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BIOLOGY OF MAIZE STEM BORER *CHILO PARTELLUS* [SWINHOE] UNDER LABORATORY CONDITION

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ABSTRACT

The newly hatched larvae feed on the leaves of the central whorl and it mines the sheath and often tunnels inside the midrib. The older larvae bore down inside the funnel of the plant and feed on internal tissues of stem which caused 'dead hearts'. The female of *C. partellus* preferred to lay eggs in clusters usually on lower surface of leaves near the midrib and sometimes on upper surface of leaves. It was oval in shape and overlapping each other in rows. The length and breadth of eggs were 0.96 ± 0.05 and 0.62 ± 0.02mm., respectively. The incubation period was 3.45± 0.45 days with hatching per cent of 59.47 ± 11.29.The caterpillars passed through six larval instars. The total larval period was 21.40 ± 3.74 days. The duration of pre–pupae was 1.80 ± 0.84 days. The duration of male and female pupa was 4.10 ± 0.92 and 4.20 ± 1.42 days, respectively. The longevity of male and female adult was 3.06 ± 0.60 and 3.40 ± 0.60 days, respectively. The pre–oviposition, oviposition and post–oviposition periods noted as 1.60 ± 0.55, 1.60 ± 0.55 and 1.30 ± 0.45days, respectively. The total life span of male and female was 34.60 ± 2.01 and 36.04 ± 2.46days, respectively.

Key words: *Chilo partellus* [Swinhoe], biology, larvae stage, pupa stage, adults

INTRODUCTION

Maize (*Zea mays* Linnaeus) known as 'corn' is one of the most important cereals crop ranking third among the food crops next to rice and wheat, both in respect of area and production in the world. It occupies 17 per cent of the world acreage and accounts for about 24 per cent of the world production of grain (Anon., 2009). In India maize is cultivated in area of 6.21 million hectares with the production of 13.95 million tonnes of grains with 2246.3 kg ha^{-1} productivity (Anon., 2009a). Gujarat occupies 0.44 million hectares of area producing 0.88 million tones of grain with 1990 kg ha^{-1} productivity (Anon., 2009b). It is attacked by nearly 130 species of insect pests in India (Atwal and Dhaliwal, 2002). Among these, maize stem borer (*C. partellus*) is notorious pest of this crop and plays havoc all over the world (Atwal, 1976). Inspite of regular occurrence of *C. partellus* on maize crop and causing economics losses, systemic work has been done on biology of maize stem borer, *C. partellus* in laboratory condition.

MATERIALS AND METHODS

1. Maintenance of culture

Larval and pupal stage of *C. partellus* was collected from the severely infested fields of maize crop grown at farm of Agricultural School, S. D. Agricultural University, Khedbrahma during the year 2008 to 2010 in *kharif* season. The larvae thus collected were kept in plastic bottle (3.8 cm diameter and 5 cm height) having pieces of maize stem (5 to 6 cm in length) as food. The plastic bottle was covered with plastic lid having sieve for aeration. The food was changed daily and proper sanitation was maintained. The pieces of maize stem were observed daily till the formation of pupae. The pupae, thus formed were placed in Petridish. The sex of adult moths could be differentiated in the pupal stage by examining the location of genital slit in relation to anal slit with the help of binocular microscope. Male and female pupae were kept in an iron wire cage (30 cm x 30 cm x 30 cm) covered with white muslin cloth for adult emergence after determining the sex. A small sponge piece (5 cm x 5 cm) was kept in Petridish in cage after soaked in 5 per cent honey solution as a food. The sponge was replaced every morning. Freshly emerged male and female were collected with the help of plastic tube (7.5 cm diameter x 2.5 cm length). A pair of male and female was released in iron wire cage (60 x 60 x 60 cm) covered with white muslin cloth (Plate–I). The tender part of the maize fixed in earthen pot with the help of cotton having water. This prepared part was placed in center of the cage for egg laying. The cage was observed daily till the death of adults. The freshly laid eggs were collected for further studies.

