Plant Archives Vol. 19, Supplement 1, 2019 pp. 904-907 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

BIOLOGICAL STUDIES AND CONTROL OF COTTON LEAF WORM *SOPDOPTERA LITTORALIS* (LEP: NOCTUIDAE) IN IRAQ

Musa Mahmood AL-Hasnawy
Department of Plant protection, College of Agricultural Engineering Sciences, University of Baghdad, Iraq

Abstract

Laboratory studies were conducted to investigate some biological aspects including mating behavior, timing and period rate, time of adults' emergence, number of egg masses deposition per female and cannibalism of cotton leaf worm *S. littoralis*. Results showed that pupation percent was 88%. The highest adult's emergence percent was 32% at 12-1 AM until 4 PM at 82%. About 86% of adults were emerged between 8 PM and 3 AM with 32% and 68% or males and female sex ratio, respectively. The estimated mating period was about e 68 min between 8-11 PM. The mean number of egg mass was 5-8 per female at 350-450 eggs/mass with 96.5% fertilization percent. The hatching time of egg-mass was between 8-11 PM. The cannibalism percentage and natural death of 2nd stage larvae were 16% and 5% respectively. Treatment of eggs with the biocides Spinosad and *Beauveria bassiana* decreased hatching up to 0% and 12% respectively compared to 95% for untreated control. High death percentage in larvae treated with Spinosad attained to 100% one day after treatment, while no lethal effect of *Beauveria* on larvae was observed a week of treatment. However, larvae exposed to *B. bassiana* showed low movement and poor feeding performance 2 days of treatment, then they regained their activity later on.

Key words: Cotton leaf worm, Insect behavior, biological control

Introduction

Cotton leaf worm, *Spodoptera littoralis* (Boisd), family Noctuidae, is one of the most important pests infesting Solanaceous plants in Iraq causing significant economic losses. This worm was reported to attack leaves, buds, flowers and fruits (Hussny *et al.,* 1976). *S. littoralis*is highly prevalent during the year in both protected and open field cultivation (Saleh *et al.,* 1999). The insect was reported to attack up to 27 host plants in Baghdad areas (Al-Zubaidy, 1987). The female can deposit eggs hours to two days of mating. Adults age, was reported to be short in summer season, varied from 2-7 days, as the insect is highly sensitive to temperature at all stages. The insect is very sensitive to low temperature with high mortality rate in cold season. AT the last stage the larvae pupate in the soil or plant debris. The pupae color is greenish turning to reddish brown during the time. The length of the larvae is between 18-22mm. The pupal stage ranges 5-10 days, 14-19 days 21-31 days in summer, spring, autumn, and winter respectively. The mature insect can fly 1-5 Km within 4 hrs during the night (Beagher *et al.,* 2008). Different methods were applied to control this pest including, insecticides, growth regulators and plant extracts such as black pepper (Bkr *et al.,* 2013, Al-Khazraji *et al.,* 2016). Grafton-Cardwell *et al.* (2005) indicated that the biocide Spinosad affect neuromuscular junction in the insect. The biocides have a low toxicity with short duration degradation period in the soil, harmless to insect natural enemies and can be included in integrated pest management programs (Moulton *et al.,* 2002, Pineda *et al.,* 2007). In Turkey, Spinosad was highly effective against cotton leaf worm larval stage when caused 100% mortality (Eydin and Oktay, 2006). EL-Hawary and E-Salam (2009) have tested the activity of some fungi against cotton leaf worm larvae and found that *B. bassiona, Lecanicillium lecanii* and *Paecidomyces fumosoroseus* caused mortality percent, ranged 40-87.5%, 37.5-72.5%, and 27.5-67.5%, respectively.

The objectives of this study is to determine cotton leaf worm behavior at deferent development stages and evaluate the effect of some biocides on eggs and larval stages.

Material and Methods

Insect Rearing

Cotton leaf worm egg-masses was collected from chrysanthemum leaves in green house at Plant protection Department, College of Agriculture-University of Baghdad. About 180 1st stage larvae were transferred into 30 X40X15 cm plastic containers, at three replicates (60 larvae each). Larvae were fed on alfalfa leaves were used to feed larvae and replaced every 3 days. Each container was covered with muslin and maintained at 25± 2 ºC and humidity 70 ± 5% and the nutritional behavior was observed daily until pupation. The number of pupae was recorded.

Adults Emergence Time

Pupae, in the soil and under nutrients residual, were collected from each container and placed on filter paper in 20 X 5 cm petri-plates, in three replications. The pupae were covered with a thin layer of sterilized humid mixed soil and continually observed during 24hrs using a digital camera connected to computer to determine the time of adult emergence.

