



## Development of rearing technique of brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* GUENEE

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### Abstract

Rearing of brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee was studied in the laboratory on brinjal fruit, the usual host and potato in slice form or whole tuber as factitive host. Suitability of the host was determined on the basis of larval and pupal development and adult emergence of BSFB. Potato tuber was found as promising medium than brinjal fruit for rearing BSFB in the laboratory. Brinjal fruit and slice potato were identical as host for rearing BSFB. Whole potato was found to be better host for rearing than slice potato. An average of 40 larvae to be developed successfully in a single potato tuber of size 70-80g. Formation of pupae (49.76%) and emergence of adults (67.63%) of BSFB was significantly higher when whole potato was used as host. BSFB developed from the whole potato showed the highest fecundity (226.37).

**Keywords:** rearing technique, brinjal shoot and fruit borer, potato tuber

### Introduction

Brinjal (*Solanum melongena* L), a popular vegetable crop in Bangladesh belongs to the family solanaceae and widely cultivated almost all over the world. From the time of planting to harvest this crop is affected more than 36 insect pests (Regupathy *et al.* 1997) <sup>[1]</sup>. Brinjal shoot and fruit borer is one of them. An efficient and effective laboratory rearing technique is important to minimize the crop damage and quality vegetable production against economically important insect pest, *Leucinodes orbonalis*. A sustainable integrated pest management approach can be achieved to control this pest through implementing appropriate biology study. In the laboratory modified oviposition chamber plays an important role to enhance maximum egg laying capacity of the adults in terms of fecundity and fertility of the eggs. The percentage of survivality of neonate larvae depends on appropriate food/hosts supplied in the laboratory. Mass rearing of insects is an important part of conducting research to achieve better management of insect. Economical important insect pests are mass reared under controlled conditions with the purpose of evaluating chemical insecticides and plant resistance to insects. Important information can be observed while rearing insects for example their lifespan, duration of life stages, feeding behaviour and preferences, reproduction and the effect of biotic factors. Susceptibility to biological and chemical insecticides can be monitored and can give early warning if resistance develops within a pest species.

The knowledge on the biology of an insect is important for rearing the pest. A large number of brinjal shoot and fruit borer larvae and adults are needed for different laboratory, green house and field trials. Mass rearing of BSFB is still a great problem in Bangladesh. Potato, tomato, sweet potato and brinjal were reported to be the host plants of *L. orbonalis* by several authors (Bradley 2000, CAB International 2005, EPPO 2005 and Patnaik 2000) <sup>[9]</sup>. In Philippines, BSFB is known to feed mainly on brinjal plant under field conditions but has been successfully reared on

tomato fruits and potato tubers. In India, BSFB has been recorded in tomato, potato and in weeds such as *Solanum nigrum* while other crop plants have been reported as possible hosts of the pest (IPM CRSP 2007). In developed countries, mass rearing techniques have been used in research centers those are mostly on artificial diet. In Bangladesh artificial diets are not readily available and very costly also. To overcome these constraints, a method for rearing BSFB in the laboratory throughout the year is to be developed. Therefore, an experiment was undertaken to study the biology and rearing technique of BSFB in the appropriate hosts. The objectives of the study were to investigate the suitability of utilizing two host plants for mass rearing of BSFB in the laboratory.

### Materials and Methods

Mass rearing technique of brinjal shoot and fruit borer was investigated in the laboratory, Department of Entomology, Bangladesh Agricultural University, Mymensingh. To develop mass rearing technique, selection of suitable host is of prime importance. Easy availability of host is a prerequisite for mass rearing. Although brinjal is the main host of BSFB but the insect can develop on other solanaceous plants (Bradley 2000 and CAB International 2005). In addition, it should be mentioned here that it is difficult to use brinjal plant and fruit in the laboratory to rear BSFB for quick drying, shrinking and rotting properties of the fruits. Potato, a solanaceous crop is reported to be an alternate host of BSFB (Korycinska and Cannon 2010). As potato is available throughout the year, comparatively cheap, less perishable and easy to handle, it was considered to be a good material for rearing BSFB in the laboratory. Two experiments were carried out to develop a mass rearing technique of BSFB in suitable host.

