



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(5): 685-688

© 2018 JEZS

Received: 27-07-2018

Accepted: 28-08-2018

Arunkumara CGDepartment of Agricultural
Entomology, UAS Bangalore,
Karnataka, India**Bheemanna M**Department of Agricultural
Entomology, UAS Raichur,
Karnataka, India**Shaila HM**Department of Agricultural
Entomology, UAS Dharwad,
Karnataka, India**Raju Teggelli**KVK, Kalburgi, UAS Raichur,
Karnataka, India**Sreedevi Chavan**Department of Plant Pathology,
UAS Raichur, Karnataka, India**Correspondence****Arunkumara CG**Department of Agricultural
Entomology, UAS Bangalore,
Karnataka, India

Biology of spotted stem borer *Chilo partellus* (Swinhoe) (Lepidoptera: Crambidae) on artificial diet

Arunkumara CG, Bheemanna M, Shaila HM, Raju Teggelli and Sreedevi Chavan

Abstract

The biology of spotted stem borer *Chilo partellus* (Swinhoe) was studied on artificial diet under laboratory conditions during *Kharif* 2016 at College of Agriculture Raichur, revealed that the pre-oviposition and oviposition period ranged from 1.0 to 1.5 and 3 to 5 days. Incubation period ranged from 3.5 to 7 days with an average of 5.15 ± 1.13 days. Larva passed through six instars and total larval period ranged from 24.5 to 47.5 days. The duration of each instar from first to six was 4.55 ± 0.64 , 4.50 ± 1.33 , 5.25 ± 1.37 , 5.75 ± 1.65 , 6.20 ± 1.13 and 7.75 ± 1.27 days respectively. The pupal period of the stem borer range from 6 to 11.05 days. The life cycle of the *Chilo partellus* occupied 34 to 66 days with an average of 48.1 ± 10.71 days. The longevity of the female moth varied from 4.5 to 7.0 days and male it was 3.0 to 6.0 days. The fecundity rate ranged from 184 to 456 with an average of 329.6 ± 96.26 .

Keywords: Spotted stem borer, *Chilo partellus*, artificial diet

1. Introduction

Maize or corn (*Zea mays* Linn.) is one of the important cereal crops in the world and it is cultivated for food, fodder and as raw material for many industries. In India, maize is the third most important food crops after rice and wheat. It is cultivated over an area of 8.69 m ha with a production of 21.80 m t and productivity of 2509 kg ha⁻¹. In Karnataka, maize occupies an area of 1.18 m ha with a production of 3.27 million tones and average productivity is 2773 kg ha⁻¹ [1]. The lepidopteran pests, particularly the stem borers are the constraint to the productivity of maize in the world. Of these, maize stem borer, *Chilo partellus* in *kharif* season and *Sesamia inferens* in *rabi* season is a major cause of damage to maize crop [3]. Yield losses in different agro climatic regions of India in maize due to *C. partellus* and *S. inferens* ranged from 26.70 to 80.40 and 25.70 to 78.90 per cent, respectively [5]. Maize is most vulnerable to *Chilo partellus* (Swinhoe) which causes severe losses to maize crop. It is an important pest in Asian and African countries [2].

2. Material and Methods

A laboratory experiment was conducted to study the biology of *C. partellus* on artificial condition. The experiment was carried out during 2016 at National Food Security Mission laboratory, College of Agriculture, University of Agricultural Sciences, Raichur.

2.1 Maintenance of pure culture

Initial culture of stem borer was collected from maize field at Main Agriculture Research Station, Raichur. The collected larvae were transferred to plastic boxes containing cut stems of maize. The boxes were cleaned daily by removing the excreta and partially eaten stems. The larvae were supplied with sufficient quantity of fresh tender stem pieces as food. The larvae were reared till they attain pupal stage. Pupae obtained were kept in separate plastic jar for adult emergence. The culture then obtained was used for the further studies on biology and biology was conducted in growth chamber at 28 °C temperature and RH of 72 per cent.

