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Short Communication

REPRODUCTIVE PERFORMANCE OF SPIRALLING WHITEFLY ON GUAVA AND IMPACT OF WEATHER PARAMETERS ON ITS IMMATURE STAGES

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ABSTRACT

The study was conducted to know the reproductive performance of spiralling whitefly on guava. Number of colony, eggs, 1st instar, 2nd instar, 3rd instar and 4th instar nymphs per five leaves ranged from 6 to 15, 8 to 32, 0 to 44, 0 to 22, 0 to 45 and 0 to 28, respectively. Maximum number of adults and nymphs were found in the month of January. Highest longevity of *Aleurodicus dispersus* (21.5 days) was recorded in adult while the lowest was in 2nd instar nymph (6.4 days). The number of colony/leaf and number of 3rd and 4th instar nymphs of *A. dispersus* had significant positive correlation with minimum and maximum temperature while non-significant positive correlation is observed between the number of egg/colony, the number 1st and 2nd instar nymphs with minimum and maximum temperature. *A. dispersus* showed non-significant positive correlation with minimum and maximum relative humidity regarding number of colony/leaf, 2nd instar nymph while non-significant negative correlation with 4th instar nymph.

Key words: *Aleurodicus dispersus,* reproductive performance, life span, weather parameters

INTRODUCTION

Guava is grown in all the districts of Bangladesh and in many other Asian countries. The major areas of guava cultivation are the Gazipur, Barisal and Jessore districts of Bangladesh where successful production is achieved. Spiralling whitefly, *Aleurodicus dispersus* Russell is a highly polyphagous insect species of tropical origin (Martin, 1987) and is reported to infest 99 host plants including fruit trees, vegetable crops, ornamentals, shade and forest trees (Aiswariaya et al., 2007). This insect has introduced in Bangladesh due to poor quarantine system and has become a

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great threat for guava cultivation (Amjad et al., 2009). The eggs are laid .by this species of whitefly, along with deposits of waxy secretions, in a spiraling pattern on the underside of leaves. The first larval stage ('crawler') is the only mobile immature stage (0.32 mm long). During the second larval stage (0.5 mm long), a row of mid-back waxy tufts form on the anterior of the body. During the third larval stage (0.65 mm long), short, evenly-spaced, glass-like, waxy rods emanate from distinctive compound pores along the side of the body (Waterhouse and Norris, 1989). During the early pupal stage (fourth larval stage), sedentary feeding continues (Waterhouse and Norris, 1989). Copious amounts of white, cottony flocculent wax, extending from the dorsum, are then secreted by the pupae; more so than for the larval stages. Young pupae are nearly flat dorsally and flat ventrally. Mature pupae (1.06 mm long) have a swollen ventral surface and are surrounded by a band of wax (Waterhouse and Norris, 1989). Whiteflies cause direct damage by feeding phloem on the undersides of leaves and indirectly through excretion of honeydew on which a black sooty appearance develop from mould fungus growing (Oliveira et al., 2001). Whiteflies develop rapidly in warm weather, and populations can build up quickly in situations where natural enemies are destroyed and weather is favourable. Rainfall and temperature are the major weather parameters affecting the population of *A. dispersus* as they influence the development of each of its six life stages (Banjo and Banjo, 2003) irrespective of the host type associated with the insect. Rainfall, temperature and other weather factors cause seasonal fluctuation and distribution of spiralling whitefly (Delinger, 1986) but it is mostly their combined effect of evapo-transpiration that is more important (Asiwe et al., 2002). When it rains heavily, many small insects get dislodged from plant surfaces by the combined effect of wetness and the kinetic energy of the rain drops as well as strong winds. The density of the spiralling whitefly was positively correlated with maximum temperature and negatively correlated with relative humidity (Krishnamoorthy and Venugopalan, 2010). Aishwariya et al. (2007) reported that the egg density of spiralling whitefly peaked during April, May, August and November months. They also observed that the incidence of all the three stages of *Aleurodicus dispersus* had significant positive correlation with maximum temperature and non-significant positive correlation with minimum temperature, non-significant negative correlation with morning and afternoon relative humidities. Considering above facts the present study was undertaken to know the reproductive performance of spiralling whitefly on guava and to know the impact of weather parameters on immature stages of whiteflies.

