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Full Length Research Paper

Study on the growth and development of brinjal shoot and fruit borer with different diets

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A laboratory experiment was conducted with two natural and one artificial diet on the growth and development of brinjal shoot and fruit borer (BSFB). The population of BSFB used in the study was in the 2nd instar larvae. Among the different diet, brinjal was the best for growth, development and longevity of larvae and pupae and prolongation of larval and pupal period. The mean length of full grown larvae fed with natural the food brinjal were 9.37, 9.80 and 12.44 mm from generations 1, 2 and 3, respectively. The larval and pupal duration on brinjal food media were 13.10 and 8.17, 12.80 and 8.23 and 13.10 and 8.03 days in generations 1, 2 and 3, respectively. The percentages of adult emergence from pupae raised in brinjal were 65.38, 47.95 and 33.78 in generations 1, 2 and 3, respectively.

Key words: Brinjal, brinjal shoot and fruit borer (BSFB), natural and artificial diet.

INTRODUCTION

Brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guen, is the most serious pest of brinjal, an important commercial vegetable crop in Bangladesh (Alam, 1969; Cork et al., 2001). The yield loss caused by this pest has been estimated up to 67% in Bangladesh (Islam and Karim, 1991). Farmers of Bangladesh particularly of intensive brinjal growing areas like Jessore apply insecticides 84 to 140 times in a growing season (Anonymous, 2003). Pesticide resistance is emerging as one of the key constraints to successful crop protection and public health problems worldwide (Dover and Croft, 1984; Sundaramurthy, 2010). Insecticides resistance in BSFB especially to pyrethroids is now widespread in many brinjal-producing countries. High levels of resistance to many organocarbamate and pyrethroids have been reported in field population of BSFB in various regions (Dittrich et al., 1985; Prabhaker et al., 1995). Such assumptions are more evident from reports of great variations in the requirements of pesticides application for BSFB control in different areas. No study has been conducted systematically with the fixed populations of different brinjal growing areas.

The information on environmental-friendly management tools for the management of this pest is scanty. In this country, the chemical insecticides still remain the key tools for the management of this pest, although in many instances, the insecticide does not yield good control. The main reason, perhaps, the indiscriminate uses of insecticides against this pest have caused enough resistance in this pest. So, at present, safer and efficient management methods alternative to chemical control have become inevitable in entomological research. It is therefore, essential to undertake detailed studies on various aspects of the insect's life and activity with a view to evolving its effective control measure. This requires continued experiment in the laboratory and field that in turn, demand continuous supply of different stages of the pest throughout the year. Laboratory-reared insects might be used for the studies on behaviors, developing management practice, screening of resistant variety (ies) or insecticides, sex pheromone, insect pathogens, effects of chemical sterilants and sterile male technique as well as growth and development of the pest.

Considering the stated perspective, this experiment was

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Table 1. Effect of natural and artificial food materials on the larval growth and development of brinjal shoot and fruit borer.

Food material	Length of larvae (mm)			Larval period (day)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
Potato	8.73±0.2 [b]	9.80±0.26[a]	11.54±0.44[a]	14.6±0.40[b]	14.1±0.12[b]	13.5±0.50[b]
Brinjal	9.37±0.46[a]	9.80±0.10[a]	12.44±0.88[a]	13.1±1.21[c]	12.8±0.29[c]	13.1±0.81[b]
Artificial diet	8.07±0.51[c]	8.77±1.42[a]	11.23±0.75[a]	15.3±0.70[a]	14.9±0.82[a]	15.8±0.68[a]

Values having the same letter(s) in a column did not differ significantly at 5% level of probability; ±, standard error.

designed to fulfill and standardize a laboratory mass rearing method for BSFB; to determine the effective food material (s) for mass rearing of BSFB and to know the effect of different food materials on the development of different stages of BSFB.