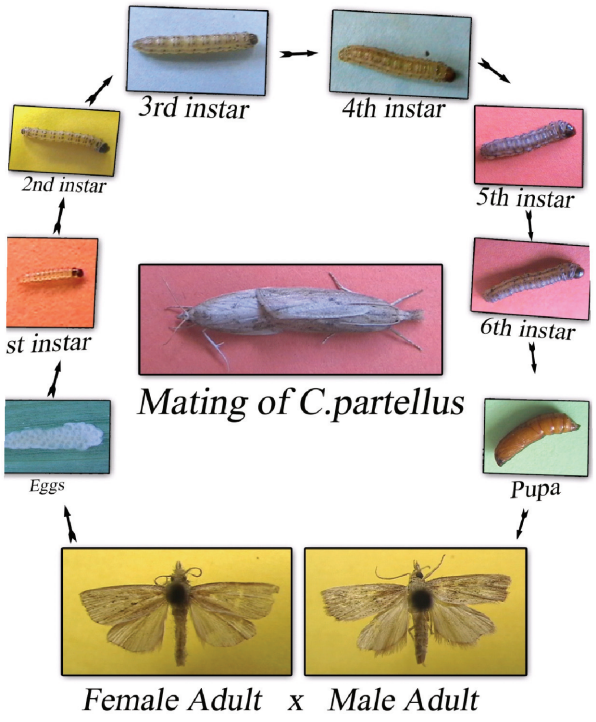

Plate I. Rearing technique of *C. partellus* in laboratory (A) Adult cage; (B) Individual rearing of larvae

2. Eggs

For the study of colour, shape and size, hundred eggs were examined under the microscope. The length and breadth of the eggs were measured with the help of ocular micrometer after calibrating with stage micrometer.

For studying incubation period and hatching percentage of the eggs, counted numbers of freshly laid eggs were observed daily in the morning till hatching and average incubation period was calculated. The eggs were considered as hatched when tiny larva came out of it. Hatching percentage was calculated based on the number of eggs hatched out from total number of eggs kept under observation.

3. Larva

To study the number and duration of different larval instars, freshly hatched hundred larvae were reared individually in plastic tube (5 cm height and 3.8 cm diameter) having small piece of tender maize stem. Then the open ends of plastic tubes were covered with plastic lid provided with small aeration holes (Plate–I). The food was changed daily and proper sanitation was maintained. The observations on change of instar were taken daily till they attained last instar. The exuvium of head capsule of the larva was the indication for the change of instar. The larvae in each instar were studied for their colour and size. The breadth of all instars as well as length of first and second instar larvae were measured with the help of ocular and stage micrometer, while the length of remaining instars were measured by using millimeter scale. The total larval period was calculated on the basis of date of egg hatching and the date of formation of pre–pupa. The growth index value was worked out with the mean percent larva survived dividing by mean larval duration (Srivastava, 1959).

4. Pre–pupa

When full grown larvae ceased feeding, turned darker and wrinkled and became sluggish was considered in pre–pupal stage and it was observed till formation of pupa. This period was considered as pre–pupal period. The length and breadth of the 100 naked pre–pupa were also measured by using millimeter scale.

5. Pupa

The individual pupa was examined for their colour and size. The length and breadth of the 100 naked pupae were measured by using millimeter scale. The male and female pupae were sexed by examining the distance between the genital pore and anal pore. Pupal period was calculated from the date of formation of pupa and the date of emergence of the adult.

6. Adult

The newly emerged male and female adults were killed by using poison bottle and preserved with expanded wings. They were observed under the microscope to study their external morphology. To work out the morphological sex differences in female moth, mating pair of adults were collected and each part of both the individuals in a pair was examined carefully. To determine the variation in size, 50 adults of each sex were measured for the length from the head to the tip of abdomen and breadth with wing expanded using millimeter scale.

[a] Pre–oviposition, oviposition, post–oviposition period and longevity: A pair of freshly emerged male and female moths was caged in iron wire cage (60 cm x 60 cm x 60 cm) covered with a fine muslin cloth to study the pre–oviposition, oviposition and post oviposition period. The tender part of the maize was examined under microscope and number of eggs laid by female was counted daily till the death of female and the average number of eggs laid by a single female was calculated. Pre–oviposition period was calculated from the date of emergence of female and the date of starting of egg laying. Oviposition period was calculated from the date of starting of egg laying and the date of ceasing the egg laying by the female. Post–oviposition period was calculated from the date of ceasing the egg laying to the date of death of female. Longevity of

the male and female was calculated separately from the date of emergence and the date of death of the adult.

