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Host Preference of *Trathala flavoorbitalis* on Brinjal shoot and Fruit Borer and Rice Leaf Folder

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ABSTRACT

The study was conducted both in the greenhouse and field from August 2003 to August 2004. *Trathala flavoorbitalis* is an efficient parasitoid of both Brinjal shoot and fruit borer (BSFB) and Rice leaffolder (RLF) but its parasitism efficiency on BSFB larvae is higher than that of RLF larvae. The highest parasitism rate by *T. flavoorbitalis* on BSFB larvae in August is 36% & July is 47% and on RLF larvae in November is 26% & Mid March-April is 28%. The parasitism rate of *T. flavoorbitalis* was always significantly higher in BSFB larvae than that of RLF. The parasitism of BSFB larvae was 1.52 to 2.14 folds higher than that of RLF. In the confined condition of cage or microplot, when *T. flavoorbitalis* was given a choice to parasitize BSFB and RLF larvae, they preferred more BSFB larvae.

INTRODUCTION

The major constraint of brinjal production is the infestation by a plethora of insect pests. It can be attacked by as many as 53 species of insect pests (Nayar *et al*., 1995). Among them, Brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee (Lepidoptera:Pyralidae) is the most destructive pest of brinjal in Bangladesh (Alam,1969; Chattopadhyay, 1987).Rice leaffolder (RLF), *Cnaphalocrocis medinalis* Guenee were previously considered minor or sporadic pest (Capco, 1957; Lim, 1962), but in recent years their importance has increased (Kalode 1974; Soejardjan and Iman, 1980). *Trathala flavoorbitalis* (Cameron) has been reported as an important parasitoid of BSFB in Srilanka (Beesan and chatterjee, 1935; Chu and Hsiu, 1937), India (Naresh *et al*., 1986, Malik *et al*., 1989) and Bangladesh (Alam and Sana, 1964). Recent studies done by Alam *et al*. (2005) in Bangladesh showed that this parasitoid has significant influence in reducing damage to brinjal crop by parasitizing BSFB.A noteworthy success in classical biological control of the leaffolder was reported in Fiji with the introduction of a larval parasitoid *T. flavoorbitalis* (Cameron) from Hawaii (Hinckley, 1963). Wada and Shimazu (1978) observed in Japan that parasitization of *C. medinalis* due to *T. flavoorbitalis* was 30%. It may also be apprehended that the RLF may be one of the alternate hosts of *T. flavoorbitalis* in Bangladesh. The parasitoid can utilize both the host during the crucial period of insecticides applications. The intensity of pesticide application is seven times higher in brinjal fields than that of rice field (PAB, 1999). Probably due to that reason, *T. flavoorbitalis* is abundant in rice fields than heavily sprayed brinjal fields. They move to brinjal fields to attack BSFB when the insecticide use is restricted (Alam *et al.,* 2005). Yet it is not identified which one is the most preferred host of *T. flavoorbitalis,*BSFB or RLF.

Now-a-days, the role of parasitoids in an integrated pest management system is well recognized. Integrated pest management practice likes removal of BSFB infested shoots and fruits and RLF infested rice leaves, biological control, mass trapping with sex pheromone and minimal or no use of toxic pesticides to encourage proliferation of different parasitoids particularly of *T. flavoorbitalis*.These approaches can facilitate to develop a low cost sustainable management practice to reduce pesticide use and yield losses caused by BSFB and RLF for farmers of south Asia (Alam *et al*.,2003). To considering the importance of parasitoid, *T. flavoorbitalis* in suppressing BSFB and RLF and to explore the environment friendly management practices for the production of brinjal and rice, this study was undertaken with the following objectives: to determine the relative preference and parasitism efficiency of *T. flavoorbitalis* for BSFB and RLF.

