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SEASONAL ABUNDANCE OF MAJOR SUCKING AND CHEWING INSECTS OF GUAVA

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Abstract: Seasonal abundances of the sucking insects, namely mealy bug, white fly and scale insects, and chewing insect *viz.,* fruit fly was monitored during September, 2016 to June, 2017 in a guava *Psidium guajava* orchard. Sucking insect was monitored by weekly observation on the leaves and chewing insect was captured using methyl eugenol trap. The mealy bug, white fly and scale insects were abundant during 4th week of November to 4th week of January and they showed fluctuations in their population. The mealy bug, white fly and scale insects had peak abundance in the 1st week of January, 4th week of November and 1st week of December, respectively. The scale insect revealed significantly higher abundance compared to other sucking insects. Two species of fruit fly, namely *Bactrocera tryoni* and *B. dorsalis* were found in the guava orchard and *B. tryoni* showed significantly higher abundance compared to *B. dorsalis* both in winter and summer seasons. In winter, *B. tryoni* reached the peak abundance in the 2nd week of January and their peak abundance in summer occurred in the 1st week of May. The daily mean temperature and relative humidity influenced the abundance of the sucking and chewing insects. Temperature individually contributed 30.0, 59.6, 59.3% abundance and temperature with relative humidity had 34.8, 60.9 and 73.5% abundance on mealy bug, white fly and scale insect, respectively. The effect of temperature on the abundance of fruit fly in winter and summer were 42.6 and 50.3%, respectively and the combined effect of temperature with relative humidity were 68.7% in winter and 61.9% in summer.

***Key words*:** Abundance, *Bactrocera* spp., *Psidium guajava,* temperature, humidity

INTRODUCTION

The climacteric fruit guava *Psidium guajava* L., originated in tropical America has been cultivated widely in many countries in the world. It is considered as the most important fruit of the family Myrtaceae and a major source of vitamin A, B and C, and also contains high amounts of calcium and pectin (Anita *et al*. 2012). Guava is an important fruit crop of Bangladesh that has been commercially cultivated in Gazipur, Barishal and Dinajpur districts. It claims to be the 5th most important fruits in area and production after banana, mango, pineapple and jackfruit (BBS 2018).

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Insect infestation is the most important limiting factor of guava production in Bangladesh. This biotic factor deteriorates the yield and market value of the fruit. Various insect species cause damage to guava in different regions of the world and their abundance vary with geographic locations, availability of food sources and seasons of the year. Al-Fwaeer *et al*. (2013) identified aphids, medfly, mealy bugs, beetle, scale insect and thrips as the insect pests of guava in Jordan. Fruit flies are the most important insect pests cause enormous damage to guava and two species of fruit flies *viz., Bactrocera dorsalis* and *Bactroceratryoni* have been found predominant in guava orchards. Sarwar (2006) reported mealy bugs, stink bug, red-banded thrips, guava moth, guava whitefly and scale insect are major insect pests of guava in Pakistan. Baker *et al.* (2012) reported nine scale insect species are destructive to guava in Egypt.

Weather factors play role in multiplication, growth, development and distribution of insects and influence on their seasonal abundance (Dhaliwal and Arora 2001). Temperature is the most influential parameter of the meteorological factors affecting insect population dynamics (Arun 2003). Baker *et al*. (2012) reported that the abundance of the insect pest is related with weather factors and the lowest population density is during winter season.

Seasonal population dynamics of any insect pest provide knowledge on relationship between weather factors and insect abundance. It indicates the farmers of a particular area or region about management program of the pest. So, the growers can take proper control measures to prevent loss due to insect attack. Insect pest species of guava, their occurrence and sseasonal dynamics have been studied in many countries (Clarke *et al.* 2001, Sarada *et al*. 2001, Mwatawala *et al.* 2006). But there is scarcity of information on insect pest species of guava in Bangladesh, their nature of occurrence and seasonal abundance. So, the aim of the study is to know the abundance of the sucking (mealy bug, white fly and scale insect) and chewing (fruit fly) insects which cause significant infestation on guava, and to find out the effect of the meteorological factors such as temperature and relative humidity on the abundance of the insects.