[b] Sex ratio: For determining the sex ratio under field condition, the larvae were collected from the infested maize plants and reared in the laboratory till the pupal stage. The sex was determined based on distance between genital pore and anal pore in male and female pupa. The sex ratio under laboratory condition was also determined in the same way from laboratory–reared culture.

RESULTS AND DISCUSSION

1. Egg

1.1 Oviposition site: The female moths laid the eggs in clusters (Plate II) usually on lower surface of leaves especially near the midrib, sometimes on upper surface of leaves but not on white cloth, covered on rearing cage. Similar egg laying pattern of *C. partellus* was also observed by Awasthi (2002), Atwal and Dhaliwal (2002), Patel (2005) and Chavan (2006). Sometimes the female moths laid eggs on upper surface of leaves.

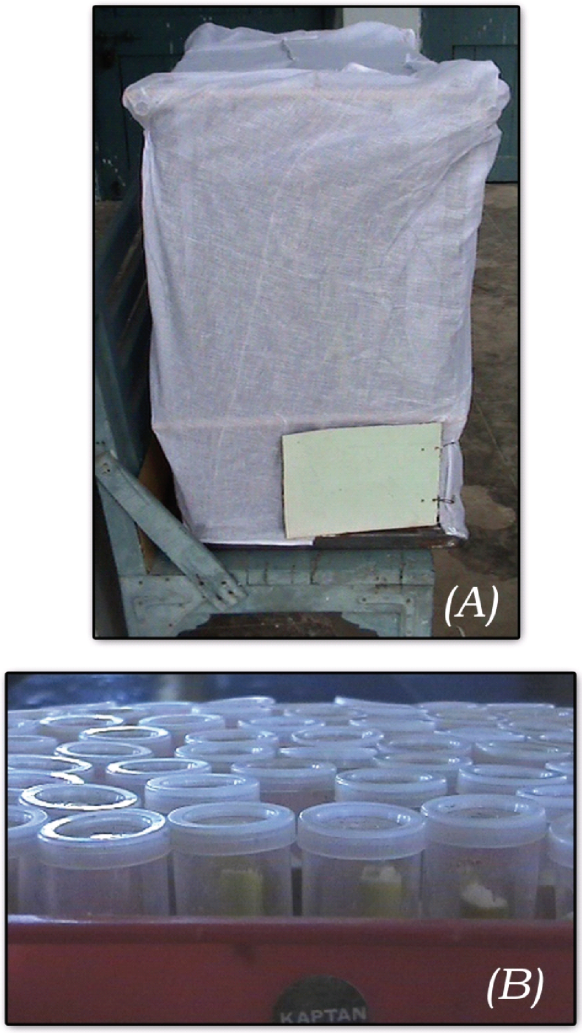

Plate II. Different developmental stages of *C. partellus*

1.2 Colour, shape and size: The freshly laid eggs were creamy white in colour and ultimately become black before eclosion. Similar colour pattern was observed by Awasthi (2002), Jalali and Singh (2003), Patel (2005) and Chavan (2006). The eggs were oval in shape and overlapping each other in rows. This is in accordance with the report of Atwal and Dhaliwal (2002), Awasthi (2002), Jalali and Singh (2003) and Patel (2005). Majority of the eggs were laid on the lower parts of the plants. Unfertilized eggs were not laid in rows. The colour of these eggs was not changed and they were dried up in two days. The length of eggs ranged from 0.93 to 1.10 mm with an average of 0.96 ± 0.05 mm, while the breadth varied from 0.62 to 0.72 mm with an average of 0.66 ± 0.02 mm (Table 1). Similar results were reported by Sepswasdi (1965). According to Patel (2005), average length and breadth was measured to be 0.98 ± 0.07 mm and 0.68 ± 0.03 mm, respectively. Similarly Chavan (2006) reported that the length of eggs varied from 0.90 to 1.00 mm with an average of 0.982 ± 0.035 mm, while breadth of eggs varied from 0.57 to 0.60 mm with an average of 0.579 ± 0.184 mm. Almost similar length of eggs was noted by Mathur and Upadhyay (1985).