MATERIALS AND METHODS

The study was carried out at the experimental field and greenhouse of the Entomology Division, Bangladesh, from August. Agricultural Research Institute (BARI), Gazipur, Bangladesh from August, 2003 to August, 2004. The land was opened by a tractor drawn disc plough and harrowing was done on the following day for proper pulverization. For ensuring good tilt, power tiller was used. Tractor drawn labeler was used to level the land. In this study, cow dung and other chemical fertilizers were applied as recommended by Rashid (1999) for commercial brinjal cultivation.

Maintenance of Brinjal and Rice

Brinjal seeds (variety: Chega, Jessore local) were collected from Horticulture Division, Bangladesh Agricultural Research Institute (BARI) Joydebpur, Gazipur. A seedbed measuring 5m x 1m was prepared and seeds were sown. Standard seedling raising practice was followed (Rashid,

Table 1. Comparison of *T. flavoorbitalis* parasitism efficiency on its host BSFB and RLF, in cage condition under greenhouse.

Treatments	No. of BSFB/RLF released	No. of *T. flavoorbitalis* released	No. of BSFB/RLF parasitised	Percent parasitism
Observation 1				
BSFB + parasitoid	24	8	21.33±0.67 [a]	88.89±2.78 [a]
RLF + parasitoid	24	8	14.00±1.56 [b]	58.33±4.82 [b]
Observation 2				
BSFB + parasitoid	24	8	22.00±1.57 [a]	91.67±4.82 [a]
RLF + parasitoid	24	8	13.33±1.77 [b]	55.56±6.36 [b]
Observation 3				
BSFB + parasitoid	24	8	20.67±1.77 [a]	86.11±7.36 [a]
RLF + parasitoid	24	8	10.67±2.67 [b]	38.87±5.56 [b]

Means followed by the same letter (observation wise) are not significantly different (P>0.05, t-test)

1999). The seed beds were lightly irrigated, mulched regularly for ensuring germination as well as proper growth and development of the seedlings. Thirty-six days-old (3/4 leaf stage) healthy brinjal seedlings were transplanted three times in the experimental plots (10mX10m). Brinjal plants were transplanted for the first time in last week of May 2003, second time in last week of October 2003 and lastly in the last week of March 2004. So, there was continuous brinjal cultivation in the field throughout the year.

Rice seedbed (60 m^2) was cultivated by plough and power tiller was used latter to ensure good tilt. Ploughing was done for puddling with required water. Then the whole plot was submerged with irrigation water and preserved for 7 -10 days. Rice seedbed measuring 1.25m x 0.5 m was prepared with green manure, 7 g urea/m^2 and gypsum. Forty five day-old healthy rice seedlings were transplanted in the experimental field plots (15mX12m) during first week of July (T. Aman) and first week of February (Boro).

Efficiencies and preference of *T. flavoorbitalis* on BSFB and RLF

Studies on i.Parasitism efficiencies/preference of *T. flavoorbitalis* on BSFB in the field, ii. Parasitism efficiencies/preference of *T. flavoorbitalis* on RLF in the field, iii. Parasitism efficiencies/preference of *T. flavoorbitalis* on BSFB and RLF in caged conditions and iv. Parasitism efficiencies/preference of *T. flavoorbitalis* on BSFB and RLF in Microplot conditions were undertaken. These aspects of parasitism efficiencies and host preference of *T. flavoorbitalis* on BSFB and RLF were conducted in the laboratory, green house and in the field of BARI. The details of the studies are described as follows:

Parasitism efficiencies of *T. flavoorbitalis*

Forty infested brinjal shoots, thirty infested fruits and forty infested (folder) rice leaves were collected per plot (replication) at fortnightly interval from the brinjal and rice fields from August 2003 to August 2004. Infested brinjal shoots, fruits and rice leaves were collected with the help of secateur. Collected specimens were carried to the laboratory in perforated polythene bags and placed on plastic tray (35cmX 22 cm) having sterilized sand (4 cm depth). The excised portion of infested brinjal shoots and fruits and infested folded rice leaves were wrapped with wet cotton sheet to keep them fresh for few days. The tray was then placed in a wooden rearing cage (42 x 30 x 27 cm) having windows netting with 32 mesh net for proper ventilation. The rearing cages were kept on wooden table inside laboratory maintaining 27±2^{0}C. The infested shoots, fruits and leaves were kept in the cages until the larvae came out from the shoots and fruits and pupation starts. Close observations were made till the adult RLF and *T. flavoorbitalis* emerged from the infested leaves. To determine the parasitism efficiency of *T. flavoorbitalis* in

Table 2. Comparison of *T. flavoorbitalis* parasitism efficiency on its hosts BSFB and RLF in micro plot of greenhouse.