MATERIAL AND METHODS

The study was conducted in the agroforestry field of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, Bangladesh during September, 2016 to June, 2017. The study site is located in the middle of Bangladesh (25°25′ North latitude and 89°5′ East longitude). The site is surrounded by sal *Shorea robusta* Gaertn forest. The area of the agroforestry is 1000 m^2 and constituted with mango (variety Amrapali), guava (variety IPSA peyara 3), lichi (variety bombai) and jack fruit trees and some ornamental plants.

Climatic conditions: The study area has a subtropical climate but seasonal, and characterized by a well-defined dry season (February to May), rainy season (June to September) and short winter (December and January). Annual mean maximum and minimum temperatures, relative humidity and rainfall are 36.0 and 12.7°C, 65.8% and 237.6 cm, respectively.

Observation of the abundance of sucking insects: During the study the agroforestry area was free from any management practices of insect pest. Abundance of the sucking insects, namely white fly, mealy bug and scale insect was monitored by weekly observation of the plants. In each observation day, ten infested leaves for each of the sucking insects were selected randomly from different directions of the plant and the numbers of nymphs and adults of the insects per leaf was counted by using hand lens.

Installation of methyl eugenol trap and collection of fruit flies: Abundance of fruit fly in the orchard was monitored during winter (January to February) and summer (May to June) seasons of the year when the plants had developed fruits. To assess the seasonal changes of fruit fly abundance, sampling protocol was targeted on free-living male insects. Methyl Eugenol trap which was supplied by Ispahani Agro Limited was used to capture male insects. The trap was constructed with transparent plastic bottles of approximately one liter capacity. Two holes were cut, one in the lid and the other exactly the opposite to facilitate the entry of fruit flies. The holes were fitted with a PVC (Polymerizing vinyl chloride) pipe of about 1.5 cm diameters with a length of 8 cm. The lure was suspended exactly in the center. Five traps were hung in the orchard weekly interval and each trap represented a replication. Two species of fruit fly, namely *Bactrocera dorsalis* and *B. tryoni* were found in the agroforestry area. The male flies of these species captured in each trap in a week were counted and the traps were substituted with new traps.

Collection of weather data: Mean daily temperature, relative humidity and rainfall data were collected from the weather station of BSMRAU.

Statistical analysis: One way analysis of variance (ANOVA) followed by Tukey posthoc statistic was employed for analyzing the mean abundance. Correlation coefficients were calculated for total abundance with meteorological parameters. All the analyses were performed using IBM SPSS 21.0 (IBM SPSS statistics 21, Georgia, USA).

RESULTS AND DISCUSSION

Abundance of the sucking insects in the guava orchard along with the weather data during November, 2016 to January, 2017 is presented in Table 1. Mealy bug was abundant in the 4th week of November, 4th week of December, 1st week of January and 4th week of January. The peak abundance (3.4/leaf) of this insect was found in the 1st week of January when the temperature and relative humidity were 20.5^{0}C and 58.0%, respectively and there was no rainfall (Table 1). El-Serafi *et al*. (2004) reported that the guava mealy bug had three peaks per year in Egypt and the highest peak was found by late August (6.1/leaf) and other two peaks were recorded by early January and the end of October. The present findings differed from these results because of the different climatic zone of the world.