1.3 Incubation period: The incubation period varied from 3 to 4 days with an average of 3.45 ± 0.45 days (Table 2). Almost similar incubation period have been reported by Atwal and Dhaliwal (2002), Jalali and Singh (2003), Patel (2005) and Chavan (2006).

1.4 Hatching percentage: Out of 140 eggs observed, 43 eggs hatched in 3 days and 77 eggs in 4 days, while remaining 30 eggs did not hatch. Thus, per cent egg hatched on 3rd day varied from 42.56 to 76.61 with an average of 61.28 ± 13.42, while on 4th day it was from 56.23 to 76.28 with an average of 63.84 ± 11.38. The overall hatching per cent of the eggs was varied from 42.56 to 76.28 with an average of 59.47 ± 11.93 (Table 2). According to Chavan (2006) hatching percentage varied from 66.5 to 86 per cent.

1.5 Number of eggs/cluster: Total five clusters were observed from which the numbers of eggs per cluster were ranged from 3 to 31 with an average of 19.33 ± 8.40. More or less similar number of eggs/cluster was observed by Atwal and Dhaliwal (2002) and Panwar (2006).

2. Larva

2.1 Nature of damage and behaviour: The newly hatched larva feeds on the leaves particularly of the central whorl. Here, it mines the sheath and often tunnels inside the midrib for few days. The older larva bores down inside the funnel of the plant and feed on internal tissues of stem which cause death of central shoot and formation of 'dead

Table 1. Measurements of different stages of *C. partellus*

Sr. No.	Stage	Length (mm)			Breadth (mm)		
		Minimum	Maximum	Mean ± S.D.	Minimum	Maximum	Mean ± S.D.
1.	Egg	0.93	1.10	0.96 ± 0.05	0.62	0.72	0.66 ± 0.02
2.	Larva						
	I instar	1.60	2.20	1.92 ± 0.24	0.19	0.30	0.26 ± 0.04
	II instar	3.98	4.90	4.50 ± 0.34	0.62	0.84	0.73 ± 0.08
	III instar	6.78	8.30	7.48 ± 0.64	0.83	1.12	0.96 ± 0.10
	IV instar	11.18	14.25	13.02 ± 1.24	1.62	1.78	1.70 ± 0.06
	V instar	18.40	20.80	19.68 ± 0.91	2.42	2.84	2.65 ± 0.16
	VI instar	21.04	23.30	22.65 ± 0.95	2.98	3.40	3.26 ± 0.17
3.	Pre–pupa	15.10	16.12	15.78 ± 0.40	3.02	3.54	3.30 ± 0.20
4.	Pupa						
	Male	10.83	11.45	11.15 ± 0.25	2.38	2.58	2.48 ± 0.08
	Distance between genital and anal pore	0.21	0.30	0.24 ± 0.03			
	Female	14.78	14.98	14.89 ± 0.09	3.03	3.12	3.10 ± 0.06
	Distance between genital and anal pore	1.12	1.16	1.14 ± 0.02			
5.	Adult						
	Male	9.60	10.28	9.98 ± 0.30	19.92	20.64	20.27 ± 0.34
	Female	12.10	15.05	13.79 ± 1.21	26.70	28.00	27.17 ± 0.89

hearts' without showing any external sign. Their entry from the leaf to stem was interspersed with small punctures on the leaf (Plate II). Sometimes larvae may leave the top of the plant and migrate down the stem and made entry inside the stem by making tunnel upward. The early instar larvae also feed on tassels. After completion of larval stage, the pupal chamber was made by the larva in the stem having exit hole (Plate II). The newly hatched larvae feed on the leaves particularly of the central whorl. Here it mines the sheath and often tunnels inside the midrib for few days. Similar feeding pattern of neonate larvae was reported by Awasthi (2002) and Patel (2005) on maize crop. The older larvae bore down inside the funnel of the plant and feed on internal tissues of stem which cause death of central shoot and formation of 'dead hearts' without showing any external sign. The early instar larvae also feed on tassels. After completion of larval stage, the pupal chamber was made by the larva in the stem having exit hole.

2.3 Larval instars: During the present study, larvae of *C. partellus* passed through six larval instars (Table 2 and Plate II). Similar observations were observed by Atwal and Dhaliwal (2002), Jalali and Singh (2003), Patel (2005) and Chavan (2006) which strongly support the present findings.

