Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2020; 8(1): 787-790
© 2020 JEZS
Received: 23-11-2019
Accepted: 27-12-2019

AK Rodge
Department of Agricultural Entomology, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India.

AD Gaikwad
Department of Agricultural Entomology, College of Agriculture, Parbhani, VNMKV, Parbhani, Maharashtra, India

VB Dalvi
Department of Agricultural Entomology, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

SS Shetgar
Professor, Department of Agricultural Entomology, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

PL Sarukh
Department of Agricultural Entomology, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

Corresponding Author:
AK Rodge
Department of Agricultural Entomology, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

Studies on field life-tables and key mortality factors of cotton pink bollworm *Pectinophora gossypiella* (Saunders) on Deshi cotton

AK Rodge, AD Gaikwad, VB Dalvi, SS Shetgar and PL Sarukh

Abstract
The non-replicated field experiment on field-life tables of pink bollworm infesting Deshi cotton was conducted at the Experimental Farm of College of Agriculture, Latur (MS) India, during kharif 2016. On Deshi cotton, early instar larvae of *Pectinophora gossypiella* were died to the extent of 11.85, 12.7 and 19.2 per cent due to unknown reason during first, second and third generation, respectively. However, its 13.4, 8.92 and 7.9 per cent early instar larvae were also killed due to Apanteles during first, second and third generation, respectively. Late instar larvae of *P. gossypiella* were died to the extent of 5.3, 4.4 and 3.8 per cent due to Apanteles during first, second and third generation, respectively. Whereas, its 8.7, 5.8 and 10.34 per cent late instar larvae were also killed due to unknown reason during first, second and third generation, respectively. Unknown reasons also caused pupal mortality of *P. gossypiella* to the extent of 3.3 and 4.99 per cent in first and second generation, respectively. The maximum contribution towards generation mortality of *P. gossypiella* came from early instar larvae in all the three generations (k = 0.1175, 0.099 and 0.12). Total K for first, second and third generation was 0.195, 0.167 and 0.184, respectively.

Keywords: Deshi cotton, pink bollworm, *Pectinophora gossypiella* (Saunders), Apanteles

Introduction
India is the largest cotton growing country in the world. The top five producers in the world are China, India, USA, Pakistan and Uzbekistan. India occupies first rank in area and having second position in production. In India cotton is grown over an area of 105 lakh hectares with production of 351 lakh bales and productivity of 568 kg lint ha-1 (Annon. 2017) [1]. In Maharashtra, cotton is cultivated over an area of 38.06 lakh hectares with production of 89 lakh bales and having productivity of 398 lint kg ha-1 (Annon. 2017) [1]. Very less productivity of cotton in Maharashtra is mainly due to growing of cotton under rainfed condition (97-98 per cent of area).

The bollworms usually damage the fruiting bodies like buds, flowers and immature bolls. It is necessary to control the cotton bollworm complex effectively. The present strategy of controlling bollworms includes use of insecticides alone which are sprayed every year in enormous quantities on cotton crop to control bollworms. Nearly 40 per cent of the total pesticide consumption in India is on cotton crop alone, yet satisfactory control of bollworms is not attained. Besides these, the insecticides pollute soil, air and water resources in nature (Chaudhari, 2005) [2].

The major aim of studying life-table is one of the tools most useful in the study of insect population dynamics. The uses of field life-tables have been made recently for studying the natural population of insect-pests. When the environmental parameters are related to several cases of mortality, the field life-tables form a budget of successive process that operates in a given population. Field life-table studies indicate which age interval and independent variable should be studied in detail for the effective control of the pest. It is also important to grasp the real situation of seasonal prevalence of an insect-pest for its successful control. The field life-table has been constructed for the insect-pests of forests, orchards and agricultural crops.

Materials and Methods
The material used and methods adopted to study the field life-tables and key mortality factors of pink bollworm infesting Deshi cotton are described below.

The non-replicated field experiment comprising 120 quadrats of 1.80 x 1.80 sq. m. size. The Deshi cotton variety, Parbhani Turab was sown at the spacing of 45 x 15 cm.

Field life-tables of pink bollworm infesting Deshi cotton

Field generation studies

Frequent field visits were made after germination for record the first incidence (egg stage) of pink bollworm on Deshi cotton. After having frequent field visits at regular intervals, the known number of eggs as a start of first generation of respective pests were collected along with the plant material. On hatching of these eggs, the tiny larvae were reared in plastic boxes (6.5 x 2.5 cm) individually on fresh cotton flowers, buds or bolls in laboratory. Food was changed as and when required. These larvae were reared till adult emergence. A gap of four to six days was observed for the start of next generation. The laboratory culture was used as check culture for deciding the number of regular generations of pests in the field condition. The sampling of early and late instar larvae was done on the basis of development of pest in laboratory-reared culture. At each observation five quadrats were carefully examined twice in a week for number of larvae of target pests. The field collected larvae and pupae were brought to the laboratory and reared on cotton. This was referred as field culture. The food was changed as and when required. The culture was reared till adult emergence.