Treatments	No. of BSFB/RLF released	No. of *T. flavoorbitalis* released	No. of BSFB/RLF parasitized	Percent parasitism
Observation 1				
BSFB + parasitoid	30	12	84.33±2.03[a]	81.11±6.77[a]
RLF + parasitoid	30	12	11.33±1.45[b]	37.77±4.84 [b]
Observation 2				
BSFB + parasitoid	30	12	23.33±1.77[a]	77.78±5.89[a]
RLF + parasitoid	30	12	12.33±1.02[b]	41.11±4.01 [b]
Observation 3				
BSFB + parasitoid	30	12	24.33±1.77[a]	81.11±5.88[a]
RLF + parasitoid	30	12	13.33±2.67[b]	44.44±2.94[b]

Means followed by the same letter (observation wise) are not significantly different (P>0.05, t-test)

the field population of RLF larvae infesting rice were arranged side by side and rice plots were kept without any application of pesticides. So, there was ample opportunity of conservation of the *T. flavoorbitalis* .

Calculation of Parasitism (%)

The number of adult BSFB/RLF and parasitoids *T. flavoorbitalis* emergences were counted and recorded everyday. The percent parasitisms were then calculated using the following formula: Percent parasitization = Number of parasitoid adults emerged/ Number of BSFB/ RLF adults + parasitoid adults emerged X 100. Mean parasitism percentages of BSFB in shoots, fruits and RLF in leaves were calculated. Comparison between the means of shoots and fruits were also analyzed by student's t-test and plotted in the graphs.

Parasitism and Preference of *T. flavoorbitalis*

Cage and Microplot studies were conducted in temperature-controlled glasshouse (maintained at 28-30^{0}C) of Entomology Division, BARI during September-October 2003 and April-May 2004, respectively to observe host preference of *T. flavoorbitalis* for the BSFB larvae and RLF larvae. The cage (2ft X 1.5ft X 1.5ft) was made by wood and mesh nylon net. Three sides and door were rounded by mesh nylon net. A total of 24 RLF and 24 BSFB neonate larvae@ 8 larvae/pot were released along with 8 female 2-3 days old parasitoids, *T. flavoorbitalis* per cage (2ft X 1.5ft X 1.5ft). Another cage (2ft X 1.5ft X 1.5ft), having 24 RLF larvae and 24 BSFB larvae were kept without any parasitoids and considered as the control. There were 4 sets of such cages and one such cage was considered as one replication. On the other hand, in microplot a total of 30 BSFB and 30 RLF neonate larvae was released along with 12 female of 2-3 days old parasitoids of *T. flavoorbitalis* per micro plot after 40 days of transplanting of brinjal and rice. Another micro plot, having 30 BSFB larvae and 30 RLF larvae was kept without any parasitoid release and considered the control. Therefore, there were four sets of micro plots with same type of setting and one plot was considered control and one set was regarded as one replication. After 10 days of release of host and parasitoids larvae in cage and microplot shoots and fruits and rice plants were cut from ground level and thoroughly checked for live larvae. As the parasitoid, *T. flavoorbitalis* can parasitize all instars of the host larvae but the parasitized neonate larvae can not survive (Alam *et al*., 2003), except those who were escaped from parasitism. The number of escaped alive larvae were collected and recorded from every brinjal shoot and fruits and rice leaves. To eliminate the effect of other mortality factors acting on the pests and to determine the parasitism rate, percent mortality figures were adjusted, following Abbott's (1925) formula in both studies.