Mating Behavior of the Worm

Hard paper cages, 50 x 40 x 30 cm., with four lateral opens (10 X 5 cm.) covered with muslin were prepared. 10, 4 and 1-2 days males and females were placed in each cage for the 1st, 2nd and 3rd experiments, were placed in cages, respectively. The cage, were provided with 3 flasks of water containing alfalfa stems and a glass container containing piece of cotton saturated with 20% honey solution. Alfalfa stems were changed when required. A light source and magnification lens were supplied to detect the time, duration, and mating behavior during the night. Three replicates of each treatment were used.

Estimation of Egg Mass/Female

One new emerged female and male were placed in Petri plates containing sterilized mixed soil inside a glass cage. Insects were maintained on 20% honey solution and alfalfa parts as described above. The top open of the cage was covered with muslin. The alfalfa stems were change several times and egg masses calculated continually until female death. Three replicates for each experiment were used.

Determination of Eggs Hatching Percentage

Fifty eggs from each egg masses, ready to hatch (showed an intense brown color) were placed in a petri-plate containing filter paper under laboratory conditions and the percentage of hatching was calculated.

Larvae Cannibalism

Fifty new emerged larvae were placed in round plastic container, 20cm. dim and 25 cm. height, with round open container provided with alfalfa stems for feeding. The container open was covered with muslin and the larvae were continuously observed until pupation. The dead larvae were removed and three replicates were used.

Effect of some biocides on eggs and larvae

Eggs and larvae of cotton leaf worm were treated with two biocides *Beauveria bassiana* 10.5 $X10^9$ pores/ml and Spinosad at 0.25 ml/L. Fifty eggs, from new egg masses, were placed on a filter paper in, 9 cm Petri-dishes. and treated with biocides separately. The control was sprayed with water. The eggs were daily observed until 95% of eggs in control hatched. egg hatching percentages in each treatment were calculated. Three replications of each treatment were used.

Ten of 3rd stage larvae were placed in glass flasks provided with alfalfa stems for feeding. The larvae, were sprayed separately with *B. bassiana* and Spinosad while the control was sprayed with water. The flasks were covered with muslin, maintained at laboratory temperature, observed continually every 12 hrs for a week and the percentage of dead larvae was calculated. Three replications of each treatment were used.

Result and Discussion

Result in Figure (1) showed that the mature worm emerged during the night, between 5th PM until 4 AM. The emergence percentage was 3% at 5 PM afternoon then gradually increase to reach 21% between 10-11 PM. The highest emergence rate at 32% was between 12 - 1 PM then gradually decreased to attain 17 % at 2-3 AM and the lowest was 2 % at 4 AM. The most suitable time for adult emergence was 86% between 8-3 AM.

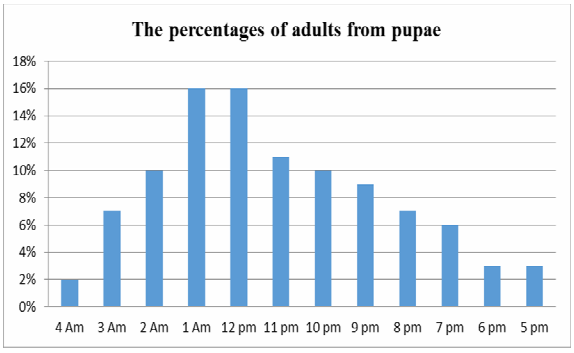

Fig. 1: Adult emergence percentages of *S. littoralis* during 24 hours.

It was reported that the adults emergence percentage of *Secamia cretica* from pupae attained to 28.5% between 4-6 AM and increased to 71.4% in the darkness period starting from the dusk until before midnight. This finding can be applied to the insect pheromone usage to confuse mating intensive hunting or timing control (Al-Hassanawi, 2010).

The percentage of pupated larvae scored 80.15% and the percentage of emerged adults was 82.35%. The male and female rate percentage was 32% and 68.0%, respectively during the period between 8-11 PM. Three mating incidences were recorded at differentiate period, 55, 67 and 87 mins at mean of 68 mins during the night between 8-11PM. The mating process of *Sesamiacretica* was reported to be between 3-4.5 AM at a mean of 74 mins, within 1-2 days of adults' emergence (AL-Hassnawi, 2010).