MATERIALS AND METHODS

The study was conducted in the homestead area of the Patuakhali Science and Technology University (PSTU) campus and in the entomology laboratory during November 2013 to April 2014. Geographically, the area is covered Gangetic Tidal Floodplain and falls under Agroecological Zone (AEZ-13). The area lies at 0.9 to 2.1 meter above mean sea level (Iftekhar and Islam, 2004). This region occupies a vast area of tidal floodplain land in the south-west part of Patuakhali district having warm and humid climatic condition. The observation of whitefly was recorded at weekly intervals during 6:30 to 8:30 am. The population of whiteflies (nymphs and adults) were recorded from three leaves one each from the upper, middle and lower position on five randomly selected plants. The population was counted only on five leaves and the whitefly population was expressed on per plant basis. The weekly meteorological data on temperature, relative humidity and rainfall were recorded during the experimental period.

Mass culture of the insect and observation of fecundity and longevity

The laboratory experiment was carried out under normal room temperature (32 ± ^{0}C) and relative humidity (85 ± 5%) with a 14 ± 2:10±2 light and dark cycle (L: D) following completely randomized design (CRD). Twenty pairs of *A. dispersus* adults were released into petridishes with wet cotton of the leaves of each host plant. Adults were allowed to lay eggs for 12 h before being removed. A small pen mark was used to place identifying marks next to 50 whitefly eggs on each of six leaves per species. The infested plants were placed in 60 × 60 × 60 cm^3 cages and development and survival of each stages of whitefly were recorded daily until all the whiteflies emerged. With the exception of the crawlers, which were capable of small distance movement immediately after hatching from egg, all the other immature stages were sessile and cannot move. All stages of whitefly were identified according to their characteristics described by Russell (1965) and Waterhouse and Norris (1989) Therefore, leaves with "pupae" were covered with leaf clip cages to trap emerging adult whiteflies. Emerged adult whiteflies were counted and sexed as described by Gill (1993) and used for daily longevity and fecundity studies.

RESULTS AND DISCUSSION

The number of colony per six leaves ranged from 6 to 15 with mean 10.2 and standard error 1.06 while the number of eggs per colony ranged from 8 to 32 with mean 20.2 and standard error 2.22. The number of 1st instar nymphs/6 leaves ranged from 0 to 44 with mean 8.8 and standard error 4.17. Likewise, the number 2nd instar nymph ranged from 0 to 22 with mean 5.40 and standard error 2.37. The number of 3rd and 4th instars nymphs ranged from 0 to 45 and 0 to 28, respectively with mean 18.1 and 4.60, respectively while standard errors were 5.30 and 2.54, respectively. Among four instars, the number of 3rd instar nymphs was the highest (18.1 nymphs) compared to other instars (Table 1). The relationship between selection of oviposition sites and thereafter growth, survival and reproduction of the offspring are central element in the evolution of host association between herbivorous insects and plant (Thompson, 1988).

Table 1. Fecundity of *Aleurodicus disperses* recorded on six guava leaves during April 2014

Sample No.	No. of colony/6 leaves	No. of egg/ colony	No. of 1st instar nymph/ colony	No. of 2nd instar nymph/ colony	No. of 3rd instar nymph/ colony	No. of 4th instar nymph/ colony
1	6	27	6	0	0	0
2	15	15	20	2	15	6
3	12	22	0	0	0	0
4	6	32	6	5	7	3
5	6	21	0	3	33	3
6	9	13	44	22	0	0
7	9	8	10	0	21	3
8	15	27	2	2	15	28
9	12	15	0	18	45	0
10	12	22	0	2	45	3
Range	6-15	8-32	0-44	0-22	0-45	0-28
Mean ± SE	10.2 ± 1.06	20.2 ±2.22	8.8 ± 4.17	5.40 ± 2.37	18.1 ± 5.30	4.60 ± 2.54

Figure 1 revealed that there was a major peak of different stages of whitefly population in January followed by February. Maximum number of adults, nymphs and pupae were found in the month of January along with maximum number of colony/leaf and number of eggs/colony. After January, population gradually decreased and the lowest number was recorded in April. It was observed that the population of nymph /colony was highest followed by pupae and adult.