MATERIALS AND METHODS

Mass rearing of BSFB using artificial diets

The adult population collected from Jessore was reared separately in rearing cases at the laboratory of the Department of Entomology, SAU, Dhaka. The stock of BSFB served as the source of the reference population. Fifty (50) pupae of the reference population was taken and kept in Petri dishes and placed inside separate rearing box. Female and male adults at the ratio of 3:1 were placed into a glass jar (10 cm high and 7 cm diameter) for their successful mating. The open end of the jar was covered with a piece of white cloth and was tightly closed by a rubber band. A small ball of cotton soaked in 10% sugar solution was placed inside the jar to feed the adult. After mating, the female laid eggs in cluster and singly in the inner surface of the white cloth. At least 10 to 15 newly hatched larvae were then removed from the bag and were placed on slices of the artificial diet, which was then kept in containers with hygienic tissue paper. Fresh pieces of the diet were always supplied at an interval of 3 to 4 days. Only 2nd instar larvae were placed in a fresh piece of the diet. Pupae were collected and the whole procedure was followed repeatedly up to the end of the study.

Standardization of diets for rearing of BSFB

The mass rearing method developed by Agricultural Biotechnology Support Project (ABSP) II, 2005 were used in this study.

Food materials

One artificial diet and two natural food materials such as potato and brinjal were tested. The potato and brinjal were peeled and were put in 0.01% Bavistin fungicide solution for 10 min.

Composition and preparation of the artificial diet

The composition and the method of preparation of the artificial diet, as suggested by the Agricultural Biotechnology Support Project (ABSP) II, 2005 was adopted as follows: Wessories salt mixture NaCl (10.5 g), KCl (12.0 g), $KHPO_4$ (31.0 g), $MgPO_4$ (14.9 g), $FePO_4$ (1.47 g), $MnSO_4$ (0.03 g), KAl ((0.04 g), KI (0.01 g) and the artificial diet mixtures yeast (6.5 g), Wesson's (2.5 g), methyl-4-hydroxy benzoate (1.3 g), sorbic acid (0.5 g), sucrose (10.0 g) and ascorbic acid (2.15 g) were weighted; HCHO 10% (1.0 ml), vitamin solution (4.0 ml) and H_2O (250 ml) were measured and all were mixed thoroughly. Subsequently, 70 g black gram powder was soaked in 150.0 ml water in a beaker for 1 h. Then 10.0 g agar and 250.0 ml water was heated up to boiling point. All the items were blending for well mixing and put into a plastic tray.

RESULTS AND DISCUSSION

This study dealt with two natural and one artificial diet to rear the larvae of *L. orbonalis* G. under laboratory conditions. The efficiency of the diets was compared based on the length, breadth and weight of the larvae, pupae, total period of development, percent pupation and percent of larval mortality (Saeed and Khan, 1997). Significant differences were recorded in the length of larvae due to the effect of different diets. The mean length of full grown larvae that fed on the natural food that is, reared on potato and brinjal were 8.73±0.21, 9.37±0.46; 9.80±0.26, 9.80±0.10; 11.54±0.44, 12.44±0.75 mm in generations 1, 2 and 3, respectively. On the other hand, on the artificial diet the length was 8.07±0.51, 8.77±1.42 and 11.23±0.75 mm for the same generations which was comparatively smaller than those reared on the natural diet (Table 1). Larvae become smaller in the succeeding generations in the artificial diets and in potato than in brinjal. Islam (1973) observed that larvae of brinjal shoot and fruit borer usually required a light amount of sodium, potassium, calcium and phosphorus derived from the host plants.

Significant difference among the larvae reared on different food media was recorded in terms of mean duration of the larval life. The larval duration on potato and brinjal food media was 14.6±0.40, 13.1±1.21; 14.1±0.12, 12.8±0.29 and 13.5±0.50, 13.1±0.81 days in generations 1, 2 and 3, respectively. On the other hand, on the artificial diet, the larval period were 15.3±0.70, 14.9±0.82 and 15.8±0.68 days for the same generations which was comparatively smaller than those on the natural diet (Table 1). The larval period was shorter and the larval weight was higher when reared on brinjal cultivars having higher percentage of protein contents (Isahaque and Chawdhury, 1984; Phillips et al 1990; Singh and Singh, 2003).

Significant differences were recorded in the length of pupae due to the effect of different diets. The mean length of the full fed pupae reared on potato and brinjal were 13.6±0.45, 15.0±0.90; 1 0.7±0.28, 12.2±0.20 and

Table 2. Effect of natural and artificial diet on the pupal growth and development of brinjal shoot and fruit borer.