### Host suitability for rearing BSFB

An experiment was conducted in the laboratory, Department of Entomology, Bangladesh Agricultural University,

Mymensingh to select a suitable host for mass rearing of BSFB. Round shaped eggplant, whole medium sized potato (70-80g) and sliced potato (a potato was cut into 2 pieces) were used as host for BSFB in this study. In a preliminary study it was observed that BSFB grows well on unsprouted potatoes harvested at least two months before than the freshly harvested and sprouted ones. The potato of this kind is found to be preferred host for boring by the pest and for its ability to support the development of the larvae inside. It was also noted that the neonate larvae cannot penetrate the skin of the whole potato. For this reason the potato was used either as a peeled or sliced one. The whole potato was peeled by a sharp knife. The whole peeled potato and sliced potato were treated with bevestin to protect fungal infection. The host sample was kept in a small plastic bowl. Forty neonate larvae collected from stock culture of BSFB were released on individual host of potato and brinjal fruit. After releasing larvae, the open portion of the plastic bowl was covered with its lid so that released larvae were not able to leave arena. Within 2-3 hours the larvae were found to set into the hosts by boring. In the next day, the infested hosts were transferred to open trays containing dried brinjal leaf as the larvae preferred it to go pupation. After 10-15 days which depends on temperature, the full fed larvae came out from the hosts for pupation and took shelter in the dried leaves. The pupae were collected from the dried leaves and counted which were then kept in glass cylinder where the adults emerged from the pupae. The mosquito net was placed on the open mouth of the cylinder with a rubber band in order to prevent the emerged adult from escaping. After emergence the adults were counted and sex ratio was determined. The adults (one male and one female) were then kept in oviposition chamber for egg laying. Two side open glass cylinder was used as oviposition chamber covered with fine meshed net on both sides. The females laid eggs on the net. The eggs laid by individual female were counted. Fecundity of the females of BSFB from different hosts was calculated. There were 10 replications in this experiment of complete randomized design. The data were analyzed statistically using ANOVA in MSTAT-C and compared using DMRT.

#### **Effect of larval density at release on the rearing of *L. orbonalis***

The suitable host for rearing of brinjal shoot and fruit borer in the laboratory was determined in the previous experiment. The peeled whole potato was found suitable for rearing of BSFB. To determine the capacity of the potato tuber as supporting material for the growth and development of the larvae a laboratory experiment was designed and carried out releasing variable number of neonate BSFB larvae on a single whole potato. Different number of neonate larvae viz. 20, 30, 40, 50 and 60 were released per peeled whole potato. The potatoes infested with a specific number of larvae were kept separately in plastic bowl and allowed to develop the larvae inside. After boring full fed larvae came out from the hosts for pupation. The pupae were collected and were kept in glass jar cylinder for adult emergence. The number of pupae and emerged adults of male and female from potatoes infested with variable number of BSFB larvae were counted. Percentage of successful pupal development and adult emergence was calculated. The sex ratio was determined. The duration of larval and pupal development and adult longevity were

recorded. A pair of adults (one male and one female) from each treatment were kept in oviposition chamber for laying eggs. The fecundity of the females developed from potato tubers with different larval density (20, 30, 40, 50 and 60/peeled whole potato) was determined. Complete randomized design with 10 replications was followed for this experiment.

#### **Stock culture of brinjal shoot and fruit borer, *L. orbonalis***

Infested brinjal fruits were collected from the farmers' field. Collected fruits were kept in plastic dish or in trays with dried brinjal leaves in the laboratory. Pupae were collected from those fruit samples and were transferred to glass jar cylinder where the adults emerged from the pupae. The open portion was covered with the mosquito net with a rubber band. The adults (one male and one female) were kept in oviposition chamber for mating (1 pair/chamber) providing 5% cotton-soaked sugar solution. The cylindrical glass jars were used as oviposition chamber in which both open portions were covered with small pored net. The female laid eggs on the net. The net with eggs approximately 200 was kept in plastic bowl containing 4 peeled potatoes. Biology study of BSFB indicates that hatchability of the eggs is around 90%. A batch of around 200 eggs could be released on bavistin treated 4 peeled potatoes where around 180 larvae could be expected. After hatching the neonate larvae entered into the potatoes and started to develop inside entering the potato as food. The desired stages of the larvae were collected from the infested potato and used in different experimental purposes. Immediately after larval development they were provided with dried brinjal leaves for favourable environment for the development as pupae. The adults developed from the pupae were collected and used for next mass rearing and other experimental purposes. This procedure was followed again and again for maintaining the stock culture and mass rearing.