2.3.1 First instar: The caterpillar, as it emerges from the egg, was a tiny worm like creature. It was orange in colour except the head which was black. Similar observations were made by Patel (2005). In contrast to this, Mathur and Upadhyay (1985) reported that the freshly hatched larva was white in colour. The body was slender and the head was broader as compared to the breadth of the body. Three pairs of thoracic legs and four pairs of prolegs were present. Nine pairs of spiracles situated on the prothoracic and first eight abdominal segments were visible. Deep orange coloured bands were present on each segment. Small dark hairs were present on each segment which gives a spiny appearance to the body (Plate II). The length and breadth of first instar larva varied from 1.60 to 2.20 mm with an average of 1.92 ± 0.24 mm and 0.19 to 0.30 mm with an average of 0.26 ± 0.04 mm, respectively (Table 1). Patel (2005) reported the average length and breadth of the first instar larva was 1.84 ± 0.37 and 0.21 ± 0.04 mm respectively. The duration of first instar larvae varied from 3 to 5 days with an average of 3.80 ± 0.84 days (Table 2). Similarly, the average duration of first instar was reported 3.70 ± 0.70 days (Patel, 2005) and 3.56 ± 0.05 days (Chavan, 2006).

2.3.2 Second instar: The second instar larva resembles the first instar larva except that, it was little bigger in size. The body colour becomes slightly darker than that of first

Table 2. Duration of different stages of *C. partellus* in laboratory

Sr. No.	Life stage	Period (Days)		
		Minimum	Maximum	Mean ± S.D.
1.	Egg	3	4	3.45 ± 0.45
	Hatching (%)	42.56	76.28	59.47 ± 11.93
2.	Larva			
	I instar	3	5	3.80 ± 0.84
	II instar	3	6	4.40 ± 1.10
	III instar	2	3	2.40 ± 0.55
	IV instar	3	7	5.20 ± 1.48
	V instar	2	6	3.60 ± 1.52
	VI instar	2	6	4.00 ± 1.58
	Total	18	27	21.40 ± 3.74
	Growth Index			3.56
3.	Pre–pupa	1	3	1.80 ± 0.84
4.	Pupa			
	Male	3	7	4.10 ± 0.92
	Female	3	6	4.20 ± 1.42
5.	Adult			
	Pre–oviposition	1	2	1.60 ± 0.55
	Oviposition	1	2	1.60 ± 0.55
	Post–oviposition	1	2	1.30 ± 0.45
	Longevity			
	Male	2	4	3.06 ± 0.60
	Female	2	4	3.40 ± 0.60
6.	Total life period			
	Male	31	38	34.60 ± 2.01
	Female	32	40	36.04 ± 2.46
7.	Fecundity	36	48	44.32 ± 6.58
8.	Sex ratio (Male : Female)			
	Field	1 : 1.15	1 : 1.24	1 : 1.19
	Laboratory	1 : 1.18	1 : 1.22	1 : 1.20

instar larva. There was one dark line running laterally on either side of the prothorax to the anal segment. The pro-thoracic segment was darker in colour than the remaining segments (Plate II). The length and breadth of second instar larva varied from 3.98 to 4.90 mm with an average of 4.50 ± 0.34 mm and 0.62 to 0.84 mm with an average of 0.73 ± 0.08 mm, respectively (Table 1). The duration of second instar larvae varied from 3 to 6 days with an average of 4.40 ± 1.10 days (Table 2).These observations are tally with those reported by Patel (2005) and Chavan (2006).

2.3.3 Third instar: The third instar larva was stout bodied and darker than the second instar larva. The antennae were visible and the dark spot from which the hairs arise become darker than that of the second instar larva. The lateral dark lines on either side of the larva disappear and spiracles become very prominent (Plate II). Similar observations were observed by Patel (2005) and Chavan (2006) which strongly support the present findings. The length and breadth of third instar larva varied from 6.78 to 8.30 mm with an average of 7.48 ± 0.64 mm and 0.83 to 1.12 mm with an average of 0.96 ± 0.10 mm, respectively (Table 1). The duration of third instar larvae varied from 2 to 3 days with an average of 2.40 ± 0.56 days (Table 2). Similarly, Patel (2005) reported the average length and breadth of the third instar larva was 7.73 ± 0.48 and 0.97 ± 0.10, mm respectively and average duration was 2.91 ± 0.79 days.