Table 1. Distribution of weather parameters and major sucking insect population buildup on guava at different observation days during November, 2016 to January, 2017 in Gazipur, Bangladesh

Observation day	Weather parameters			Insect abundance (Number/leaf)		
	Temperature (^{o}C)	Relative humidity (%)	Rainfall (mm)	Mealy bug (*Ferrisia virgate*)	White fly (*Bemisia tabaci*)	Scale insect (*Phyllotreta vittula*)
24 November	26.0	63.0	0.0	2.8	5.7	25.2
01 December	21.5	68.0	0.0	0.0	4.9	28.5
07 "	22.0	66.0	0.0	0.0	0.9	24.4
14 "	20.3	54.0	0.0	0.0	2.8	6.0
21 "	19.8	53.0	0.0	0.0	0.6	5.8
28 "	20.0	64.0	0.0	0.1	1.9	6.8
04 January	20.5	58.0	0.0	3.4	3.3	9.6
11 "	18.0	54.0	0.0	0.0	0.7	5.9
18 "	18.0	43.0	0.0	0.0	0.6	5.2
25 "	19.5	50.0	0.0	0.2	0.8	3.0

White fly was abundant during November, 2016 to January, 2017 and the fly reached the peak abundance (5.7/leaf) in the 4th week of November and then declined and showed fluctuation (Table 1). At the time of the peak abundance, temperature and relative humidity were 26.0^{0}C and 63.0%, respectively, and there was no rainfall. El- Serafi *et al*. (2004) observed the peak abundance of white fly in mid-November, early January and February of the year 2001 in Egypt, and reported that the highest peak (4.6/leaf) was in the mid-November.

Scale insect showed increasing trend of their abundance from 4th week of November and reached the peak (28.5/leaf) in the 1st week of December and then declined and had fluctuations (Table 1). At the time of the peak abundance temperature and relative humidity were 21.5^{0}C and 68.0%, respectively, and there was no rainfall. El-Serafi *et al*. (2004) observed two peaks of the abundance of scale insect (14.1/leaf) in Egypt in the year 2002 and the peaks were found by early August and late October. In the present study the scale insect showed their peak abundance in the first week of December. Fig. 1 showed that the mean abundance of the sucking insects varied from 0.7 to 12.1/leaf and the results differed significantly ($F_{2,27}$ = 11.2, $p \leq 0.001$). Scale insect revealed the highest and the other two insects showed statistically similar abundance.

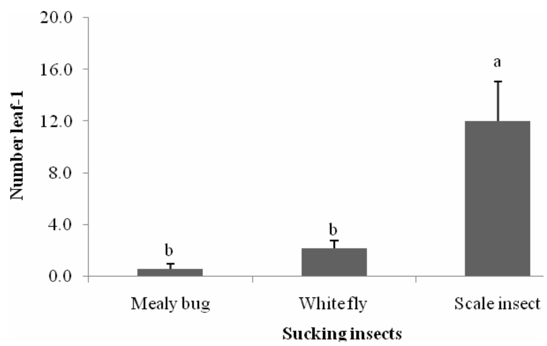

Fig. 1. Mean abundance of different sucking insects on guava leaf during November 2016 to January 2017 in Gazipur, Bangladesh.

The fruit flies showed fluctuation in their population on guava and *B. tryoni* revealed higher abundance compared to *B. dorsalis* both in winter and summer seasons (Table 2). In winter, *B. dorsalis* revealed three peaks (2.9/trap) in their abundance and the peaks were occurred in the 3rd and 5th week of January and 1st week of February. Abundance of *B. tryoni* reached to the peak (9.3/trap) in the 2nd week of January and then declined. In winter, there was no rainfall and temperature and relative humidity ranged from 16.3 to 23.0^{0}C and 43.0 to 59.0%, respectively. In summer, both the species had peak abundance (*B. dorsalis* and *B. tryoni* were 5.7 and 7.9/trap, respectively) in the 1st week of May and then declined. At that time temperature and relative humidity were 27.0^{0}C and 81.0%, respectively and there was no rainfall.

The mean abundance of the fruit flies in the guava orchard during winter and summer seasons ranged from 1.7 ± 0.4 to 5.9 ± 0.7/trap (Fig. 2) and the results differed significantly ($F_{3,28}$ = 10.2, $p < 0.001$). *B. tryoni* showed statistically similar abundance both in winter and summer but significantly higher compared to *B. dorsalis*.