### **Results and Discussions**

#### **Host suitability for rearing BSFB**

Three different types of hosts were tested for their suitability in rearing BSFB. The hosts had significant effect on the development of BSFB which was assessed by the pupal and adult emergence and also the fecundity of the female (Table 1). It was evident from the suitability study that a peeled potato can support around 40 larvae for their development. Formation of pupae and emergence of adult of BSFB was significantly highest when whole potato was used as host. The probable reason could be the availability of food for the development of BSFB larvae inside whole potato. Formation of pupae in whole potato was 49.76% whereas it was 40.08% in brinjal and 35.25% in slice potato. The trend of adult emergence in three different hosts was similar with that of pupal development. The adult emergence was maximum (67.63%) in whole potato and minimum (53.57%) in slice potato.

Females developed from different hosts did not show significant variation in sex ratio. The ratio of male and female of BSFB developed from different hosts were more or less similar ranging from 1:1.02 to 1:1.07. Nearly 50% individuals or a slightly higher number of moths were female. Results of the sex ratio found in the present experiment indicate that distribution of sex is not dependent

on the host. This is also evident from the findings of Shobharani and Nandihalli (2010) [12] and Singh and Singh (2001). Shobharani and Nandihalli (2010) [12] reported that the male-female sex ratio of BSFB was 1:1.04 and Singh

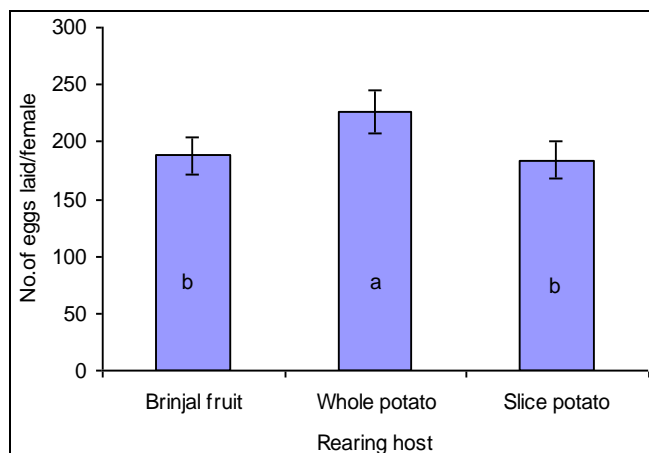
and Singh (2001) also reported the sex ratio of BSFB was 1:1.03. It can be concluded that sex ratio of BSFB is not host dependent.

**Table 1:** Effect of different hosts on the formation of pupae and emergence of adult BSFB

Hosts used for rearing	%Pupae developed ± SE	%Adult emergence ± SE	Sex ratio (Male: Female)
Brinjal fruit	40.08 ± 1.10 b	62.80±1.82 b	1:1.02
Whole potato	49.76 ± 1.51 a	67.63±1.81 a	1: 1.07
Slice potato	35.25 ± 1.19 c	53.57±2.20 c	1:1.04
Level of significance	**	**	
CV%	16.49	9.81	

- Mean with different letter(s) in a column differ significantly
- \*\* Significant at 1% level
- 40 neonate larvae were released on each host
- 10 replications were made

Fecundity of BSFB female developed from different hosts varied significantly (Figure 1). The highest fecundity (226.37) was found when reared in whole potato. Fecundity of females developed from brinjal fruits and slice potato was statistically identical.



**Fig 1:** Effect of different rearing hosts on the fecundity of BSFB. Vertical bars represent ±SE. same letter(s) within the bars don't differ significantly ( $p \leq 0.01$ ). Fecundity calculated from the egg laying of 10 females

Both the hosts potato and brinjal belonging to the family solanaceae were found promising for rearing BSFB in the laboratory. However, successful completion of larval development leading to the formation of pupae and thereafter adult emergence of *L. orbonalis* were significantly highest on whole potato than the slice potato and brinjal fruit. Moreover, the fecundity of the female in the whole potato was also significantly higher. It indicates that whole potato is superior for rearing BSFB. The probable reason could be the availability of food in the whole potato for the development of larvae as the host remained in good conditions for a longer period. Continuous supply of nutrition is a prerequisite for the development of the larvae and thereby for rearing of it. Two other hosts slice potato and brinjal fruit were found to lose their freshness

and also found to deteriorate in quality in short period of time due to drying out and fungal infection which affected the continuous supply of nutrition. These are the probable reasons for making the host less suitable for rearing BSFB in the laboratory. Although brinjal fruit is the usual host of BSFB, deterioration of nutritional quality could be considered as the main factor for less suitability of brinjal fruit as rearing medium. However, if the BSFB were reared in the standing brinjal fruit in the field, the result would be different as the conditions of the fruits remain better than those left in laboratory.

