Acta Ecologica Sinica xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Acta Ecologica Sinica

journal homepage: www.elsevier.com/locate/chnaes

Survival and development of maize stem borer *Chilo Partellus* (Swinhoe) Lepidoptera: Crambidae on artificial diet

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ARTICLE INFO

Article history:
Received 20 September 2016
Received in revised form 6 July 2017
Accepted 7 July 2017
Available online xxxx

Keywords:
Chilo partellus
Artificial diet
Life cycle
Oviposition and fecundity

ABSTRACT

The Life cycle of maize stem borer, *Chilo partellus* (Swinhoe) was studied in *in vitro* conditions. Development of stem borer undergoes following stages like egg, larvae, pupa and moth. The egg incubation period ranged from 3 to 6 days, larval stage was observed in five instars. The mean value of I, II, III, IV and V instars showed 3.8 ± 0.16, 5.2 ± 0.02, 6.1 ± 0.06, 7.35 ± 1.5, and 10.12 ± 0.29 days, respectively and complete larvae period ranged from 42 to 49 days. Pupae stage was observed in 8–9 days. The pre-mating and mating period was found at 9.10 ± 1.20 and 5.14 ± 1.08 h while egg laying period in 4.1 ± 1.32 days respectively. Fecundity rate of stem borer is from 262 to 657 eggs. The life span of adult male (3-7) and female (3-8) days was observed with a mean of 6.30 ± 0.85 and 5.10 ± 0.69 days respectively. Life cycle of stem borer gets completed in 47 to 51 days. Development of quality insects in required quantities at different developmental stages and their timely supply plays an inevitable role particularly for insect-breeding resistant programs. Hence to meet these challenges we had tried to standardize an artificial diet with cost effective to rear *Chilo partellus* under *in vitro* conditions.

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1. Introduction

The spotted stem borer (*Chilo partellus*) is one of the most important and destructive pests of sorghum and maize in India [5]. *Chilo partellus* affects plants at seedling, flowering and post-harvestal stages [4]. Predominantly it infects stem part causing 40–90% yield losses [6]. There is also evidence that in some locations the exotic stem borer is displacing indigenous stem borer species [7]. Its infestations are detected by characteristic holes of funnel leaves, the presence of dead hearts and holes in tunneled stems. Acclaimed chemicals to control the pest were not opted by farmers as they are not economical and ecofriendly. An alternative and best approach is to develop insect–resistant cultivars. It requires a clear understanding on insect-host interaction strategies. Consequently in nature insect can locate a host plant through a sequence of behavioral and biological responses. Six main categories of insect behavioral and physiological responses are considered to be important during insect establishment on plants: (i) orientation and settling (ii) feeding (iii) metabolism of ingested food (iv) growth (v) survival and fecundity and (vi) oviposition [3]. For developing borer-resistance maize cultivars, a large number of insects are used in artificial field screening programs. The success of screening studies relies on the timely supply of quality insects in adequate numbers at specific stages of plant development [12]. In the literature, the life cycle of *Chilo partellus* is not well documented. Many researchers have developed various artificial diet by changing components which show influence on growth at various stages like number of larvae per generation, pairing densities, moth development duration etc. In India considering and realizing the significance of all these aspects in rearing stem borer in laboratory conditions, an attempt was made to study the *Chilo partellus* life cycle by optimizing the diet components in lowered cost for effective mass rearing technology.

2. Materials and methods

This study was carried out at Department of Biotechnology, KL University, Guntur, Andhra Pradesh, India.

2.1. Diet preparation

Among the constituents used in artificial diet, Vitamin E plays a crucial role in pupa formation. While bean powder, casein and yeast served as protein sources, Sucrose as carbon source, Ascorbic acid and formaldehyde as preservatives. To ensure microbial free medium methyl para-hydroxy benzoate and agar as solidifying agent. This is the cheapest and best diet for *Chilo partellus* compared to the previously described diets [9]. Diet was prepared in 3 fractions (Table 1). Primarily fraction A components were added in water and allowed to boil on magnetic stirrer. Then fraction B components were added and the total

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http://dx.doi.org/10.1016/j.chnaes.2017.07.001
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Please cite this article as: D. Peddakasim, et al., Survival and development of maize stem borer *Chilo Partellus* (Swinhoe) Lepidoptera: Crambidae on artificial diet, Acta Ecologica Sinica (2017), http://dx.doi.org/10.1016/j.chnaes.2017.07.001

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Table 1
Composition of Ingredients employed in standardizing artificial diet.

S. No	Ingredients	Quantity
Fraction A		
1	D. H_2O	100 ml
2	Bean powder	13.6 g
3	Casein	1 g
4	Carboxyl methyl cellulose	0.25 g
5	Methyl-p-hydroxyl benzoate	0.25 g
6	Yeast	2.8 g
7	Sucrose	4.37 g
8	Ascorbic acid	0.16 g
9	Vitamin E	0.31 g
Fraction B		
10	Agar	1.5 g
Fraction C		
11	Formaldehyde	0.25 ml

mixture was cooled. Finally 0.25 ml of formaldehyde component of fraction C was added. Then mixture was distributed into the cages.

