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HOST PREFERENCE, FECUNDITY AND LONGEVITY OF WHITEFLY *BEMISIA TABACI* ON BRINJAL AND TOMATO

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ABSTRACT

Studies were conducted to compare host preference, fecundity and longevity of *Bemisia tabaci* on brinjal and tomato. Results revealed that the highest number of eggs (76.41), nymph (14.5) and adult (9) of whitefly were on brinjal than tomatoes and found it suitable for feeding and oviposition. Significantly more *B. tabaci* adult females (81.32) were found feeding on brinjal than tomato (27.50). The longevity of developmental stages of *B. tabaci* was slightly higher on brinjal than tomato while the longevity of 2nd and 3rd instar nymphs was higher on tomato than brinjal. Females laid an average of 142.60 ± 3.01 eggs over their lifetime on brinjal and 98.41 ± 1.96 eggs on tomato.

Keywords: *Bemisia tabaci*, brinjal, fecundity, host preference, tomato.

INTRODUCTION

Brinjal (*Solanum melongena* L.) and tomato (*Lycopersicon esculentum* Mill) are considered as important commercial vegetables that planted in different parts of Bangladesh. Both of these are grown in the open fields and in homestead garden. Tomato is one of the major vegetable grown extensively throughout the world. Now–a–days Tomato yellow Leaf curl virus (TYLCV) constitutes one of the key challenges for tomato production. Whitefly has the ability to inoculate and transmit the TYLCV from infected to healthy plant especially due to their transient feeding behaviour. It injects toxicogenic substances present in their saliva that can induce physiological changes in plant lead to typically stunted and crinkled plant growth having very small fruits or no fruits that drastically reduces the fruit yield (Makkouk 1978).

The whitefly, *Bemisia tabaci* (Gennadius) has became a problematic pest in greenhouses and open fields for many years. It is an insect pest capable of reducing

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plant productivity and longevity, as well as vectoring a lot of plant pathogenic viruses. It is the most devastating pest in tropical countries, both nymphs and adults feed on phloem sap from sieve tubes with their sucking mouthparts. High population of the whiteflies *B. tabaci* drains out enough nutrients by consuming large quantity of sap which resulted scarce amino acids and this activity also lead to the production of great quantities of honey dew (Bethke *et al*. 1991). This honey dew becomes a substrate for growing sooty mold that reduces the photosynthetic capacity of the foliage (Bethke *et al*. 1991). Frequent use of pesticides on whitefly has raised environmental concerns and produced resistance in whitefly population. As a result, whitefly became a major problem for the green houses and many field crops of commercial importance. Whitefly has become a major agricultural pest of protected horticultural crops such as tomato, pepper, melon, lettuce, etc. in tropical and subtropical areas causing direct damage through feeding and honeydew deposition, as well as geminiviruses transmission (Prabhaker *et al.* 1985). Since then, it has become one of the most important sucking pest of world's industrial and food crops like cotton, sunflower, melon, tomato, brinjal etc. Over 500 plant species from Asia, Africa, America, Europe, Russia, Australia and the Pacific Islands confirms its polyphagous nature. It causes severe damage to cotton, mungbean, soybean, okra, brinjal and other cultivated crops by feeding on sap, secreting honeydew and transmitting virus diseases (Jose and Usha 2003). Whitefly acts as a sole vector for more than 100 plant viruses, which cause diseases to many commercial crops in different parts of the world (Jones 2003) and the severity of the disease depends on the population of whitefly. Whitefly can rapidly disseminate viruses in the field even when populations are not appreciable, and cause severe crop damage in susceptible plantings. It is an insect pest capable of reducing plant productivity and longevity, as well as a virus vector (Bourland *et al.* 2003). Considering above facts the present research work was conducted to compare host preference, fecundity and longevity of *Bemisia tabaci* on brinjal and tomato.

MATERIALS AND METHODS

Studies were conducted in the experimental farm of Patuakhali Science and Technology University (PSTU) campus and entomology laboratory during November 2013 to April 2014. A culture of *B. tabaci* was maintained in a laboratory on the brinjal and tomato cultivars, respectively raised in pots before starting the actual study. Seedlings of brinjal and tomato were raised in a separate isolated compartment of the laboratory at 25 - 35°C with 70 – 80% RH and placed in the study site at 4 leaf stage. Twenty individual plants of each species were maintained in the demarcated plot measuring 50 x 30 ft^2 in PSTU experimental farm.

Host plants and whitefly: Seeds of brinjal and tomato were collected from Bangladesh Agricultural Research Institute, Gazipur. The seeds were placed in Petri dishes (150 cm diameter) with wet cotton to initiate germination. The partially germinated seeds were grown individually in 12 cm diameter plastic pots and used in the study at 4 leaf stage. These pots were placed into cages (60 x 60 x 60) cm^3. Whiteflies were collected from tomato and brinjal plants grown in homestead garden of PSTU campus to maintain stock culture.

