INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES
IJPAES
Volume-3, Issue-4, Oct-Dec-2013 ISSN 2231-4490

Coden : IJPAES www.ijpaes.com
Received: 04th July-2013 *Revised: 09th July-2013* *Accepted: 13th July-2013*

Research article

LIFE CYCLE OF *CHILO PARTELLUS* (SWINHOE) (LEPIDOPTERA: PYRALIDAE) ON AN ARTIFICIAL DIETS

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ABSTRACT: *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae) are major insect pests of *Sorghum bicolor* (L) Moench, the main staple food crop in India. Life cycle of *C. partellus* (Swinhoe) (Lepidoptera: Pyralidae) was studied under laboratory conditions by using artificial diet. The research revealed that the *C. partellus* (Swinhoe) (Lepidoptera: Pyralidae) was completed its life cycle in 30-40 days. Larval growth and development was significantly faster on an artificial diet. Feeding by fourth-instar *C. partellus* larvae was significantly higher than third- instar larvae. Feeding on an artificial diet the *C. partellus* pupal period was 7-10 days. Eggs hatch in five to six days, egg hatch from 45-78% in the first generation.
Key Words: *Chilo partellus* larvae, artificial diet, advanced rearing techniques.

INTRODUCTION

Insect pests are the major constraints on its production and productivity, of which stem borers mainly *C. partellus* (Swinhoe) (Lepidoptera: Pyralidae) are most important worldwide [1]. *C. partellus* (Swinhoe) (Lepidoptera: Pyralidae) are the predominant stem borer species in lowland areas of the region [2]. It is becoming increasingly important at higher elevations [3]. The stem borer, *C. partellus* (Swinhoe) is a serious pest of cereals; *Sorghum bicolor* (L) Moench and *Zea mays* in various parts of Asia and Africa [4-6].

Most insect pests are not monophagous [7], they can survive on a wide range of host plants. Cereal stem borers, including *C. partellus*, are polyphagous and have several gramineous and other non cultivated wild host plants [8, 9]. Stem borers have alternative hosts in the Cyperaceae, Graminiae and Typhaceae families. Examples of gramineous species which are hosts to *C. partellus* are *Hyparrenia*, *Panicum*, *Pennisetum*, *Setaria*, Sorghum and Sporobolus species [10]. Sorghum stem borers can cause severe damage at different stages in the development of cereal crops; from seedling to maturity. When infestation is severe, there is a physiological disruption of plant growth, and panicle emergence and grain formation are severely affected, resulting in reduction in kernel number and mass [11].

The sorghum stem borer, *C. partellus* is damaging crops from 26.7% to 80.4% in different agro-climatic regions of India [5]. *Sorghum bicolor* (L) moench is a rich source for food, feed, and fuel [12]. In India, maize and sorghum cultivated in over 6.51m ha with more than 50% area in four states viz., Uttar Pradesh, Rajasthan, Madhya Pradesh and Bihar [13].

In nature an insect locates a host plant through a sequence of behavioral and biological responses. Six main categories of insect behavioral and physiological responses are considered 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 [14].

In this research study the life cycle of larvae, eggs, pupae and moths of *C. partellus* on artificial was investigated.

MATERIALS AND METHODS

Materials

Zay mays, Casein, sucrose, brewer's yeast, sorbic acid, ascorbic acid, methyl-p-benzoate, chlorampenicol and formaldehyde were purchased from merck, chemical, Germany. Cages (60 x 60 x 48 cm) made from acrylic material, tissue papers, cotton, plastic containers and glass wares.

Insects

The *C. partellus* was raised from larvae collected from infested maize and sorghum fields, located on Aurangabad (MS), India. These larvae were arranged according to their size and age, and transferred into plastic containers provided with an artificial diet.

Diet preparation

Diet ingredients were prepared in 3 fractions (A, B and C), [15]. A diet containining 25.2g of 30% casein and 70% *Zea mays* stem tissue powder were mixed with yeast 22.7g, ascorbic acid 2.5g, sorbic acid 1.3g, methyl-p-hydroxy benzoate 2.0g, vitamin E capsules 2.1g, sucrose 35.3g, distilled water 403.1ml, agar powder 12.6g and formaldehyde (40%) 2.0ml were added, mixed thoroughly, and poured into trays. Cubes of feed were cut and used for the feeding experiments. The larvae were reared on this diet and recorded the life cycle of *C. partellus* larvae.

LABORATORY BIOASSAY

Eggs

Eggs oviposited on the tissue paper were collected daily from the cage, and fresh tissue paper replaced. Tissue paper sheet (with the attached eggs) were folded, put diagonally in plastic container, transferred to the insectory, and then allowed to develop at 26-27ºC.A.RH of 70-78% was maintained in the environmental chamber.

Moth rearing

The adult moths were collected from the plastic containers. Adult moths, male and female were introduced into rearing cages. A ball of cotton soaked in distilled water was introduced into cages as source of nourishment. Strips of tissue paper folded longitudinally were suspended with the cage from the top for *C. partellus* onto which the moths laid eggs [16]. The number of eggs laid was recorded.