2.2 Incubation period

For this ten pairs of freshly emerged male and female adults were released into oviposition jar (20 x 15 cm) which was prepared by covering the inner wall of jar with folded paper, fresh

maize plants. Ten per cent sugar solution was provided as a food to the moths by soaking cotton plug in the solution. The open end of oviposition jar was covered with muslin cloth. Folded paper and leaves served as an ovipositional site and observations were recorded every day for oviposition. Eggs laid on the folded paper by the female moth were transferred with the help of a camel hair brush and needle to a petri-dish with moistened cotton sponge. The petridish was covered and observed for hatching of the egg. Time taken for hatching was recorded by making observation at 12 hours interval. The morphometric measurements *viz.*, breadth and length of ten eggs were measured using stereo-zoom microscope.

2.3 Larval period

The period from hatching of the eggs till pupation was recorded as larval period. Larvae reared on semi-synthetic diet in laboratory condition.

2.3.1 Preparation Semi-Synthetic diet

Rearing of the larvae on natural diet is not only cumbersome but also predisposes the larvae to mechanical injury. Besides, fresh plant material may not be available all the time. Hence *Chilo partellus* was maintained on semi-synthetic diet under laboratory condition. Eggs laid all over the surface of the folded paper provided in the oviposition cage were transferred to petri plate with moist cotton sponge. After hatching the larvae were taken out of the petri plate with the help of fine sterilized camel hair brush and then transferred to plastic culture tubes (2.5 cm diameter x 7.5 cm length) containing semi synthetic diet. The pupation obtained were collected and kept for emergence. Time gap between each instar was recorded and the total larval period was also recorded. Observation was made at 12 hours interval to study the number of instars and the size of the larvae and behaviour of each instar.

The base material used for the diet was green gram powder, wheat flour in agar medium fortified with vitamins and the diet was also provided by antibacterial and antifungal preservatives. List of ingredients used for the preparation of diet is as below^[9].

Sl. No.	Ingredient	Quantity (grams)
01	Green gram powder	75
02	Wheat powder	20
03	Yeast powder	5
04	Ascorbic acid	1.7
05	Methyl paraben	0.8
06	Sorbic acid	0.4
07	Multivitamin	1cap.
08	Vitamin- E	0.4
09	Streptomycin sulphate	0.5
10	Agar-agar powder	6
11	Formaldehyde 40% (ml)	1
12	Distilled water (ml)	390

Green gram and wheat powder were added with 190 ml distilled water in a blender and mixed for three minutes. Agar-agar was boiled separately in a container. Hot agar-agar along with yeast, ascorbic acid, sorbic acid and methyl paraben was added in blender and mixed thoroughly. Multivitamin, vitamin-E streptomycin sulphate and formaldehyde were added at the end and finally mixed for two minutes and poured in the bread box.

2.4 Pupal period

Pupae obtained after completion of the larval cycle were collected in plastic container and kept for emergence. The time taken from the pupation till emergence of the adult recorded as a pupal period. These pupae were observed for the morphometric characters.

2.5 Adult longevity

Adult emerged from pupa was observed for their colour, shape and size. The male and female moth was measured across their expanded wing with the help of standard scale. Male and female were differentiated on the basis of morphological differences. The male and female longevity were calculated separately from date of emergence of adult to the death of adult.

2.6 Pre-oviposition period and oviposition period

The pre-oviposition period was recorded from ten pairs of moths. The period from despairing of copulated pair till first egg laid by female was counted as pre-oviposition period. The period from first egg laid till the last egg laid was recorded as oviposition period.

2.7 Fecundity

Individual pairs of freshly emerged moths were kept in cylindrical boxes provided with folded paper and 10% honey solution. Honey and oviposited paper were changed daily till the death of female of the pair. Eggs were counted on oviposited paper and leaves on daily basis and finally total fecundity was calculated.

2.8 Total life cycle

The duration of entire life span of insect was considered as total life cycle.

3. Results

The results of the study on biology, incidence and management of maize stem borer *Chilo partellus* (Swinhoe) during *kharif* season of 2016-2017 are presented here under.

3.1 Egg

Eggs were creamy white, flat, oval and scale like in appearance. Eggs became yellowish after two days and turned to yellowish brown on the third day. The average length and breadth of egg ranged from 0.46 to 0.84 mm and 0.33 to 0.48 mm, respectively with an average of 0.66 ± 0.13 mm and 0.38 ± 0.05 mm, respectively (Table 2).The incubation period lasted for 3.5 to 7 days (Table 1).