Feeding and oviposition preference of whitefly: Free choice tests were conducted to compare the feeding and oviposition preference of *B. tabaci* on the brinjal and tomato plant. Six plants of each crop were selected. Twenty four leaves, 12 from each crop were randomly selected and labeled with small pen marks. The plants were individually placed in cages (60 x 60 x 60 cm^3) in which 240 adult females of *B. tabaci* (10 adult females per leaf) were introduced. These cages were maintained at the controlled conditions having temperature of 27 ± 0.5 °C, 70-80% RH, 14:10 LD cycle. The number of *B. tabaci* adults and eggs associated with the leaves of each plant was recorded after 24 hours.

Development and survival of immature by Petridish assay: Approximately 10 pairs of *B. tabaci* adults were released on the leaves of each host plant placed in petridishes (150 cm diameter) where petioles of leaves were wrapped with wet cotton to maintain moisture of the leaves. Adults were allowed to lay eggs for 12 h before being removed. The infested plants were placed in 60 x 60 × 60 cm^3 cages. The development and survival of each immature stage on the two crops were recorded daily until all the whiteflies emerged. With the exception of the crawlers, which were capable to move small distance immediately after hatching from egg, the other immature stages were sessile and cannot move. Leaves with last instar nymphs were covered with leafclip cages to trap emerging adult whiteflies. Emerged adult whiteflies were counted and sexed as described by Gills (1993) and used for daily longevity and fecundity studies.

Life table by clip cages assay: Clip cage was a hand-made instrument having a crystal clear, plastic, round-shaped tube (1.5 cm diameter). Specifically, a tube was cut to a length of 0.5 cm and sealed at one side with a fine insect-proof mesh. A small-sized hole (2 mm diameter) was prepared on the side of the cage in order to allow whiteflies to enter. A lid was prepared with a plastic piece having the same size (1.5 cm diameter) as the tube, after which both the cage and lid were attached to the clip. The clip cage was attached to the underside of brinjal and tomato plant leaf. Mated females were obtained and introduced into clip cages. They were then transferred to fresh leaves every 24 hours until death, to determine the daily fecundity (number of eggs laid by female whitefly over its lifetime). Longevity and number of eggs laid each day were recorded. Fecundity and longevity data were used to calculate daily and lifetime fecundity of *B. tabaci*.

Statistical analysis: Every data for host preference, developmental period, survival, longevity and fecundity on the two host plant were subjected for analysis of variance. Analysis of variance (ANOVA) was carried out in order to analyze the means by using significant differences among mean values. Means were determined using LSD test at a 95% confidence level. Data were analyzed by using a completely randomized design (CRD) with six individual replications.

RESULTS AND DISCUSSION

Host preference of whitefly: Host preference of whitefly in terms of number of eggs, nymphs and adults found on different host plants is presented in Fig. 1. Fig. 1 revealed that the highest number of eggs (76.41), nymphs (14.5) and adults (9) of whitefly was recorded on brinjal plant than tomatoes for both feeding and oviposition. The cumulative distribution of various life stages of *B. tabaci* also showed a clear preference of host plant selection in a free choice test between brinjal and tomato (Fig. 1). Whiteflies can show some degree of variability in the preference for host plants depending on the time, season, environmental conditions and agronomic practices (Gerling 1990).

Adult feeding and oviposition preference: Under free choice test, significantly more number of *B. tabaci* adult females were found feeding on brinjal (81.32) than tomato (27.50) showing a stronger preference for feeding ($F = 64.56$, $Df = 1$; $P = 0.0001$) on brinjal among two host plant. Similarly, there was a significant difference ($F = 47.21$, $Df = 1$; $P = 0.0001$) for oviposition preference which was also greater on brinjal (213.00 ± 33.00) than on tomato (102.00 ± 22.00) (Table 1). The preference for brinjal over tomato in terms of both number of whiteflies attracted and oviposition could be due to differences in physical and chemical characteristics of the leaves of the two plant species as reported earlier (Chu *et al*. 1995).

Stage specific survival of all developmental stages: The stage specific survival of all developmental stages of the whitefly was compared between brinjal versus tomato. It was found that the longevity of developmental stages like eggs, 1st instar and 4th instar nymphs was slightly higher on brinjal than tomato while the longevity of 2nd and 3rd instar nymphs was higher on tomato than brinjal (Table 2). However,

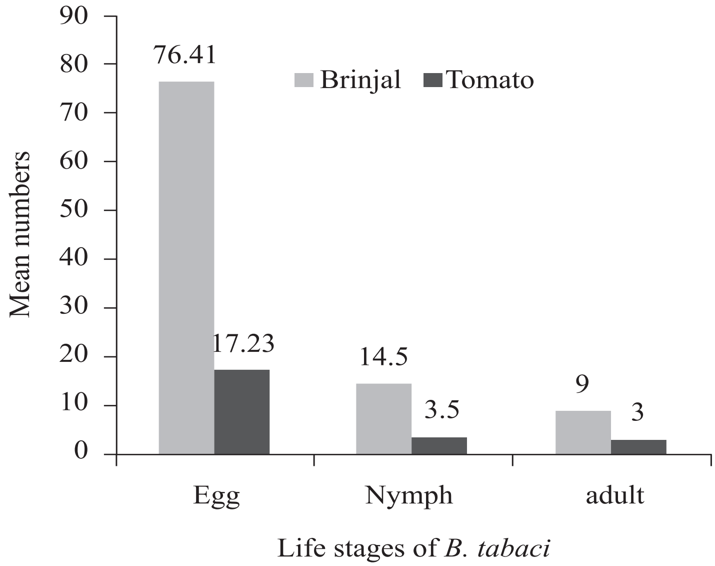

Fig. 1. Mean population density of life stages of *B. tabaci* on two host plants measured per 6 leaves of brinjal and tomato