Statistical analysis

Statistical analyses were performed using SPSS for windows (version 15). Statistical significance between treatments was evaluated at the 5% probability level. General linear model (GLM) ANOVA was used further analysis of data. Values were expressed as means ± S.E.M.

RESULTS

Life cycle

Laboratory life cycle *C. partellus* larvae were placed in laboratory with a temperature of 26-27 °C and 70-78% humidity. The experiments were conducted in the acrylic cages, newly hatched larvae of *C. partellus* on sorghum plants were studied in the laboratory. These larvae were arranged according to their size and age. transferred into plastic provide containers with an artificial diets [15], the diet was replenished in the containers as and when required, until pupation, pupae were removed from the rearing containers, washed in distilled water, surface dried and kept in plastic containers (35mm height and 30mm diameter). The bottom of the container was lined with moisture whatman filter paper. The life cycle of *C. partellus* on an artificial diet was completed in 30-40 days. The life cycle is completed in 25-50 days when conditions are favourable [8]. Sometimes longer in colder months, and shorter in shot ones, one successive, generation may develop in favorable conditions, in regions where there were favorable conditions. An abundance of host plants, *C. partellus* normally develop continuously all year, round.

Eggs

Eggs were flat and oval, creamy white and about 0.8mm long (Figure1), an egg mass may contain 15-35 eggs. The eggs overlap and appear as fish scales or roof shingles. Eggs appear pearly white to yellow when first laid, but turn darker as they age. Eventually, a dark spot appears in each egg, which was the head of a developing larva. Eggs hatch in five to six days, eggs hatch in the early morning (6.00-8.00h), four to eight days after being oviposited. A developmental period of the species was *C. partellus* 21days. Fecundity results showed by number of eggs laid were 155 for *C. partellus*.

Larvae

Five stages of *C. partellus* larvae, eggs, early instar larvae, late instars larvae and pupae. Full grown larvae were stout smooth, about 25-30mm, in length purplish pink on the dorsal side and white on ventral side (Figure 2). They have a black or dark brown head and appear off-white or gray, with rows of black dots on the body. The life cycle was completed in 5-6 weeks, and the larvae period takes 28-35 days. The mean duration of I, II, III, IV and V instars was 4.80± 0.78, 6.40± 1.89, 7.30± 1.88, 7.90± 2.28, and 8.10± 2.37 days, respectively. The young larvae eat part or all of the egg shell during hatching in *C. partellus*. The newly hatched larvae show varied behavior. They may start feeding immediately after their hatching. Larval mortality would be very low under artificial conditions.

Moth

The moths has pale brown a 20-30mm wingspan, the male has pale brown forewings with dark brown scale forming a line on the tips of the wings, the hind wings were pale yellow the female was much lighter than the male. The male moth was much darker and appears olive brown with less distinct lines on the wings (Figure 3). *C. partellus* moths were more active during full moon and were attracted by a crop 3-4 weeks old. Planting was therefore best done between full moons, early planting was also important. The premating and mating period occupied 9.10± 1.20 and 5.14± 1.08hrs, respectively, oviposition period occupied 4.1± 0.35 days. The adult male and female lived for 3 to 8 days and 3-7 days with a mean of 6.30± 0.85 and 5.10± 0.69 days, respectively.

Pupae

The pupae were cylindrical in shape and dark brown and, average weight was 200±1.52mg. There were usually one generation, the pupal period takes 7-10 days. The size of female pupa was slightly larger than of the male pupa (Figure 4). Male pupa measured 13.38±0.62mm in length 3.30±0.21mm in width and female pupa measured 16.47±0.87mm in length 4.26±0.19mm in width. The male pupa period was 7.37±0.71 days, and the female pupa 8.07±0.91 days. Sex differentiation could be detected in the pupal stage using morphological differentiation at the tip of abdomen especially the space between the genital pores. The pore of the female pupa was wider than that of the male.

DISCUSSION

The fecundity of *C. partellus* was reported to be approximately 434 eggs per female [17]. These were much higher than reports of [16] of 150 eggs for *C. partellus*. Developmental period of *C. partellus* was 45 days [16]. Depending on the species, the larval stage may last 25-58 days [18]. The young larvae eat part or all of the egg shell during hatching in most of the lepidoptera [19]. Larval mortality can be very high under natural conditions. Oloo [20], found that 90% of the larvae did not complete their development. Small larvae suffer heavily from cannibalism, predation and abiotic factors such as wind and rain, and mortality up to 100% has been recorded [20]. Mating occurs soon after emergence and on the two to three subsequent nights [17], egg batches of 10-80 overlapping eggs were laid on the undersides [21], or upper sides of tissue papers, often near midribs. Pupation normally takes 5-14 days after which adult moths emerge [8, 22, 23]. These research results corroborate finding by [24, 25].

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. This was because larvae of the *C. partellus* had to be reared singly in plastic container. However, various aspects of these techniques have been modified to suit our conditions, and also to make the rearing process more efficient. Fecundity and life history of the artificially reared *C. partellus* were similar those of the wild colonies. 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.

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