2.3.4 Fourth instar: The fourth instar larva was light brown in colour with dark brown head. The prothoracic shield was very prominent. The thoracic as well as abdominal segments have some scattered tubercles each with one, two or even three setae and spiracles were well developed (Plate II). Similar observations were observed by Patel (2005) and Chavan (2006). The length and breadth of fourth instar larvae varied from 11.18 to 14.25 mm with an average of 13.02 ± 1.24 mm and 1.62 to 1.78 mm with an average of 1.70 ± 0.07 mm, respectively (Table 1). Similarly, Patel (2005) reported the average length and breadth of the fourth instar larva was 13.13 ± 0.95 mm and 1.66 ± 0.07 mm respectively. Whereas, Chavan (2006) reported the average length and breadth of the fourth instar larva was 7.64 ± 1.279 mm and 1.182 ± 0.210 mm, respectively. The duration of fourth instar larvae varied from 3 to 7 days with an average of 5.20 ± 1.48 days (Table 2). Similarly, the larval duration of fourth instar was 4.17 ± 1.07 days (Patel, 2005) and 5.64 ± 1.036 days (Chavan, 2006), which is more or less in conformity with the present finding.

2.3.5 Fifth instar: The fifth instar larva resembles the fourth instar larva except that the tubercles were quite prominent. The sub–dorsal stripes, one on either side were present along the body length of the larva. The head was reddish brown in colour and prothoracic shield was light brown in colour (Plate II). Similar observations were made by Patel (2005) and Chavan (2006). The length and breadth of fifth instar larvae varied from 18.40 to 20.80 mm with an average of 19.68 ± 0.91 mm and 2.42 to 2.84 mm with an average of 2.65 ± 0.16 mm, respectively (Table 1). Chavan (2006) reported the average length and breadth of the fifth instar larva was 13.04 ± 1.767 and 1.932 ± 0.266 mm, respectively. The duration of fifth instar larvae varied from 2 to 6 days with an average of 3.60 ± 1.52 days (Table 2). Similarly, the larval duration of fourth instar was 5.64 ± 1.036 days (Patel, 2005) and 4.8 ± 0.764 days (Chavan, 2006), which is more or less in conformity with the present finding.

2.3.6 Sixth instar: The sixth instar larva was quite different from fifth instar larva. The tubercles were larger. The sub–dorsal stripes disappeared. Prothoracic shield was dark brown in colour and body was dirty white. Posterior region of each segment appears white (Plate II). Similar observations on morphological characters of full grown caterpillars have been reported by Atwal and Dhaliwal (2002), Patel (2005) and Chavan (2006). The length and breadth of sixth instar larva varied from 21.04 to 23.30 mm with an average of 22.65 ± 0.95 mm and 2.98 to 3.40 mm with an average of 3.26 ± 0.17 mm, respectively (Table 1). According to Patel (2005), the average length and breadth of sixth instar larva was 22.80 ± 0.40 mm and 3.13 ± 0.10 mm, respectively. The duration of sixth instar larvae varied from 2 to 6 days with an average of 4.00 ± 1.58 days (Table 2). Similarly, the larval duration of sixth instar was 3.96 ± 1.12 (Patel, 2005) and 6.56 ± 1.44 days (Chavan, 2006), which is in conformity with the present finding. The differences in measurement may be due to the effect of food and rearing method.

2.3.7 Total larval duration: Total larval duration varied from 18 to 27 days with an average of 21.40 ± 3.74 days (Table 2). More or less similar larval duration was reported by Awasthi (2002).

2.3.8 Growth index value: The larval growth index value under laboratory condition was 3.56 (Table 2). Present finding tally with those reported by Patel (2005), the larval growth index value was 3.60.