RESULTS AND DISCUSSIONS

Parasitism efficiencies of *T. flavoorbitalis*

There was a seasonal effect on the number of BSFB as well as its parasitoid, *T. flavoorbitalis*. The number of both the host and parasitoids were highest during the hot humid period of September-October and lowest in cool dry period of December-February. The average number of *T. flavoorbitalis* adults recovered from the field-collected shoots and fruits was 4.33 amounting to parasitism of 16% BSFB larvae (Figure 1). But the number of parasitoids from the same number of damaged shoots and fruits increased to 40.67, amounting to parasitism of 49% within 12 months from the plots without insecticides application. *T. flavoorbitalis* had an affinity to parasitize more BSFB larvae feeding within the shoot than that in the fruit (Figure 2). Alam *et al*.(2005) reported that from December to February, the BSFB population as well as their parasitoid; *T. flavoorbitalis* was generally lower than rest of the year.

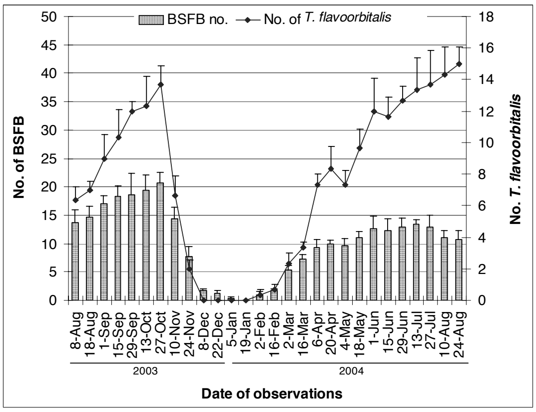

Figure 1. Population fluctuation of BSFB and parasitoid *T. flavoorbitalis* in brinjal shoots in the non-sprayed brinjal plots.

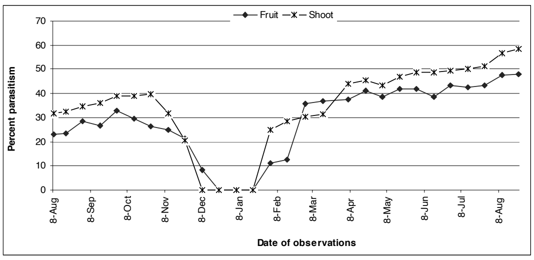

Figure 2. Comparison of parasitism rate by *T. flavoorbitalis* on BSFB in brinjal fruits and shoots in the non-sprayed brinjal fields.

The average year-round parasitism rate of *T. flavoorbitalis* on BSFB larvae attacking both fruits and shoots of brinjal and RLF larvae infesting rice leaves was plotted on the (Figure 3).

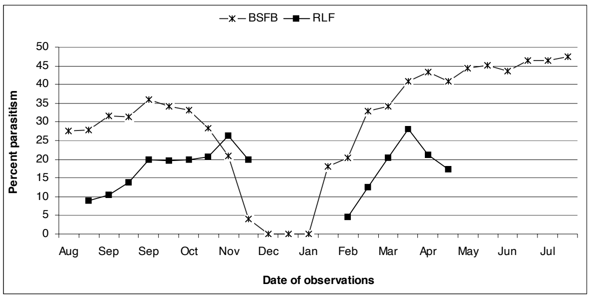

Figure 3. Comparison of parasitism rate by *T. flavoorbitalis* on BSFB larvae in brinjal and on RLF larvae in rice in the non-sprayed brinjal and rice fields.

