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Bionomics of spotted stem borer, *Chilo partellus* (Swinhoe) Crambidae: Lepidoptera on maize

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Abstract

Spotted stem borer, *Chilo partellus* (Swinhoe) is the major pest of maize causing a huge loss to its production. The Present investigation on the biology of this pest was carried out at Entomological laboratory, College of Agriculture J. A. U. Junagadh during 2017. The females of *C. partellus* lay eggs in masses and the egg laying capacity varied from 283 to 314 eggs per female. Incubation period varied from 3-7 days. Hatching percentage varied from 75.10 to 89.14 per cent. The total larval period ranged from 23 to 47 days. During its larval period the caterpillar moulted five times and had six larval instars. The duration of each instar varied from 4-5, 3-7, 3-8, 4-9, 3-8 and 5-11 respectively. The fully developed larva undergoes pupation in the larval tunnel with an average pupal period of 9.16 ± 1.59 days. The longevity of female moth varied from 3 to 8 days and male varied from 4 to 8 days. The average duration of life cycle of the insect is 49.3 ± 6.2 days.

Keywords: bionomics, spotted stem borer, *Chilo partellus*, maize

Introduction

Maize is one of the most important cereal crop after wheat and rice in India. (Kumar and Alam 2017) [3] In several tropical and subtropical countries it is used as a principle staple food. In recent years, farmers showing greater interest in cultivating maize because of its wide adaptability to different environmental conditions and availability of high yielding varieties which can be cultivable throughout the year. In India during 2015-16, maize occupied an area of 8.80 m ha with production of about 22.56 million tonnes. (Anon., 2016) [2] Even though area under this crop increasing year by year the productivity is still considerably low which may be due to several reasons and one of that is undoubtedly the attack of various insect pests particularly the stem borer, *Chilo partellus* (Swinhoe) which causes greater losses to this crop. (Prakash *et al.*, 2017) [6].

Yield loss up to 75 per cent is reported from this pest alone. (Shahid *et al.*, 2018) [8]. Maize stem borer *C. partellus* starts its infestation by ovipositing on the leaves (Ajala and Saxena, 1994) [1]. Siddalingappa *et al.* (2010) studied extensively on biology of this pest and lot of information available on the life cycle of it. Saranya and Samiyyan (2017) [7] reported the incubation period of 4.5 days and the total developmental period of 36.3 days. The present investigation on biology of stem borer, *Chilo partellus* (Swinhoe) on maize was carried out at J.A.U., Junagadh during the *Kharif* season of 2017-18.

Materials and Methods

Rearing techniques

In order to raise the initial culture of *C. partellus* in the laboratory, 50 larvae were collected from the field and were reared in the separate plastic bottles one larva in each bottle by providing tender and fresh maize leaves and stem as their diet every day. Pupae were collected in separate bottles then it was kept in rearing cage for adult emergence. The emerged moths after mating were released to oviposition jar. The egg masses on paper and leaves were kept in petridish then it was transferred to hatching jar. Then the following observation on biology of stem borer was recorded.

Study on various stages of *C. partellus*

Eggs laid by ten female moths were observed and measured with the help of leica microscope. Incubation period and hatching percentage were calculated. Twenty five larvae were taken and duration of different larval instars and total larval period was determined. Measurements on length and breadth of the body, width of head capsule were recorded with the help of stage and ocular micrometers. Pre-pupal period and pupal period was recorded and measurement of

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length and breadth of pupa was taken. Five pairs of male and female moths were taken and observed for morphological characters. Duration on pre-oviposition period, oviposition period and post oviposition period were recorded. To determine the longevity, five pair of male and females were examined separately and longevity was recorded. Five percent honey solution was given as their diet during studies. Egg laying capacity of female was determined by counting the total number of eggs laid by ten female moths during their life span and fecundity was calculated. The duration from egg to adult emergence of insect was considered as total life cycle.

Results and Discussion

Detailed biology of *C. partellus* was studied in the laboratory by providing maize plants (leaves and stem) as their diet from August to October at room temperature and relative humidity.

Egg

Eggs of *C. partellus* usually observed on under surface of the leaves in masses which consists of nearly 10 to 30 eggs / mass. They were white to yellow or light brown in colour. Eggs are transparent in nature. The length of eggs varied from 0.85 to 1.1 mm with an average of 0.95 ± 0.089 mm. While the breadth of eggs varied from 0.50 to 0.70 mm with an average of 0.61 ± 0.06 mm. Eggs hatched after an incubation period of 3-7 days with an average of 4.76 ± 1.47 days. Similar observations were reported by Mullar (2014)^[4] that length of eggs to be ranged from 0.81 to 1.00 mm and Siddalingappa *et al.* (2010) reported that the incubation period vary from 3 to 6 days. Thus the present findings on length and incubation period were more or less in conformity with the present findings.