Food material	Length of pupae (mm)			Pupal period (days)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
Potato	13.6±0.45[b]	10.7±0.28[b]	11.4±0.23[b]	9.23±0.25[b]	9.23±0.25[b]	9.17±0.21[b]
Brinjal	15.0±0.90[a]	12.2±0.20[a]	12.7±0.65[a]	8.17±0.21[c]	8.23±0.25[c]	8.03±0.06[c]
Artificial diet	12.6±0.90[c]	9.88±0.40[c]	10.3±0.25[c]	10.2±0.26[a]	8.23±0.25[c]	10.4±0.32[a]

Values having the same letter(s) in a column did not differ significantly at 5% level of probability; ± standard error.

Table 3. Effect of natural and artificial diets on adult emergence of brinjal shoot and fruit borer.

Food material	Adult emergence (%)		
	Generation 1	Generation 2	Generation 3
Potato	43.85±1.84[b]	33.78±1.37[b]	24.65±1.48[b]
Brinjal	65.38±2.11[a]	47.95±1.92[a]	33.78±1.85[a]
Artificial diet	41.22±1.95[b]	32.77±1.39[b]	23.41±2.08[b]

Values having the same letter(s) in a column did not differ significantly at 5% level of probability; ±, standard error.

11.4±0.23, 12.7±0.65 in generations 1, 2 and 3, respectively. On the other hand, on the artificial diet, the length of the pupae was 12.6±0.90, 9.88±0.40 and 10.3±0.25 mm in the same generations which was comparatively smaller than those reared on the natural diet (Table 2). Islam (1973) observed that the pupae of brinjal shoot and fruit borer larvae usually require a light amount of sodium, potassium, calcium and phosphorus derived from the host plants.

Mean duration of pupal life significantly differed among the larvae reared on the different food media. The pupal duration that was recorded on potato and brinjal food media were 9.23±0.25, 8.17±0.21; 9.23±0.25, 8.23±0.25 and 9.17±0.21, 8.03±0.06 days in generations 1, 2 and 3, respectively. On the other hand, on the artificial diet, the larval period was 10.23±0.26, 10.3±0.42 and 10.4±0.32 days for the same generation which was comparatively smaller than that on the natural diet (Table 2). Isahaque and Chawdhury (1984) reported that the pupation period was shorter and the larval weight was higher when reared on brinjal cultivars having higher percentage of protein contents.

Percentages of adult emergence from pupae reared in potato, brinjal and the artificial diet were 43.85±1.84, 33.78±1.37 and 24.65±1.48; 65.38±2.11, 47.95±1.92 and 33.78±1.85 and 41.22±1.95, 32.77±1.39 and 23.41±2.08 in generations 1, 2 and 3, respectively (Table 3). Das (1984) studied the mass rearing on brinjal fruits and found that the adults emerging from such rearing were quite normal with usual fertility and about 98% of them mated successfully.

Alam et al. (2003) reared brinjal shoot and fruit borer on potato, brinjal, whole potato and sliced potato and found that adult emergence and rate of development after the 3rd generation was higher in potato than its original host, brinjal. The brinjal diet which gave higher larval and pupal lengths and shorter period of development, higher percent of adult emergence, higher growth index and lower percentage of larval mortality, was considered as the best one for mass rearing of any insect (Hoque 1974; Srinivasan et al., 1998; Tohnishi et al., 2005). In this experiment, the growth and development of larval to adult stages were compared with those fed on natural food (brinjal) along with other different hosts under laboratory condition. Among the diets tested, potato was found as the best alternative for the growth and development as well as the reproductive performances of BSFB. Rearing of brinjal shoot and fruit borer is still a difficult job. Many reports have so far been published on the mass rearing of BSFB among them only at AVRDC, a procedure for successful rearing of BSFB was reported so far (AVRDC, 1996). The growth and development and reproductive potentiality was higher in potato than in the artificial diet. Although, BSFB can be reared on artificial diet but it is expensive and not commercially available in Bangladesh. On the other hand, potato is available throughout the year with an affordable price. So, considering the earlier mentioned reasons, potato can be considered as the best alternative host materials for BSFB rearing.

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