2.2. Eggs

The eggs were sterilized with double distilled water and air dried at room temperature. The sterilized dark spotted egg masses were reserved in 7.8 cm length and 6.7 cm width of plastic jars filled with 20 ml artificial diet. The flasks were closed with muslin cloth attached with cotton wool and set aside in an incubator at 26 °C and 60 ± 10% RH. During the process of egg hatching cotton wool stopper was removed and a juvenile larva develops by consuming the artificial diet.

2.3. Collection of larvae and pupa

The larvae of *Chilo partellus* were surface sterilized by methods as described by Songa et al. [11] and then introduced into 250 ml plastic jar containing artificial diet. Jars containing larvae were taken into the raring units and reared at 60 ± 10% RH and 26 °C with a photoperiod of 12 h light and 12 h darkness (12 L: 12 D) until the emergence of pupation and transformation to adults occur. Diet was replenished at adequate time intervals whenever required. The experimental generation was reported in the results. Pupas were collected and transferred into the sterile boxes until they grow into moths.

2.4. Collection of moths

Adult moths, male and females are carefully collected from the plastic containers and were introduced into rearing cages lined with butter paper (45 × 60 × 45 cm) at the bottom. Cotton swab soaked in distilled water was introduced into cages to nourish the moths. Subsequently cages were kept at room temperature (23–24 °C); 12:12 light: dark photoperiod. Couple of moths was placed in each rearing cage to check and record total number of eggs laid.

Alive moths were transferred to fresh raring cages and dead were removed.

Table 2
Duration of different life stages of maize stem borer, *Chilo partellus* under laboratory conditions.

Stage of insect	Range (days)	Mean ± SEM
Egg incubation period	5–6	5.45 ± 0.51
Larval duration		
I instar	4–5	4.80 ± 0.78
II instar	5–6	6.40 ± 1.89
III instar	7–9	7.30 ± 1.88
IV instar	8–9	7.90 ± 2.28
V instar	8–10	8.10 ± 2.37
Total larval period	32–39	34.5 ± 12.4
Pupal period male	8–9	8.84 ± 1.23
Pupal period female	9–10	9.42 ± 1.15
Premating and mating period (hours)	5–9	7.4 ± 1.20
Oviposition period (days)	4–5	4.1 ± 1.32
Total life cycle (egg to adult emergence)	46–54	48.02 ± 14.87
Adult longevity		
Female	6–7	6.30 ± 0.85
Male	5–6	5.10 ± 0.69

2.5. Statistical analysis

The data was analyzed in triplicates and statistical significance among the replications was evaluated at 5% of probability level. Values were expressed as means ± S.E.M.

3. Results and discussion

Most of the stem borers possess similar life cycles [4] particularly *Chilo partellus* completes its lifecycle in almost seven weeks or 47–51 days [9]. Both sexes of *Chilo partellus* moths were in pale brown color and remain alive for approximately four to eight days as shown in Fig. 4. Mating occurs at early morning mostly between 05.00 am to 07.00 am and then declines on successive nights [5]. Pats [8] observed and reported that flight activity of *Chilo partellus* female moths get decreased during night time. The activity of mated female moths increases gradually and is higher between three to 8 h after the onset of the scotophase (the dark period (night) during a 24 hour period of light and dark) [10]. *Chilo partellus* moths lay 50–100 eggs per batch on smooth surfaces [2]. The whitish eggs of *Chilo partellus*, are flattened, scale like and ovoid [1]. Mortality rate of female moth remains 2 or 3 days longer than male in the voyage of matting.

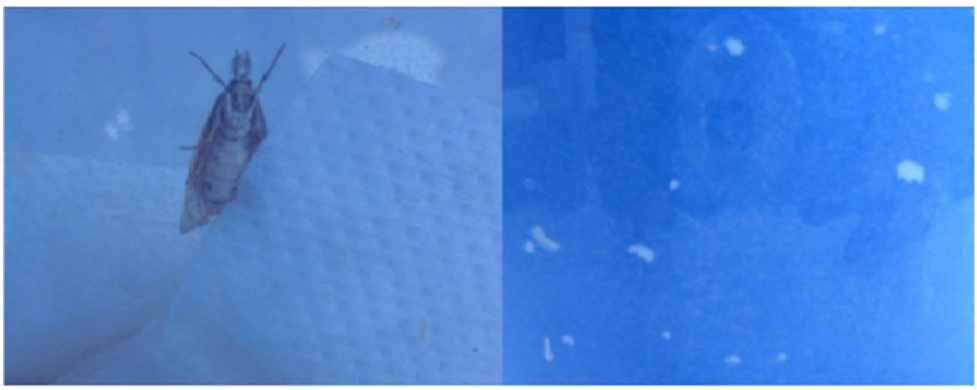

Fig. 1. a) *Chilo partellus* moth b) eggs.

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