It has been found that the new emerged adults of both sexes were moved toward the sucrose solution for feedings. The males showed to be more active than females within 15min of emergence as they raised the fore wings like butterflies which can be differentiated them from females. It was observed that the male flew in the cage searching for a suitable female, stopped behind it within the head on the abdomen end part for more than 20min, then the male and female start to shake the wings and antennae and moving the abdomen end followed by eruption and active circular flying indicating that the sexual pheromone was released. Harris *et al.* in (1992) reported that female of *Basseola fusca* produced the sexual pheromone that induces the male to search female for mating after few hours of emergence. The mating process occurred during the first 6 hours of the night. The abdomen ends of both male and female touched and the male covered female abdomen and wing end a with its wing. The abdomen end for both sexes is raised up for mating compared to other body parts. AL-Ali *et al.* in (1987) reported that mating in *Drosophila* happened in a similar manner.

It has been found (table 1) that cotton worm female deposit 5-8 egg masses with deposition rate at 31 egg mass /4 female and 51 egg mass /10 female, during the 8-10 days of experiment. These egg masses were observed at the lower surface of the leaf in layers, covered with a thick layer of pellicle. The egg masses were deposited after or in the next day of the mating. The number of eggs in the 1st egg mass batch was higher than in the next ones. Four egg masses with, 496, 397, 353 and 154 egg/mass were calculated with an average number of 350-450 egg/mass-. Rabea, in (2002) reported that the mean number of egg deposit by female was 107 and, 503 eggs at 20 and 30 °C, respectively. The infertile females have deposited large eggs and randomly distributed around the leaves and the glass cage and gradually wrinkled.

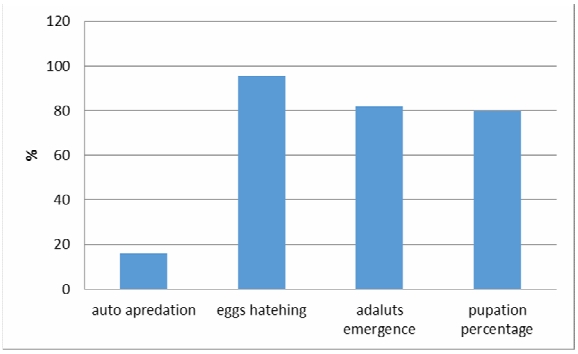

Fig. 2 : Percentages of some biological aspects of cotton leaf worm *S. littoralis*

Table 1 : The mean of some biological aspects of cotton leaf worm *S. littoralis*

Biological aspects	The mean
Sexual ratio	32male,68 female
Period of male and female mating	68minutes
Eggs mass/female	5-8eggmass
Number of eggs/egg mass	350-450eggs
Time of eggs hatching	8-11h night

The percentage of egg hatching was 95.5% (Fig. 2), which is similar to that reported by (Ali, 2008) with 91.01%. The larvae were found to prefer moving in, aggregation and forming movement line in first and second ages only.

Egg hatching time was at 8-11PM producing small spotted larvae with black heads. The cannibalism percentage of among 2nd stage larvae was 16%. Whereas, A previous study reported that the cannibalism in cotton leave worm was happen among 4th, 5th, 6th stages larvae due to crowded and deficiency of essential nutrients for growth (Rabiea,2002). Natural death among larvae at 5% due to infection with pathogens was recorded.

Effect of some biocides on cotton leaf worm eggs and larvae

Treatment of eggs with Spinosad and *B. bassiana* caused high reduction in eggs hatching up to 0% and 12%, respectively compared with 95% in control a week after treatments.

Treatment of larvae with Spinosad caused high mortality percentage up to 100% a day after treatment while no effect of *B. bassiana*was observe on larvae a week after treatment, with 0% mortality compared to 0% for water control. Slight effects, like poor feeding and movement performance, were shown on larvae treated with *B. bassiana* 2 days of treatment.

Table 2: Effects of some biocides on eggs and third stage Larvae of cotton leaf worm *S. littorales*.

Treatment	concentration	% eggs hatching after a week of treatment	% dead larva after a week of treatment
Beauveria bassiana	$10*10^9$ Spores/ml	12	0
spinosad	0.25ml/l	0	100
Control		95	0
L.S.d P=0.05		1.937	2.372

Moreover, larvae recovered their activity in 3rd and 4th days of treatment. It was reported that the biocide Spinosad caused 100% mortality to cotton leaf worm larvae r 14 days of treatment (AL-ubaidy, 2006). He

reported that the effect of *B. bassiana* on the larvae was quite low in the first days of treatment but the death percentage reached to 100% 14 day of treatment. These findings have clarified some biological aspects of cotton leaf worm and the inhibitory activity of Spinosad and *B. bassiana* against eggs hatching and larvae development which may be promising in the insect management .

Acknowledgments:

The author wishes to thank Prof. Dr, Hussam, Assist. Prof. Dr_Ferial and Assist. Prof. Dr. Nawres Al-Kuwaiti for technical assistance.