Table 2. Distribution of weather parameters and major chewing insect population buildup on guava at different observation days during winter and summer 2017 in Gazipur, Bangladesh

Season	Observation day	Weather parameters			Insect abundance (Number/trap)	
		Temp. (°C)	Relative humidity (%)	Rainfall (mm)	*Bactrocera dorsalis*	*Bactrocera tryoni*
Winter	08 January	18.0	47.0	0.0	1.4	9.3
	15 "	16.3	43.0	0.0	2.9	7.1
	22 "	20.5	48.0	0.0	2.4	6.4
	29 "	20.5	52.0	0.0	2.9	6.7
	05 February	22.0	46.0	0.0	2.9	5.9
	12 "	21.5	51.0	0.0	0.5	5.0
	19 "	23.0	52.0	0.0	0.3	3.6
	26 "	20.8	59.0	0.0	0.3	3.0
Summer	03 May	27.0	81.0	0.0	5.7	7.9
	10 "	28.0	83.0	0.0	5.6	7.1
	17 "	30.0	89.0	0.0	5	6.1
	24 "	29.0	87.0	0.0	4.7	5.7
	31 "	32.0	80.0	0.0	4.3	5.0
	07 June	33.0	81.0	0.0	2.9	4.7
	14 "	29.0	84.0	0.0	1.4	4.3
	21 "	28.0	80.0	0.0	0.4	3.6

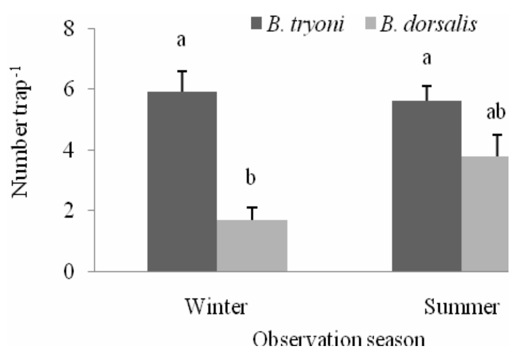

Fig. 2. Mean abundance of fruit fly species (*Bactrocera tryoni and B. dorsalis*) in guava orchard during winter and summer, 2017.

The variations of the meteorological conditions, blooming flowers and availability of the tender fruits during the study affect the population dynamics of the pest. Vargas *et al.* (2013) reported that the guava fruit fly showed most abundance in Hawaii during March to April and September to November, which coincided with the guava fruiting season. Liu and Ye (2005) found that the population of the fly was closely related to the fruiting period of host plants.

The daily mean temperature and relative humidity had insignificant positive correlation with mealy bug and the results showed that the temperature individually exerted 30.0% population abundance and temperature with combination of relative humidity had 34.8% abundance, which was statistically insignificant (Table 3).

Table 3. Multiple regression models along with coefficients of determination (R^2) regarding the impact of weather parameters on the seasonal abundance of the major insect pests of guava

Insect	Regression equation	R^2	100 R^2	Role of individual factor	F statistic	
Mealy bug (*Ferrisia virgata*)	$Y = -5.706 + 0.309 X_1$	0.300	30.0	30.0	$F_{1,8} = 3.4$	$p = 0.10$
	$Y = -5.171 + 0.415 X_1 - 0.047 X_2$	0.348	34.8	4.8	$F_{2,7} = 1.9$	$p = 0.22$
White fly (*Bemisia tabaci)*	$Y = -10.823 + 0.634 X_1$	0.596	59.6	59.6	$F_{1,8} = 11.8$	$p < 0.01$
	$Y = -11.223 + 0.556 X_1 + 0.035 X_2$	0.609	60.9	1.3	$F_{2,7} = 5.5$	$p < 0.05$
Scale insect (*Phyllotreta vittula)*	$Y = -55.597 + 3.290 X_1$	0.593	59.3	59.3	$F_{1,8} = 11.7$	$p < 0.01$
	$Y = -62.579 + 1.914 X_1 + 0.615 X_2$	0.735	73.5	14.2	$F_{2,7} = 9.7$	$p < 0.05$
Fruit fly (Winter) (*Bactrocera dorsalis)*	$Y = 25.281 - 0.872 X_1$	0.426	42.6	42.6	$F_{1,6} = 4.5$	$p = 0.08$
	$Y = 34.474 - 0.450 X_1 + 0.357 X_2$	0.687	68.7	26.1	$F_{2,5} = 5.5$	$p = 0.06$
Fruit fly (Summer) (*Bactrocera tryoni)*	$Y = 34.438 - 1.261 X_1$	0.503	50.3	50.3	$F_{1,6} = 6.1$	$p < 0.05$
	$Y = 1.902 - 1.264 X_1 + 0.392 X_2$	0.619	61.9	11.6	$F_{2,5} = 4.1$	$p = 0.09$