3.2 Larva

In order to study the various larval instars of *C. partellus*, newly hatched larvae were reared individually in plastic culture tubes with semi synthetic diet till they pupated. The data obtained on duration and sizes of different instars are presented in table 1 & 2. During its larval period the caterpillar moulted five times and had six larval.

3.2.1 First instar

Newly hatched larva was slender, tiny, active and dirty white with dark brown head. Body of the larva was covered with number of short hairs. The length and breadth of first instar was 1.50 to 3.00 mm and 0.25 to 0.48 mm, respectively with an average of 1.99 ± 0.42 mm and 0.39 ± 0.07 mm, respectively. The duration of first instar lasted for 3.5 to 5.5 days with an average of 4.55 ± 0.64 days.

3.2.2 Second instar

Second instar larva was translucent and dirty white and was darker than the first instar larvae. Head and prothorax were dark brown in colour. Length and breadth of second instar was 3.20 to 4.75 mm and 0.80 to 0.92 mm, respectively with an average of 4.06 ± 0.53 mm and 0.84 ± 0.05 mm, respectively. The duration of second instar lasted for 3.5 to 6.5 days with an average of 4.50 ± 1.33 days.

3.2.3 Third instar

The colour of third instar larva was dull white with elongated body and brown head. The average length and breadth of third instar ranged from 5.20 to 10.25 mm and 0.95 to 1.41 mm, respectively with an average of 7.93 ± 1.72 mm and 1.17 ± 0.18 mm, respectively. The duration of the third instar lasted for 4.0 to 8.5 days with an average of 5.25 ± 1.37 days.

Table 1: Biological parameters of stem borer, *Chilo partellus* under artificial diet

Developmental stages	Range*	Mean \pm SD* (days)
Pre - oviposition period	1.0 – 1.5	1.30 ± 0.25
Oviposition period	3.0 – 5.0	3.75 ± 0.67
Egg incubation period	3.5 – 7.0	5.15 ± 1.13
Duration of larval and pupal stage		
I instar	3.5 – 5.5	4.55 ± 0.64
II instar	3.5 – 6.5	4.50 ± 1.33
III instar	4.0 – 8.5	5.25 ± 1.37
IV instar	3.5 – 9.0	5.75 ± 1.65
V instar	4.5 – 8.5	6.20 ± 1.13
VI instar	5.5 – 9.5	7.75 ± 1.27
Total larval period	24.5 – 47.5	34.75 ± 8.00
Pupa	6.0 – 11.5	8.20 ± 1.58
Adult longevity		
Male	3.0 – 6.0	4.25 ± 0.94
Female	4.5 – 7.0	5.45 ± 1.18
Total life cycle	34.0 – 66.0	48.10 ± 10.71
Male	37.0 – 72.0	52.35 ± 11.65
Female	38.5 – 73.0	53.55 ± 11.89
Fecundity (Number)	184.0 – 456.0	329.60 ± 96.26

* Mean of 10 observations

3.2.4 Fourth instar

Fourth instar larva was comparatively stout and long with translucent white body. Head and prothoracic shield were brown. Length and breadth of fourth instar was 9.51 to 16.04 mm and 1.68 to 2.06 mm respectively with an average of 13.2 ± 1.77 mm and 1.86 ± 0.12 mm respectively. Duration of fourth instar varies from 3.5 to 9.0 days with an average of 5.75 ± 1.65 days.

3.2.5 Fifth instar

Fifth instar larva was almost similar to fourth instar, except for its size. Length and breadth of fifth instar was 14.70 to 20.60 mm and 2.40 to 3.08 mm respectively with an average of 18.73 ± 2.09 mm and 2.75 ± 0.22 mm respectively. The duration of fifth instar lasted for 4.5 to 8.5 days with an average of 6.20 ± 1.13 days.