The observations were made on the larval and pupal parasitism as well as mortality because of unknown reasons and entomopathogens in early instars, late instars and pupal stage as well. An interval of four to six days was provided before sampling of eggs of next generation after the mean adult emergence of previous generation. This period was considered for completion of oviposition by the moth of previous generation.

Analysis of causes of fluctuation of population and identification of key mortality factors

The important step in explaining the population fluctuations is to determine the stage in the life of the pest which has major contribution to the index of population trend (I) or generation survival (SG). Separate budget was prepared to find out the key factors that influenced the population trend of cotton bollworms. The method of key factors analysis developed by Varley and Gradwell (1963 and 1965) [5, 6] was used to detect density relationship of mortality factors. By this method, the killing power (K) of such mortality factors or group of mortality factors in each age group was estimated as the difference between the logarithams of population density before and after its action. As a series of mortality factors operated in succession during generation or a population, the total killing power of 'K' was equal of the sum of the killing power of 'K's.

Results and Discussion

First Generation

The results on field life-tables and key mortality factors of *P. gossypiella* infesting Deshi cotton in first generation during *kharif* season 2016 are presented in Table 1.

Table 1: Key mortality factors for first generation of *P. gossypiella* on Deshi cotton

Age interval	Number alive /ha at the beginning of x	Factors responsible for d_x	Number dying during x	d_x as % of 1_x	Survival rate at age x
X	1_x	d_xF	d_x	100 q_x	s_x
Larval population Early instar larvae (N_1)	83333	Unknown reason	9876	11.85	0.76
	73457	*Apanteles* sp.	9876	13.4	-
Late instar larvae	63581	Unknown reason	5556	8.7	0.86
	58025	*Apanteles* sp.	3086	5.3	-
Pupae	54939	Unknown reason	1852	3.3	0.96
Moths	53087	-	-	-	-
Females x 2 (N_3)	53087	(Reproducing female = 26543)			
Trend index (N_2/N_1)	69136/83333			0.83	
Generation survival (N_3/N_1)	53087/83333			0.63	

It is evident from Table 1 that the incidence of *P. gossypiella* in first generation was first recorded in 46th standard meteorological week. The mortality of early instar larvae infesting deshi cotton was observed to the extent of 13.4 and 11.85 per cent due to *Apanteles* sp. and unknown reason, respectively.

The mortality of late instar larvae to the extent of 8.7 and 5.3 per cent was also observed due to unknown reason and *Apanteles* sp., respectively. The pupal mortality was observed to be 3.3per cent due to unknown reason. The negative trend index (0.83) revealed that the mortality factors operated during first generation of *P. gossypiella* were effective in decline in pest population in next generation. The generation survival was 0.63.

Table 2: Budget of *P. gossypiella* for first generation on Deshi cotton

Age interval	Number / ha.	Log No./ ha.	'k' values
Early instar larvae After mortality due to unknown reason and *Apanteles* sp.	83333	4.9208	-
Late instar larvae After mortality due to unknown reason and *Apanteles* sp.	63581	4.8033	0.1175
Pupae	54939	4.7398	0.0635
Moth	53087	4.7249	0.0149
K= 0.1959			

Table 2 indicated that the maximum contribution towards generation mortality came from early instar larvae (k= 0.1175) followed by late instar larvae (k= 0.0635) andpupae (k= 0.0149). The total 'K' for all life-stages was 0.1959.

Second Generation

The results on key mortality factors of *P. gossypiella* infesting deshi cotton in second generation during *kharif* season 2016 are summarized in Table 3 and 4.

Table 3: Key mortality factors for second generation of *P. gossypiella* on Deshi cotton

Age interval	Number alive /ha at the beginning of x	Factors responsible for d_x	Number dying during x	d_x as % of 1_x	Survival rate at age x
X	**1_x**	**d_xF**	**d_x**	**100 q_x**	**s_x**
Larval population Early instar larvae (N_1)	69136	*Apanteles* sp.	6173	8.92	0.79
	62963	Unknown reason	8025	12.7	-
Late instar larvae	54938	*Apanteles* sp.	2469	4.4	0.89
	52469	Unknown reason	3086	5.8	-
Pupae	49383	Unknown reason	2469	4.9	0.95
Moths	46914	-	-	-	-
Females x 2 (N_3)	46914	(Reproducing female = 23457)			
Trend index (N_2/N_1)	48148/69136			0.70	
Generation survival (N_3/N_1)	46914/69136			0.67	

The incidence of *P. gossypiella* in second generation was noticed in 50th standard meteorological week. The data (Table 3) revealed that early instar larvae to the extent of 12.7 and 8.92 per cent were killed by unknown reason and *Apanteles* sp., respectively.