Higher fecundity was evident in the female developed from whole potato than those from the other hosts. One of the reasons is the variation of the size of the female. Although no attempt was made to measure the size of the female developed from different hosts but the casual observation showed that the female emerged from the whole potato were found comparatively healthy than those developed from other hosts. The reason could be explained similarly as the size of the many individuals as relationship with the nutritional supply of the host.

**Effect of larval density at release on the rearing of *L. orbonalis***

Based on the available information of host suitability, whole potato was selected as host for rearing *L. orbonalis*. When different numbers of neonate larvae (20, 30, 40, 50 and 60/host) were released on whole potato for their development, it was found that there was a significant variation for the formation of pupae, the emergence of adults and the fecundity of the females (Table 2). Highest percentage of pupae formation (57.01%) and the adult emergence (62.73%) were recorded when 30 larvae were released per potato. There was no significant variation in the formation of pupae and adult emergence when 20, 30 and 40 neonate larvae released/potato (Table 2). When the larval density was 50, it showed a significant reduction in the pupal formation (38.71%) and adult emergence (43.62%). Further increase of larval density to 60 did not cause significant variation in the development of BSFB with the density of 50. In general fecundity of the females developed from the host with a lower larval density was higher than those with higher larval density. Maximum fecundity was 211.10 when developed from the density of 30 individuals per potato. The insects developed from the density of 60 laid minimum number of eggs (159.53).

**Table 2:** Effect of number of larvae released on whole potato for mass rearing of *L. orbonalis*

No. of larvae released	%Pupal emergence ± SE	%Adult emergence ± SE	Eggs laid/female ± SE
20	55.53±2.33 a	61.48±2.05 a	198.67±19.47 ab
30	57.01±1.72 a	62.73±1.97 a	211.10±18.38 a
40	56.13±2.25 a	58.42±2.59 a	206.73±18.24 a
50	38.71±2.57 b	43.62±2.24 b	190.67±13.92 ab
60	35.38±2.47 b	42.63±1.94 b	159.53±18.81 b
Level of significance	**	**	**
CV%	15.14	12.84	29.55

• Data in a column followed by same letter(s) do not differ significantly • \*\* Significant at 1% level








The developmental success of BSFB was higher comparatively low BSFB larvae released. This is might be the due to nutritional supply as well as the space. Lower number of individuals had better nutritional supplement and sufficient space for the development. On the contrary developmental success was low in the host with high density of BSFB larvae which can be assumed for higher competition among the individuals for nutrition and space. The female developed from the host with lower density had higher fecundity. It indicates that they had better chance for their reproductive development also. Among the treatments

a significant reduction of number of eggs per female was evident with the highest larval density.

Considering all these developmental parameters, it could be highlighted that a larval density of 40 per potato tuber should be maintained for the successful rearing of BSFB in the laboratory. As no reports on density related rearing of BSFB in potato tuber is available, it is not possible at this moment to discuss the present results with the findings of others. Potato could be selected as a good rearing medium for BSFB. The present results support the findings of Anonymous (2005). In addition, it provides the information on the optimal density of the BSFB larvae per unit size of host for rearing the pest in the laboratory.

**Procedure of rearing technique of *L. orbonalis* in whole potato**

 <p><b>Step 1:</b> BSFB infested brinjal fruits collected from farmers' field are kept in tray with dried brinjal leaves</p>	 <p><b>Step 2:</b> Collected BSFB pupae developed from infested brinjal fruits of tray</p>
 <p><b>Step 3:</b> Collected pupae in glass cylinder and emerged adult of BSFB from pupae covered with mosquito net</p>	 <p><b>Step 4:</b> Two pairs of freshly emerged BSFB adults (male and female) are placed in rearing chamber for deposition of eggs</p>
 <p><b>Step 5:</b> Eggs laid by BSFB female on the nylon net</p>	 <p><b>Step 6:</b> Eggs of BSFB on piece of net kept in film container for hatching</p>

 <p><b>Step 7:</b> The neonate larvae of BSFB are being released into peeled potato</p>	 <p><b>Step 8:</b> Peeled potato with neonate larvae of BSFB kept in plastic box for 2 hours for settling</p>
 <p><b>Step 9:</b> BSFB infested peeled potatoes in tray with some dried brinjal leaves</p>	 <p><b>Step 10:</b> Visible symptom of BSFB infestation in peeled potato after 10 days of larval release</p>
 <p><b>Step 11:</b> A cross section of infested potato showing full grown BSFB larvae inside</p>	 <p><b>Step 12:</b> Full feed larva is coming out from the potato tuber and searching dried brinjal leaf for pupation</p>
 <p><b>Step 13:</b> Pupae of BSFB collected from pupal site which will be used for next generation</p>	

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