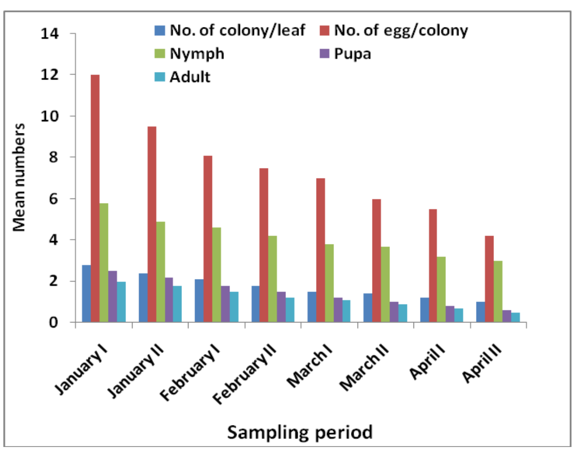

Figure 1. Mean fecundity of *Aleurodicus dispersus* at fortnightly interval on guava during January to April 2014

Abiotic factors such as temperature, rainfall, humidity, fog and sunshine might have tremendous effect on whitefly. *A. dispersus* population as most tropical insects is affected by the climatic conditions which dictate the season (Banjo et al., 2003; Asiwe et al., 2002). A period of moderate rainfall combined with high day temperature which usually occur between April and May, following the onset of rain after the very dry months (December and January) in Nigeria and other tropical regions favours high population of the spiraling whiteflies (Banjo and Banjo, 2003). However the population is at optimum at the drier months of November, December and January (Banjo et al., 2003). During monsoon (June and July) conversely, the population of spiralling whiteflies declines gradually as all the stages of life especially eggs of the insect are washed away by heavy rain couple with wind that is normally associated with such rain (Banjo et al., 2003; Asiwe et al., 2002).

The longevity of different stages of *A. dispersus* is shown in figure 2. Highest longevity of *A. dispersus* (21.5 days) was recorded in adult followed by egg (9.5 days) and pupal (9 days) stages while the lowest was in 2nd instar nymph (6.4 days) followed by 1st instar (7 days) and 3rd instar nymph (8.5 days) (Figure 2).