References

Al-Ali; AbdulBaki, M.H. and Mawlod, K.A. and Moaid, A.Y. (1987). Insect Ecology. Ministry of Higher Education and Scientific Research, University of Baghdad, pp254.

Al-Hassnawi, M.M. (2010). Emergence pattern, mating and oviposition behavior of the corn stalk borer, *Sesamia cretica* Led. (phalaenidae : Lepidoptera). AL-Anbar journal of agricultural sciences 8(3): 1992-7479.

Ali, H.I. (2008). Effect of chitin synthesis inhibitor (Applaud) the non- steroidal ecdysone (Methoxyfenozide) and bio-insecticide (Abamectin) in biological performance of cotton leafworm *spodoptera littoralis* (Biosd) (Lepidoptera: Noctuidae). Master of science in Agriculture / University of Baghdad in plant protection / Entomology, 98.

AL-Khazraji, H.I.; Ahmed, R.F. and AL-Jorany, R.S. (2016). Effect of Feeding Treatment with some Extracts of Black Pepper on some Biological Aspects of Cotton Leaf Worm. The Iraqi Journal of Agricultural Sciences, 47(3): 856- 864.

Al-Obeidi; Shaimaa, H.; Al-Ani, L.Q. and Wafa, A.H. (2008). Field study on the effect of the Entomopathogenic Fungi *Beauveria bassiana* (Bals.) Vuil. On the cotton leaf worm *Spodopteralittoralis* (Boisd.) on potato plant J. of biotechnology research centre number (2): 24-32.

Al-Zubaidi, A.N. (1987). influence of bacterial insecticide Bactospeine on three insects of Lepidoptera and its compatibility with some chemical pesticides in greenhouses. Master. The College of agriculture. The University of Baghdad. Iraq 107 page.

Aydin, H.M. and Oktay, G. (2006). The efficacy of spinosad on different strain of *spodoptera littoralis* (Biosd) (Lepidoptera: Noctuidae). Turk. J. Biol. 30: 5-9.

Bakr, R.F.A.; AbdElaziz, M.F.; El-barky, N.M.; Awad, M.H. and Abd El-Halim, H.M.E. (2013). The activity of some detoxification enzymes in *Spodoptera littoralis* (Boisd.) larvae (Lepidoptera: Noctuidae) treated with two different insect growth regulators. Egypt. Acad. J. Biolog. Sci., 5(2): 19-27.

El-Hawary, F.M. and Abd El-Salam, A.M.E. (2009). Laboratory bioassay of some entomopathogenic fungi on *Spodoptera littoralis* (Boisd.) and *Agrotis ipsilon* (Hufn.) larvae (Lepidoptera: Noctuidae). Egypt. Acad. J. biolog. Sci., 2(2): 1- 4.

Grafton-Cardwell, E.E.; Larry, D.G.; William, E.C. and Walter, J.B. (2005). Various novel insecticides are less toxic to humans, more specific to key pest . California Agric., 59(1): 29-34 .

Harris, K.M. and Newanze, K.F. (1992). *Busseola fusca* (Fuller), The African maize stem borer ,a hand book of information, 33, information Bulletein, ICRISA, CABI, UK. 84p.

Hosny, M.M.; AleemAssem, M.A. and Nasser, A.N. (1976). Insect and animal pests. House of Al-marefa in Egypt.1122 Page.

Meagher, R.L.; Brambila, J. and Hung, E. (2008). Monitoring for Exotic *Spodoptera* species (Lepidoptera: Noctuidae) in Florida. Florida Entomologist. 91(4): 517-522.

Moulton, K.; Pepper, A.; Jansson, K. and Dennehy, J. (2002). Proactive management of beet armyworm (Lepidoptera: Noctuidae) resistance to the tebufenozide and methoxyfenozide; baseline monitoring ,risk assessment ,and isolation of resistance .J. Econ . Entomol. 95. 414-424.

Pineda, S.; Marcela-Ines, S. and Smagghe, G. 2007. Lethal and sublethal effects of Methoxyfenozide and Spinosad on *Spodopteralittoralis* (Lepidoptera :Noctuidae). J. Econ Entomol .100(3): 773-780.

Rabea, K.S.J. (2002). Life and environmental cotton leaf worm *Spodoptera littoralis* (Lepidoptera: Noctuidae) And control Kimaaúaa. Master - Faculty of Agriculture / University of Baghdad 91 Page.

Saleh, H.; Abboud, H.M.; Ali, H.; Abud, F.H. and Hassan, F. (1999). Evaluation of pathogenicity of fungal pathogen susceptibility to insect whitefly *Bemisia tabaci*. Journal of agriculture. 4 (1): 154-163.