Y, insect population; X_1, temperature (°C); X_2, relative humidity (%).

Abundance of white fly revealed significant positive correlation with daily mean temperature and relative humidity, and the results exerted that the temperature individually contributed 59.6% abundance and temperature with combination of relative humidity was 60.9%, which was statistically significant (Table 2).

Abundance of scale insect was positively correlated with daily mean temperature and relative humidity, and the results showed that the temperature individually exerted 59.3% abundance and temperature with combination of relative humidity was 73.5%, which was statistically significant (Table 2).

Fruit fly showed insignificant negative correlation with daily mean temperature and relative humidity in winter, and the results exerted that the temperature individually contributed 42.6% abundance and temperature with combination of relative humidity was 68.7%, which was statistically insignificant (Table 3). In summer, fruit fly showed significant negative correlation with daily mean temperature and insignificant positive correlation with relative humidity, and the results exerted that the temperature individually contributed 50.3% abundance and temperature with combination of relative humidity was 61.9%, which was statistically insignificant (Table 3).

The present findings showed agreement with Rajitha and Viraktamath (2006) who reported that the *B. dorsalis* showed a highly significant and positive correlation with minimum temperature and relative humidity. The role of abiotic factors is closely related with fly distribution (Vera *et al.* 2002, Duyck *et al.* 2006). Jalaluddin *et al.* (2001) recorded positive correlation of minimum temperature and relative humidity with the population of guava fruit fly, *B. tryoni*. Rainfall appeared as the most important factor for fruit fly population fluctuation and infestation (Chen *et al*. 2006). But there was no rainfall during the present study.

Bangladesh is a subtropical country and the air temperature remains quite high in summer but not very cold in winter. However, stepwise regression analysis indicated that temperature and relative humidity showed relation with the insect population of guava. Fluctuation of the fruit fly population is due to prevalence of fruiting and flowering time of the guava.

The findings indicated that the sucking insects showed higher abundance during November to January and abundance of fruit flies were related with fruiting season, when the growers should be more conscious for implementation of integrated management program.

LITERATURE CITED

AL FWAEER, M., ABO-ABIED, I., ABO-ALLOSH, A., HALYBIH, M., OBEIDAT, K., ATAWEE, E and AL-HAWAMLEH, H. 2013. Study of pests attacking guava in Jordan. *Angewandten Biol. Fors*. **1**: 43-48.

ANITA, M., SIVARAM, V. and JAYARAMAPPA, K.V. 2012. Influence of bee attractants on pollination and yield parameters in guava (*Psidium guajava*L.). *Intl. J. Plant Reprod. Biol.* **4**: 41-46.

ARUN, P.R. 2003. Butterflies of Siruvani forests of Western Ghats, with notes on their seasonality. *Zool. Print J.* **18**:1003-1006.

BAKER, R.F.A., MOUSA, S.F., HAMOUDA, L.S., BADAWY, R.M. and ATTIA, S.A. 2012. Scale insects infesting guava trees and control measure of *Pulvinaria psidii* (Hemiptera: Coccidae) by using the alternative insecticides. *Egypt. Acad. J. Biol. Sci.* **5**: 89-106.

