنة بالكنترول (2.9 طن/فدان) للعروة الصيفى.(٥) اظهرت النتائج ان وزن ١٠٠/ثمرة كان اعلى للعروة الربيعى عن الصيفى، واعلى وزن كان باستخدام (تراسر+ طفيل التريكوجراما + الفرمونات الجنسية)، واقل وزن كان باستخدام (الزيت المعدنى + طفيل التريكوجراما + الفرمونات الجنسية) للعروتين.(٦) اظهرت النتائج ان نسبة الاصابة للثمار كانت اعلى فى العروة الربيعى باستخدام (الزيت المعدنى + طفيل التريكوجراما + الفرمونات الجنسية) واقل نسبة اصابة كانت باستخدام (كوراجن٢٠% + الفرمونات الجنسية).(٧)– إشارت النتائج ان عدد الثمار/نبات فى العروة الربيعى كان اعلى باستخدام (تراسر+طفيل التريكوجراما + الفرمونات الجنسية)، واقل باستخدام (الزيت المعدنى + طفيل التريكوجراما + الفرمونات الجنسية).