In late instar larvae the mortality was observed to the extent of 5.8 and 4.4 per cent due to unknown reason and *Apanteles* sp., respectively. The pupal mortality was observed to be 4.9 per cent due to unknown reason. The negative trend index revealed that key mortality factors operated during second generation of *P. gossypiella* were effective in decline in pest population in next generation. The generation survival was 0.67.

Table 4: Budget of *P. gossypiella* for second generation on Deshi cotton

Age interval	Number / ha.	Log No./ ha.	'k' values
Early instar larvae After mortality due to *Apanteles* sp. and unknown reason	69136	4.8397	-
Late instar larvae After mortality due to *Apanteles* sp. and unknown reason	54938	4.7398	0.099
Pupae After mortality due to unknown reason	49383	4.6935	0.046
Moth	46914	4.6713	0.022
K= 0.167			

It is evident from Table 4 that maximum mortality of *P. gossypiella* was observed in the early instar larvae (k= 0.099) followed by late instar larvae (k= 0.046) and pupal stage (0.022). The total 'K' for all the life-stages was 0.167.

Third generation

The results on key mortality factors of *P. Gossypiella* infesting Deshi cotton for third generation during *Kharif* season 2016 are summarized in Table 5 and 6.

Table 5: Key mortality factors for third generation of *P. gossypiella* on Deshi cotton

Age interval	Number alive /ha at the beginning of x	Factors responsible for d_x	Number dying during x	d_x as % of 1_x	Survival rate at age x
X	**1_x**	**d_xF**	**d_x**	**100 q_x**	**s_x**
Larval population Early instar larvae (N_1)	48148	Unknown reason	9259	19.2	0.74
	38889	*Apanteles* sp.	3086	7.9	-
Late instar larvae	35803	Unknown reason	3704	10.34	0.86
	32099	*Apanteles* sp.	1235	3.8	-
Pupae	30864	-	-	-	-
Moths	30864	-	-	-	-
Females x 2 (N_3)	30864	(Reproducing female = 15432)			
Trend index (N_2/N_1)	0/48148			0	
Generation survival (N_3/N_1)	30864/48148			0.64	

The incidence of *P. gossypiella* in third generation was noticed in 2nd standard meteorological week. The data (Table 5) revealed that early instar larvae to the extent of 19.2 and 7.9 per cent were killed by unknown reason and *Apanteles* sp. respectively. The mortality of late instar larvae to the extent of 10.34 and 3.84 per cent was observed due to unknown reason and *Apanteles* sp. respectively. The zero-trend index revealed that the population of *P. gossypiella* infesting Deshi cotton was ceased after third generation. The generation survival was 0.64.

Table 6: Budget of *P. gossypiella* for third generation on Deshi cotton

Age interval	Number / ha.	Log No./ ha.	'k' values
Early instar larvae After mortality due to unknown reason and *Apanteles* sp.	48148	4.6825	-
Late instar larvae After mortality due to unknown reason and *Apanteles* sp.	35803	4.5539	0.12
Pupae	30864	4.4894	0.064
Moth	30864	4.4894	0
K= 0.184			

It is evident from Table 6 that maximum mortality of *P. gossypiella* was observed in the early instar larvae (k= 0.12) followed by late instar larvae (k= 0.064). The total 'K' for all the life-stages was 0.184.

Mahinder and Verma (1981) [3] observed parasitization of *P. gossypiella* by parasitoid, *Apanteles* sp. in untreated cotton crop. The mortality of pink bollworm was caused by *Apanteles* sp. (29.26 per cent) and unknown reason (21.37 per cent). Similarly *Apanteles* sp. was observed to be parasitizing this pest and considered as key mortality factor Simwat and Sidhu (1982) [4].

Conclusion

In conclusion it is to state that cotton pink bollworm passed through 3 generations each on deshi cotton during *kharif* 2016. *Apanteles* sp. and unknown reason contributed more to cause the mortality of early instar larvae of *P. gossypiella* infesting deshi cotton.

References

1. Anonymous. Annual progress report of cotton, 2017. www.cab.com.
2. Chaudhari JE. Evaluation of different intercrops for the management of bollworms in cotton. M.Sc. Agri. Thesis, Marathwada Agricultural University, Parbhani (Unpublished), 2005.
3. Mahinder S, Verma GC. Existence of egg parasitoid of Earias vittella and larval parasitoid of Pectinophora gossypiella (Sau.) in insecticide treated and untreated area in Punjab. Cotton Dev. 1981; 11(1):64-65.
4. Simwat GS, Sidhu AS. Mortality of diapausing larvae of pink bollworm *Pectinophora gossypiella* (Saund) in cotton stacks during summer in the Punjab. Indian J Ent, 1982; 44(2):182-184.
5. Varley GC, Gradwell GR. The investigation of insect population changes. Proc. XII. Ceylon Assoc. Adv. Sci. 1963; 18:142-156.
6. Varley GC, Gradwell GR. Interpreting winter moth population changes. *Proc.* XII Int. Congr. Entomol. (London), 1965, 377-378.