Hatching percentage

Hatching percentage of eggs of *C. partellus* varied from 76.49 to 87.78 per cent with an average of 83.87 ± 3.81 per cent (Table 2). Tanpure (2014)^[10] reported that hatching percentage ranged from 79.47 to 89.64 per cent which is more or less in agreement with the present findings.

Larva

Larva undergoes five moults with six instars.

First instar larva

First instar larva was very active, small and slender. Minute hairs were present all over the body. The length of first instar larvae varied from 1.5 to 2.4 mm with an average of 1.89 ± 0.31 mm, while breadth varied from 0.09 to 0.18 mm with an average of 0.13 ± 0.03 mm. Width of head capsule ranged from 0.2 to 0.3 mm with an average of 0.24 ± 0.05 mm. The larval period was varied from 4 to 5 days with an average of 4.48 ± 0.50 days. Panchal and Kachole (2013)^[5] reported that average duration of first instars was 4.80 ± 0.78 days which is more or less in concurrence with present findings.

Second instar larva

It was slightly darker than the first instar larvae. The second instar larvae measured 2.9 to 4.8 mm with an average of 3.85 ± 0.66 mm in length and 0.40 to 0.55 mm in breadth with an average of 0.48 ± 0.05 mm. The width of head capsule varied from 0.40 to 0.46 mm with an average of 0.42 ± 0.02 mm. The larval duration varied from 3 to 7 days with an average of 4.72 ± 1.36 days.

Third instar larva

The body of third instar larva was ashy white, elongated with brownish black spots or dots. The length of larva ranged from 5.2 to 9.5 mm with an average of 7.8 ± 1.5 mm and 0.65 to 0.98 in breadth with an average of 0.82 ± 0.11 . The width of head capsule ranging between 0.6 to 0.69 mm with an average of 0.64 ± 0.03 . The duration of third instar ranged from 3 to 8 days with an average of 5.4 ± 1.6 days. (Table 2).

Fourth instar larva

The larva was bigger and longer than third instar with increased area of brownish spots. Length of the larva ranged from 6.5 to 14.8 mm with an average of 10.08 ± 2.96 while breadth varied from 1.02 to 1.51 mm with an average of 1.31 ± 0.16 mm. The width of head capsule varied from 0.81 to 0.99 mm with an average of 0.90 ± 0.06 mm. The duration of the fourth instar larva ranged from 4 to 9 days with an average of 5.72 ± 1.51 days.

Fifth instar larva

The duration of the fifth instar ranged from 3 to 8 days with an average of 5.52 ± 1.68 days. The length of larvae ranged from 12.4 to 19.6 mm with an average of 16.17 ± 2.33 mm while breadth varied from 1.3 to 1.8 mm with an average of 1.55 ± 0.18 mm. The width of head capsule varied from 1.4 to 1.5 mm with an average of 1.47 ± 0.05 mm which is more or less similar with the duration of 3 to 9 days reported by Mullar (2014)^[4].

Sixth instar larva

Body of sixth instar larvae were creamy white, elongated and robust. The length of the larva varied from 20.5 to 28.8 mm with an average of 24.4 ± 2.7 mm. The breadth varied from 2.0 to 2.7 mm with an average of 2.37 ± 0.23 mm, while the width of head capsule of larvae ranged from 1.69 to 1.78 with an average of 1.73 ± 0.02 mm. The larval period of the sixth instar larva was varied from 5 to 11 days with an average of 8.08 ± 2.05 days (Table 2).

Total larval period

The total larval period ranged from 22 to 48 days with an average of 33.90 ± 4.89 days. Siddalingappa *et al.* (2010) reported the total larval period was 20 to 51 days. The above reports are more or less similar with the present findings. The variations in larval durations may be due to laboratory conditions like temperature and relative humidity.

Pupa

Pre-pupa

Pupation takes place inside the larval tunnel. The length of pre-pupa varied from 16.00 to 22.00 mm with an average of 18.6 ± 2.0 mm while, breadth varied from 2.3 to 2.8 mm with an average of 2.52 ± 0.16 mm. The width of head capsule varied from 1.3 to 1.7 mm with an average of 1.52 ± 0.14 mm. The duration of pre-pupa ranged from 1 to 2 days with an average of 1.52 ± 0.50 days (Table 2).

Pupa

Pupa was reddish-brown in colour. The male pupa was slightly narrow and smaller than that of female. Length of pupa varies from 15.0 to 17.5 mm with an average of 16.24 ± 0.75 mm, while the breadth varied from 2.3 to 2.8 mm with an average of 2.55 ± 0.18 mm. The duration of pupal stage varied from 7 to 12 days with an average of 9.16 ± 1.59 days (Table 2).

Adult

The adult moths of *C. partellus* were medium in size and yellowish brown to straw coloured. The forewings were pale straw, while the hind wings possessed black spots along their outer margins.