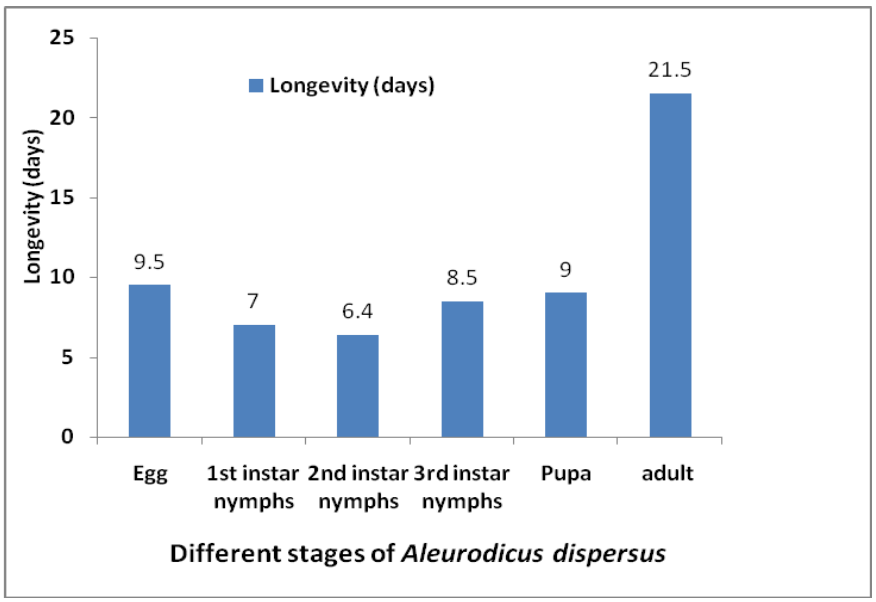

Figure 2. Longevity of different stages of *Aleurodicus dispersus*

From table 2, it is seen that the number of colony/leaf and number of 3rd and 4th instar nymphs of *A. dispersus* had significant positive correlation with minimum and maximum temperature while non-significant positive correlation is observed between the number of egg/colony, the number 1st and 2nd instar nymphs with minimum and maximum temperature. *Aleurodicus dispersus* showed non-significant positive correlation with minimum and maximum relative humidity regarding number of colony/leaf, 2nd instar nymph while non-significant negatine correlation with 4th instar nymph. The number of egg/colony and 1st instar nymph had non-significant negative correlation with minimum temperature while these stage showed non-significant positive correlation with maximum temperature (Table 2).

Table 2. Correlation coefficient (r) between weather parameters and different stages of spiralling whitefly (*Aleurodicus dispersus*) population on guava

Weather parameters	No. of colony/ leaf	No. of egg/ colony	No. of 1st instar nymph	No. of 2nd instar nymph	No. of 3rd instar nymph	No. of 4th instar nymph
Temperature ^{0}C (Minimum)	0.829*	0.161	0.259	0.270	0.627*	0.524*
Temperature ^{0}C (Maximum)	0.758*	0.466	0.239	0.190	0.615*	0.572*
Relative humidity (%) (Minimum)	0.184	-0.307	-0.434	0.419	0.000	-0.297
Relative humidity (%) (Maximum)	0.263	0.318	0.313	0.427	-0.000	-0.170

*= Significant at 5% level of probability

Krishnamoorthy and Venugopalan (2010) reported that density of the spiralling whitefly was positively correlated with maximum temperature and negatively correlated with relative humidity and support the present findings of incidence in whiefly population with increase in temperature, minimum and maximum relative humidity. Rainfall, temperature and other weather factors cause seasonal fluctuation and are important regulating factors of many tropical insects (Delinger, 1986) but it is mostly their combined effect of evapo-transpiration that is more important (Asiwe et al., 2002). Heavy rainfall and strong wind flow are not favourable for whitefly population due to dislodging from plant surfaces (Banjo, 2010). When it rains heavily, many small insects get dislodged from plant surfaces by the combined effect of wetness and the kinetic energy of the rain drops as well as strong winds. The orientation of the leaves on the plant and consequently the position of the insect on the plant would be critical (Asiwe et al., 2002). *A. dispersus* population as most tropical insects is affected by the climatic conditions which dictate the season (Banjo et al., 2003; Asiwe et al., 2002). Wen et al. (1994) reported that a curvilinear relationship was found between temperature and development rate in *Aleurodicus dispersus* in the laboratory in the range 10-32°C, and a linear regression at 15-25°C. Adults were active at 12.3-32.3°C and adult lifespan decreased as rearing temperature increased from 15 to 30°C. The mean fecundity was highest (28 ± 14.5 eggs/female) at 25°C. A period of moderate rainfall combined with high day temperature which usually occur between April and May, following the onset of rain after the very dry months (December and January) in Nigeria and other tropical regions favours high population of the spiraling whiteflies (Banjo and Banjo, 2003). Aishwariya et al. (2007) reported that spiralling whitefly was found throughout the year on guava and the incidence of this whitefly was found to build up during April-May. The egg density peaked during April, May, August and November months. The nymphal population was relatively low during June and first fortnight of July and it was found to fluctuate before attaining peak in first fortnight of November and then slowly declined. They also observed that the incidence of all the three stages of *A. dispersus* had significant positive correlation with maximum temperature and non-significant positive correlation with minimum temperature, non-significant negative correlation with morning and afternoon relative humidity. Rainfall was found to show non-significant negative correlation with all stages of *A. dispersus*.

CONCLUSION

Among different developmental stages, highest longevity of *A. dispersus* was recorded in adult compared to nymphs. Highest number of adults, nymphs and pupae were found in the month of January. *A. dispersus* had significant positive correlation with minimum and maximum temperature while non-significant positive correlation with minimum and maximum relative humidity.

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