Table 1. Adult feeding and oviposition preference of *B. tabaci* on brinjal and tomato measured on the average of three leaves per plant in poly culture habitat

Plant species	Adult *B. tabaci* attracted (± SE)	Number of eggs laid (± SE)
Brinjal	81.32 ± 6.45a	213.00 ± 33.00a
Tomato	27.50 ± 5.40b	102.00 ± 22.00b
F	64.56	47.21
P	0.0001	0.0001

the survivability of egg stage was approximately same on brinjal (7.75) and tomato (6.68) plants. Earlier, 7-11 days was reported by Berlinger (1986) but in the present study, almost 7-8 days on each substrate shows no significant effect of any particular host plant. Butler & Wilson (1984) reported some other aspects of host plant like pH of the leaf which act as repellent rather than only morphological character.

Adult longevity of *B. tabaci*: The adult longevity of *B. tabaci* on brinjal and tomato is presented in Table 3. The mean longevity differ significantly ($F = 57.21$, $df = 1$; $P = 0.0001$) between the two host plants with females living longer on brinjal (13.45 ± 4.51 days) than on tomato (11.65 ± 3.27 days) (Table 3). These means were however not too different from the range (10-15 days) as reported by Gerling *et al.* (2001) for *B. tabaci* in the field when temperatures was higher than twenties.

Fecundity of *B. tabaci*: Females laid an average of 142.60 ± 3.01 eggs over their lifetime on brinjal and 98.41 ± 1.96 eggs on tomato (Table 4), which were significantly different (F = 141.07, df = 1; P = 0.0001). The reason for the difference in fecundity on the two host plant species might possibly be attributed to difference in the external physical characteristics of the leaf surface (e.g; hairiness) and the internal chemical composition of the leaves (pH of leaf sap) of brinjal probably being of a better nutritional quality for the whitefly than tomato. However, daily mean fecundity on the two plants was not significantly different (F = 0.43, df =1; P = 0.4192) (Table 4). The mechanisms that determine selection of a plant as substrate by *B. tabaci* for progeny development have been only particularly elucidated. Several factors such as plant colour, texture, free metabolites in the sap, quantity of trichomes on the leaves, and nutritional state etc may play vital role (Van Lenteren & Noldus 1990, Bentz *et al*. 1995, Chu *et al*. 1995, Andres & Connors 2003). Additionally, whiteflies can show some degree of variability in the preference for host plants depending on the time, season, environmental conditions and agronomic practices (Gerling 1990).

Table 2. Stage specific survival of *B. tabaci* on brinjal and tomato in the laboratory

Stage	Brinjal	Tomato	F	P
Egg	7.750 ± 0.4351	6.680 ± 0.1758	0.23	0.614
1st instar	3.120 ± 0.0856	1.143 ± 0.0862	45.20	0.017
2nd instar	1.600 ± 0.0000	1.642 ± 0.2827	3.75	0.114
3rd instar	1.821 ± 0.2590	1.900 ± 0.1680	0.12	0.742
4th instar	2.167 ± 0.0872	1.681 ± 0.0871	4.48	0.637

Rearing conditions: 28 ± 0.5 °C, 75-80% RH.

Table 3. Adult longevity of *B. tabaci* on brinjal and tomato

Host plants	n	Mean longevity (days ± SE)	Range
Brinjal	20	13.45 ± 4.51	12-18
Tomato	20	11.65 ± 3.27	13-15
F		57.21	
P		0.0001	

Table 4. Fecundity of *B. tabaci* on brinjal and tomato in the laboratory condition

Host plants	n	Lifetime Fecundity ± SE	Range	Daily mean fecundity ± SE
Brinjal	20	142.60 ± 3.01a	121-179	7.85 ± 1.35
Tomato	20	98.41 ± 1.96b	78-126	6.20 ± 1.30
F		141.07		0.43
P		0.0001		0.4192

Means in column with the same letter are not significantly different at P> 0.05 by LSD
Rearing conditions: 27 ± 0.5 0C, 70-80% RH, 14:10 LD

CONCLUSION

From the findings of the present study the following conclusions may be drawn that between brinjal and tomato, brinjal is the most preferred host plant of *B. tabaci* for feeding (% plant attacked), oviposition (fecundity) and longevity of different developmental stages of whitefly.

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