3.2.6 Sixth instar

Sixth instar larva was robust and cylindrical. Body was dull white with reddish brown head and prothoracic shield highly chitinized, yellowish brown. Length and breadth of sixth instar was 23.60 to 32.40 mm and 3.01 to 3.48 mm respectively with an average of 28.04 ± 2.55 mm and 3.26 ± 0.14 mm respectively. The duration of sixth instar lasted for 5.5 to 9.5 days with an average of 7.75 ± 1.27 days.

3.3 Total larval period

Total larval period ranged from 24.5 to 47.5 days with an average of 34.75 ± 8.00 days (Table 1).

Table 2: Morphometric measurements of stem borer, *Chilo partellus*

Growth stages	Length* (mm)		Breadth* (mm)	
	Range	Mean \pm SD	Range	Mean \pm SD
Egg	0.46 – 0.84	0.66 ± 0.13	0.33 – 0.48	0.38 ± 0.05
Larva				
I instar	1.50 – 3.00	1.99 ± 0.42	0.25 – 0.48	0.39 ± 0.07
II instar	3.20 – 4.75	4.06 ± 0.53	0.80 – 0.92	0.84 ± 0.05
III instar	5.20 – 10.25	7.93 ± 1.72	0.95 – 1.41	1.17 ± 0.18
IV instar	9.51 – 16.04	13.2 ± 1.77	1.68 – 2.06	1.86 ± 0.12
V instar	14.7 – 20.60	18.73 ± 2.09	2.40 – 3.08	2.75 ± 0.22
VI instar	23.60 – 32.4	28.04 ± 2.55	3.01 – 3.48	3.26 ± 0.14
Pupa				
Male	8.23 – 9.42	8.72 ± 0.44	1.85 – 2.23	2.05 ± 0.15
Female	9.26 – 11.43	10.29 ± 0.62	2.29 – 2.52	2.44 ± 0.08
Adult				
Female moth	16.00 – 17.00	16.56 ± 0.34	30.00 – 31.00	30.62 ± 0.34
Male moth	11.00 – 12.50	11.70 ± 0.43	23.00 – 25.00	24.23 ± 0.66

* Mean of 10 observations

3.4 Pupa

Pupa was obtect type with broad anterior end which tapered towards posterior end with small spines, black compound eyes and distinct segmentation of the body. The male pupa was narrow and smaller than that of female. The range of length and breadth of male pupa ranged from 8.23 to 9.42 mm and 1.85 to 2.23 mm respectively with an average of 8.72 ± 0.44 mm and 2.05 ± 0.15 mm respectively. The average length and breadth of female pupa ranged from 9.26 to 11.43 mm and 2.29 to 2.52 mm respectively with an average of 10.29 ± 0.62 mm and 2.44 ± 0.08 mm respectively. The pupal period ranged from 6.0 to 11.5 days with an average of 8.20 ± 1.58 days (Table 1&2).

3.5 Adult moths

The adult of *C. partellus* were medium sized with yellowish brown forewings having rows of black spots all along anterior margin. Male moth was dark brown in colour with pale brown forewings and pale yellow hindwing. The female hind wing was much lighter than that of male. The longevity of female moth varied from 4.5 to 7 days with an average of 5.45 ± 1.18 whereas that of male was 3 to 6 days with an average of 4.25 ± 0.94 days. Length and breadth of male moth was 11.00 to 12.50 mm and 23.00 to 25.00 mm, respectively with an average of 11.70 ± 0.43 mm and 24.23 ± 0.66 mm, respectively (Table 1&2).

3.6 Pre-oviposition period

The pre oviposition period ranged from 1.00 to 1.50 days with an average of 1.30 ± 0.25 (Table 1).

3.7 Oviposition period

The oviposition period ranged from 3.0 to 5.0 days with an average of 3.75 ± 0.67 (Table 1).

3.8 Fecundity

Fecundity per female ranged from 184 to 456 eggs with an average of 329.6 ± 96.26 (Table 1).

3.9 Total life cycle

Total life cycle of stem borer from egg to death of the adult in

laboratory condition was 52.35 ± 11.65 in male with range of 37.0 to 72.0 days and in female it was 53.55 ± 11.89 with a range of 38.5 to 73 days (Table 1).

4. Discussion

4.1 Egg

The results were found to be in line with the previous report which stated that the incubation period was 3 to 6 (4.70 ± 1.15) days^[8] and another report which stated that incubation period of stem borer is about 5 to 6 days^[7].