3. Pre–pupa

After a variable number of larval moults and when the larva has become full–fed, pre–pupal stage was reached. It was marked by absence of feeding, preparing pupal chamber, sluggish movement and more contracted form. The length and breadth of pre–pupae varied from 15.10 to 16.12 mm with an average of 15.78 ± 0.40 mm and 3.02 to 3.54 mm with an average of 3.30 ± 0.20 mm, respectively (Table 1). The duration of pre–pupae varied from 1 to 3 days with an average of 1.80 ± 0.84 days (Table 2). According to Patel (2005), the average length, breadth and breadth of head capsule of pre–pupal stage was 15.70 ± 0.40, 3.38 ± 0.31 and 2.25 ± 0.34 mm, respectively and the average duration of pre–pupal stage was 1.96 ± 0.56 days.

4. Pupa

4.1 Site of pupation: Pupation was occurred in the maize stem in a chamber constructed by the mature larva. The pupa lies with its head facing the closed exit hole (Plate II). Similar site of pupation was noted by Atwal and Dhaliwal (2002), Awasthi (2002), Jalali and Singh (2003), Patel (2005) and Chavan (2006).

4.2 Colour, shape and size: Pupa was creamy yellow when freshly formed and turned reddish brown subsequently. They possessed six spines arranged in two rows at the tip of the abdomen (Plate II). Awasthi (2002), Patel (2005) and Chavan (2006) observed more or less similar colour and structure of pupae. The length and breadth of male pupae varied from 10.83 to 11.45 mm with an average of 11.15 ± 0.25 mm and 2.38 to 2.58 mm with an average of 2.48 ± 0.08 mm, respectively. The distance between genital and anal pore of male pupae varied from 0.21 to 0.30 mm with an average of 0.24 ± 0.03 mm (Table 1). The length and breadth of female pupae varied from 14.78 to 14.98 mm with an average of 14.89 ± 0.09 mm and 3.03 to 3.12 mm with an average of 3.10 ± 0.06 mm, respectively and the distance between genital and anal pore of male pupae varied from 1.12 to 1.16 mm with an average of 1.14 ± 0.02 mm (Table 1). Patel (2005) reported the average length, breadth and distance between genital and anal pore of female pupa was 14.78 ± 0.07, 3.05 ± 0.03 and 1.14 ± 0.02 mm, respectively, which was slightly lower (11.21 ± 0.18, 2.44 ± 0.04 and 0.23 ± 0.03 mm, respectively) for male pupa. While, Chavan (2006) reported the average length and breadth of pupa was 11.4 ± 1.609 and 2.54 ± 0.207 mm, respectively and the male pupa was narrow and smaller than that of female. This report tally with the present findings.

4.3 Morphometric differences in male and female pupa: The distance between genital pore and anal pore (Table 1) was more in case of female (ranged from 1.12 to 1.16 mm with an average of 1.14 ± 0.02 mm) than that of male (ranged from 0.21 to 0.30 mm with an average of 0.24 ± 0.03 mm). According to Patel (2005), the distance between genital pore and anal pore was more in female than male.

4.4 Pupal period: The duration of male pupae varied from 3 to 7 days with an average of 4.10 ± 0.92 days, while the duration of female pupae varied from 3 to 6 days with an average of 4.20 ± 1.42 days (Table 2). The pupal stage was 7 to 10 days (Awasthi, 2002 and Jalali and Singh, 2003) and male and female was 4.12 ± 0.95 and 4.23 ± 1.42 days, respectively Patel (2005).

5. Adult

5.1 Colour, size and appearance: The moth was pale straw coloured with forewing slightly darker than the hind wing and a pair of prominent palpi projecting in front of the head like a beak. The male moths were smaller than the female moths and usually darker in appearance. At the time of rest, the wings were laid on the back, one overlapping the other. The tip of abdomen in female was dilated and tufts with hairs while in male it was pointed and devoid of tuft (Plate II). The moth had a pair of prominent palpi projecting in front of the head like a beak. Similar structure was noticed by Awasthi (2002) and Patel (2005). The male moths were smaller than female. Patel (2005) and Chavan (2006) have mentioned the similar