Measurement of adult females revealed that the length varied from 15.0 to 16.5 mm with an average of 15.7 ± 0.4 , while breadth varied from 31.0 to 32.5 mm with an average of 31.6 ± 0.5 . In case of males the length varied from 12.00 to 13.50 mm with an average of 12.7 ± 0.4 , breadth varied from 25.00 to 28.00 mm with an average of 26.20 ± 1.03 mm. Thus, female moth was slightly bigger in size than the male moth.

Pre-oviposition period

The pre-oviposition period varied from 1 to 2 days with an average of 1.48 ± 0.50 days.

Oviposition period

The oviposition period varied from 4 to 5 days with an average of 4.5 ± 0.5 days.

Post oviposition period

The post oviposition period was found to be varying from 1 to 2 days with an average of 1.48 ± 0.50 days.

Fecundity

The egg laying capacity (Table 2) recorded during studies was

varied from 283 to 314 eggs per female with an average of 303.1 ± 9.38 eggs.

Total life cycle

The life cycle of the insect (egg to adult emergence) occupied 33 to 69 days with an average of 49.40 ± 6.39 days. Mullar (2010)^[4] reported that total duration of life cycle ranged from 33 to 65 days which is more or less in agreement with the present findings.

Table 1: Fecundity and hatching percentage of eggs of *C. partellus*

Sr. no.	Hatching percentage		
	No. of eggs observed/female	No. of eggs hatched	Hatching percentage
1	311	273	87.78
2	307	242	78.82
3	297	254	85.52
4	283	234	82.68
5	304	249	81.90
6	312	269	86.21
7	314	275	87.57
8	306	261	85.29
9	295	255	86.44
10	302	231	76.49
Minimum	283	231	76.49
Maximum	314	275	87.78
Average \pm S.D.	303.1 ± 9.38	254.3 ± 15.54	83.87 ± 3.81

Table 2: Detail life cycle of stem borer, *C. partellus*

Stage	Duration (Days)		Average
	Minimum	Maximum	
Egg	3	7	4.76 ± 1.47
Larva			
First instar	4	5	4.48 ± 0.50
Second instar	3	7	4.72 ± 1.36
Third instar	3	8	5.40 ± 1.63
Fourth instar	4	9	5.72 ± 1.51
Fifth instar	3	8	5.52 ± 1.68
Sixth instar	5	11	8.08 ± 2.05
Total larval period	22	48	33.92 ± 5.10
Pupa			
Pre pupal period	1	2	1.52 ± 0.50
Pupal period	7	12	9.16 ± 1.59
Total life cycle	33	69	49.40 ± 6.39
Adult			
Pre oviposition	1	2	1.40 ± 0.50
Oviposition	4	5	4.52 ± 0.50
Post oviposition	1	2	1.48 ± 0.50
Longevity			
Male	4	8	5.64 ± 1.35
Female	3	8	5.24 ± 1.61

Table 3: Measurements of different stages of stem borer, *C. partellus*

Stages	Length (mm)			Breadth (mm)			Width of head capsule (mm)		
	Min.	Max.	Avg. \pm S.D.	Min.	Max.	Avg. \pm S.D.	Min.	Max.	Avg. \pm S.D.
Egg	0.85	1.10	0.95 ± 0.08	0.50	0.70	0.61 ± 0.06	-	-	-
Larva									
First instar	1.50	2.40	1.89 ± 0.31	0.09	0.18	0.13 ± 0.03	0.20	0.30	0.24 ± 0.05
Second instar	2.90	4.80	3.85 ± 0.66	0.40	0.55	0.48 ± 0.05	0.40	0.46	0.42 ± 0.02
Third instar	5.20	9.50	7.80 ± 1.57	0.65	0.98	0.82 ± 0.11	0.60	0.69	0.64 ± 0.03
Fourth instar	6.50	14.80	10.08 ± 2.96	1.02	1.51	1.31 ± 0.16	0.81	0.99	0.90 ± 0.06
Fifth instar	12.40	19.60	16.17 ± 2.33	1.30	1.84	1.55 ± 0.18	1.40	1.56	1.47 ± 0.05
Sixth instar	20.50	28.80	24.49 ± 2.73	2.00	2.70	2.37 ± 0.23	1.69	1.78	1.73 ± 0.02
Pupa									
Pre pupa	16.00	22.00	18.6 ± 2.01	2.30	2.80	2.52 ± 0.16	1.30	1.75	1.52 ± 0.14
Pupa	15.00	17.50	16.24 ± 0.75	2.23	2.75	2.47 ± 0.16	-	-	-

Adult									
Male	12.00	13.50	12.7 ± 0.41	25.00	28.00	26.20 ± 1.03	-	-	-
Female	15.00	16.50	15.77 ± 0.46	31.00	32.50	31.65 ± 0.52	-	-	-

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