4.2 Larva

The present investigations are in agreement with earlier report that the first, second, third, fourth, fifth and sixth instars larval period ranged from 4.0 to 6.0, 2.0 to 7.0, 3.0 to 8.00, 3.0 to 9.0, 3.00 to 9.00 and 5.0 to 12.0 days, respectively and larval duration ranged from 20 to 51 (38.9 ± 11.43)^[8]. Likewise, another experiment also reported total larval period varied from 24 to 38 days. The total larval duration was slightly more in the present findings, which might be due varied response of individual larvae to the artificial diet^[5].

4.3 Pupa

The present findings are in agreement with previous report that the pupal period to be 6 to 11 days^[5] and also reported the pupal period to ranges from 6 to 12 days^[8].

4.4 Adult moths

Earlier results revealed that longevity of adult female moth varied from 3 to 8 days with an average of 6.20 ± 1.75 and that of male was 3.0 to 7.0 days with an average of 5.00 ± 1.49 days^[8].

4.5 Oviposition period

These results are in the conformity with earlier records that pre-oviposition and oviposition period of 1 to 2 days with an average of 1.44 ± 0.33 days and 3 to 5 (4.18 ± 0.64) days, respectively^[4]. Similar, another report also reported the oviposition period to ranges from 3.00 to 5.00 days with an average of 4.2 ± 0.63 days. Thus, the present finding of oviposition period was more or less in conformity with past report^[8].

4.6 Fecundity

The present findings are in agreement with earlier results reported 258 to 512 eggs with an average of 351.6 ± 83.55 eggs^[8].

4.7 Total life cycle

These findings are in agreement with previous records reported that life cycle of stem borer as 30 to 65 days^[6] and also reported the life cycle as 30 to 69 days with an average of 49.50 ± 13.50 days^[8].

5. Conclusion

The present study indicated that rearing conditions were important factors, affected survival, growth, and development parameters of *C. partellus*. The diet infestation has been a major problem in an artificial diet. Cheaper alternatives for the expensive items in the artificial diet must be sought. The time taken to rear adequate *C. partellus* was reported to be a function of time.

6. References

1. Anonymous. Director's review: annual maize workshop MPUAT, Udaipur, 2017.
2. Arabjafari KH, Jalali SK. Identification and analysis of host plant resistance in leading maize genotypes against spotted stem borer, *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae). Pakistan Journal of Biological Sciences. 2007; 10(11):1885-1895.
3. Chatterji SM, Young WR, Sharma GC, Sayi JV, Chabai BS, Khare BP *et al.* Estimation of loss in yield of maize due to insect pests with special reference to borers. Indian Journal of Entomology. 1970; 31:109-115.
4. Chavan NP. Biology, varietal screening against stem borer, *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae) in sorghum (*Sorghum bicolor*) L. (Monech). M.sc. (Agri) thesis submitted to Navsari Agricultural University, Navsari, 2006.
5. Deshpande VP. Studies on the bionomics of sorghum stem borer, *C. partellus* (Swinhoe) and reaction of different sorghum varieties to it. M. Sc. (Agri.) Thesis, University of Agricultural Sciences Bangalore, 1978.
6. Marulasiddesha KN. Bio-ecology of stem borer, *Chilo partellus* (Swinhoe) and impact of its damage on juice quality of sweet sorghum. M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka, 1999.
7. Panchal BM, Kachole MS. Life cycle of *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae) on an artificial diets. International Journal of Plant Animal and Environmental Sciences. 2013; 3:19-22.
8. Siddalingappa, Thippeswamy C, Venkatesh H, Shivsharanappa Y *et al.* Biology of maize stem borer, *C. partellus* (Swinhoe) (Crambidae: Lepidoptera). International Journal of Plant Protection. 2010; 3(1):91-93.
9. Siddiqui KH, Sarup P, Panwar VPS, Marwah KK *et al.* Evaluation of base-ingredients to formulate artificial diet for the mass rearing of *Chilo partellus* (Swinhoe). Journal of Entomological Research. 1977; 2(2):117-131.