observation. The tip of abdomen in female was dilated and tufts with hairs while in male it was pointed and devoid of tuft. Awasthi (2002), Patel (2005) and Chavan (2006) have recorded the similar observations on type of abdomen in male and female moths. The length of the male adults ranged from 9.60 to 10.28 mm with an average of 9.98 ± 0.30 mm, while the breadth with wing expanded varied from 19.92 to 20.64 mm with an average of 20.27 ± 0.34 mm (Table 1). The length of the female adults ranged from 12.10 to 15.05 mm with an average of 13.79 ± 1.21 mm, while the breadth with wing expanded varied from 26.70 to 28.00 mm with an average of 27.17 ± 0.89 mm (Table 1). According to Patel (2005), average length of male and female was 9.90 ± 0.31 and 13.45 ± 0.79 mm, respectively whereas, the average breadth of male and female with wing expanded was 20.29 ± 0.21 and 27.21 ± 0.56 mm, respectively. Atwal and Dhaliwal (2002) and Awasthi (2002) have mentioned that the breadth of adults with wing expanded was 20 to 30 mm, which tally with the present findings.

5.2 Pre–oviposition: The pre–oviposition period of female moth varied from 1 to 2 days with an average of 1.60 ± 0.55 days (Table 2). The pre–oviposition period was 1 to 2 days at Bangalore (Jalali and Singh, 2003) 1.75 ± 0.50 days (Patel, 2005) and 1.66 ± 0.38 days (Chavan, 2006). These reports were more or less in conformity with the present finding.

5.3 Oviposition: The oviposition period of *C. partellus* female ranged from 1 to 2 days with an average of 1.60 ± 0.55 day (Table 2). Similar observations were reported by Patel (2005) and Chavan (2006).

5.4 Post–oviposition: The female moth lived for 1 to 2 days after the oviposition and occupying on an average post–oviposition period of 1.30 ± 0.45 days (Table 2). The post oviposition period was 0.75 ± 0.35 days (Patel, 2005) and 1.20 ± 0.408 days (Chavan, 2006). Present results are in agreement with these reports.

5.5 Fecundity: The female lay eggs in one to three clusters. The egg laying capacity of female varied from 36 to 48 eggs in each cluster with an average of 44.32 ± 6.58 eggs (Table 2). Present results are in agreement with those reported by Patel (2005). In contrast to this, the female moth laid over 300 eggs (Atwal and Dhaliwal, 2002) and 100 to 500 eggs on maize at Bangalore (Jalali and Singh, 2003). These reports showed higher number of eggs which might be due to the effect of host or environment.

5.6 Longevity: The longevity of male moths ranged from 2 to 4 days with an average of 3.06 ± 0.60 days, while the longevity of female moths ranged from 2 to 4 days with an average of 3.40 ± 0.60 days (Table 2). The longevity of male adult was 3.07 ± 0.64 days, while it was 3.43 ± 0.62 days for female (Patel, 2005) 4.44 ± 0.506 days in female (Chavan, 2006). This duration of male and female moths reported by above workers is more or less in agreement with present findings. In contrast to this, the more life span of female moth was noted as 2 to 12 days and 3 to 7 days on maize by Atwal and Dhaliwal (2002) and Jalali and Singh (2003), respectively, which might be due to the favorable condition prevailed for the pest.

5.7 Sex ratio: Out of 52 pupae formed from field collected larvae, 24 (46.15 %) were males and 28 (54.84 %) were females while out of 88 pupae formed from laboratory reared culture, 40 (45.45 %) were males and 48 (54.54 %) were females. Thus, in field condition the male and female ratio ranged from 1 : 1.15 to 1 : 1.24 with an average of 1 : 1.19, while in laboratory condition it ranged from 1 : 1.18 to 1 : 1.22 with an average of 1 : 1.20 (Table 2). This finding tallied with the reports of Patel (2005).

5.8 Total life period: The total life period of male ranged from 31 to 38 days with an average of 34.60 ± 2.01 days, while the total life period of female ranged from 32 to 48 days with an average of 36.04 ± 2.46 days (Table 2). The pest completed its life–cycle in 5 to 6 weeks (Awasthi, 2002) and 34.68 ± 2.09 days in case of male and 35.06 ± 2.56 days in case of female (Patel, 2005) 57.5 ± 0.033 days in case of male and 59.0 ± 0.092 days in case of female (Chavan, 2006). These reports tallied with the present findings. The lower (3 to 4 weeks) and higher (7 weeks) life span of the pest was reported by Atwal and Dhaliwal (2002). The difference in total life span might be due to the variation in climatic condition.

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