It was observed from the figure that parasitism rate of *T. flavoorbitalis* on BSFB larvae in August was 26% and in July was 47% and on RLF larvae in November were 26% and Mid March-April it was 28%. So, the parasitism rate of *T. flavoorbitalis* was always less in RLF larvae than that of BSFB. Similarly Sakai *et al*. (1942) reported that in the rice field they found numbers of parasitoids infesting rice leaf folder's eggs, larvae and even pupae. On the other hand in brinjal, the list of natural enemies attacking BSFB is not very long. So, *T. flavoorbitalis* probably is facing less competition in parasitizing BSFB larvae than that of RLF. This may be the reason for more parasitism in BSFB larvae than RLF larvae. It has been reported that high parasitism of *T. flavoorbitalis* occurred on the later instars of the pests, especially in the 3rd and 4th instars (Sandanayake and Edirisinghe, 1992). They further observed that when given a choice for oviposition, the parasitoid prefers 3rd to 5th instars larvae to 1st and 2nd instars. Under natural conditions, however, the parasitoid may attack the early instars when older instars are scarce or absent. In case of RLF the later larval instars hide themselves inside the folded leaves and the BSFB larvae kept them inside the feeding tunnels made by them. But in BSFB an exit hole prevails through which the live excreta of the pest is generally coming out. That is an external sign of the presence of the live larvae of BSFB and which attract the parasitoid, *T. flavoorbitalis*. So, to locate the BSFB larvae is probably easier for the parasitoids than the rice leaffolder. Due to these reasons the parasitism by *T. flavoorbitalis* on BSFB larvae might be higher than that of RLF larvae.

Preference of *T. flavoorbitalis* under cage RLF

In the caged condition percent parasitism of *T. flavoorbitalis* was significantly higher on BSFB larvae than that of RLF larvae in all the three observations (Table 1). In the 1st observation the parasitism on BSFB larvae was 88.89% while in RLF larvae it was 58.33%. In the 2nd and 3rd observations, 91.67% and 86.11% BSFB larvae and 55.56% and 38.87% RLF larvae were parasitized, respectively.

Preference of *T. flavoorbitalis* microplot RLF house

In microplot studies, *T. flavoorbitalis* parasitized significantly higher number of BSFB larvae than that of RLF larvae in all the observations (Table 2). In the 1st observation, 81.11% BSFB larvae and 37.77% RLF larvae were parasitized by *T. flavoorbitalis*, and in 2nd and 3rd observations, 77.78% and 81.11% BSFB larvae and 41.11% and 44.44% RLF larvae were parasitized by the parasitoid. In both the cage and microplot studies, when *T. flavoorbitalis* was given a choice to parasitize BSFB and RLF larvae, they preferred BSFB larvae. In the cage and microplot studies neonate larvae were released and Alam *et al*. (2003) observed that *T. flavoorbitalis* could be attack the early instars of larvae when the older instars were scarce or absent. So, in this case the neonate larvae were attacked by the parasitoids and due to parasitism the neonates could not survive. In both the studies, the neonate larvae were released on the leaves of rice and brinjal. In rice, the RLF larvae started feeding on the leaves and later part started weaving threads to fold the leaves. On the contrary, after releasing the BSFB larvae on the brinjal leaves, they started searching shoots or fruits to bore inside and start feeding. During crawling to search for shoots they were easily identified by the parasitoids and that is the most vulnerable time for BSFB larvae to be parasitized by the parasitoids. In the natural eco-system the similar scenario also happened. BSFB lays eggs on the underside of the brinjal leaves. After hatching the neonate larvae are looking for suitable shoots or fruits and during that time they are exposed to predation or parasitism. In addition, at later instars of BSFB larvae, parasitoids locate the feeding holes made by the borer inside shoots and fruits of brinjal and parasitize them easily by inserting their long ovipositor through the holes. On the other hand, in rice field, the RLF lays their eggs on rice leaves, living and after hatching, they start feeding and start to weaving threads to fold the leaves, living inside. There is ample hiding spaces of RLF larvae in the rice eco-system to escape from *T. flavoorbitalis* parasitism compared to that of BSFB in brinjal eco-system. So, it is clear from the above discussion that the parasitism efficiency of *T. flavoorbitalis* is higher on BSFB larvae than that on RLF larvae.

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