BANGLADESH BUREAU OF STATISTICS (BBS). 2018. Year Book of Agricultural Statistics 2017. Statistics and Informatics Division (SID), Ministry of Planning. Government of the People's Republic of Bangladesh.

CHEN, P., YE, H. and LIU, J. 2006. Population dynamics of *Bactrocera dorsalis* (Diptera: Tephritidae) and analysis of the factors influencing the population in Ruili, Yunnan Province, China. *Acta. Ecol. Sinica.* **26**: 2801-2808.

CLARKE, A.R., ALLWOOD, A., CHINAJARIYAWONG, A., DREW, R.A.I., HENGSAWAD, M., JIRASURAT, C., KONG, S., KRITSANEEPAIBOON, S. and VIJAYSEGARAN, S. 2001. Seasonal abundance and host use patterns of seven *Bactrocera* Macquart species (Diptera: Tephritidae) in Thailand and Peninsular Malaysia. *Raffles Bull. Zool.* **49**: 207-220.

DHALIWAL, G.S. and ARORA, R. 2001. Integrated Pest Management Concepts and Approaches. Kalyani Pulishers, New Delhi, India. 27-60.

DUYCK, P.F., DAVID, P. and QUILICI, S. 2006. Climatic niche partitioning following successive invasions by fruit flies in La Reunion. *J. Anim. Ecol*. **75**: 518-526.

EL SERAFI, H.A., GHANIM, A.A., EL- HENEIDY, A.H. and EL- SHERBENIE, M.K. 2004. Ecological studies on certain insects infesting guava orchards and their predatory insects at Mansoura district. *Egyptian J. Biol. Pest Cont*. **14**: 77-85.

JALALUDDIN, S.M., NATARAJAN, K. and KATHULLA, S.S. 2001. Population fluctuation of the guava fruit fly, *Bactrocera correcta* (Bezzi) in relation to host and abiotic factors. *J. Exp. Zool.* **4**: 323-327.

LIU, J.H. and YE. 2005. Population dynamics of *Bactrocera dorsalis* (Diptera: Tephritidae) in Yuanjiang dry-hot valley, Yunnan with an analysis of the related factors. *Acta Entomol. Sinica.* **48**: 706-711.

MWATAWALA, M.W., MEYER, D., MAKUNDI, R. and MAERERE, A. 2006. Seasonality and host utilization of the invasive fruit fly, *Bactrocera invadens* (Diptera: Tephritidae) in central Tanzania. *J. Appl. Entomol*. **130**: 530-537.

RAJITHA, A.R. and VIRAKTAMATH, S. 2006. Monitoring of fruit flies (Diptera: Tephritidae) in guava orchard at Dharwad, Karnataka. *Karnataka J. Agric. Sci.* **19**: 45-49.

SARADA, G., MAHESWARI, T. and PURUSHOTHAM, K. 2001. Seasonal incidence and population fluctuation of fruit flies in mango and guava. *Indian J. Entomol*. **63**: 272-276.

SARWAR, M. 2006. Occurrence of insect pests on guava (*Psidium guajava*) tree. *Pak J Zool*. **38**: 197-200.

VARGAS, R.I., STARK, J.D., BANKS, J., LEBLANC, L., MANOUKIS, N.C. and PECK, S. 2013. Spatial dynamics of two oriental fruit fly (Diptera: Tephritidae) parasitoids, *Fopiusaris anus* and *Diachasmimorpha longicaudata* (Hymenoptera: Braconidae), in a guava orchard in Hawaii. *Environ. Entomol*. **42**: 888-901.

VERA, M.T., RODRIGUEZ, R., SEGURA, D.F., CLADERA, J.L. and SUTHERST, R.W. 2002. Potential geographical distribution of the Mediterranean fruit fly, *Ceratitis capitate* (Diptera: Tephritidae), with emphasis on Argentina and Australia. *Environ. Entomol.* **31**: 1009-1022.

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