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ABUNDANCE AND DIVERSITY OF INSECTS ON GUAVA AND FORAGING BEHAVIOR OF POLLINATORS

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ABSTRACT

Abundance and diversity of insects associated with guava *Psidium guajava* plant was observed in the Horticulture nursery of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh during August 2016 to July 2017. Insects were monitored by collecting sweep net, aspirator and visual observation on the leaf, and the insects were categorized into pest, predator, pollinator and other group. Abundance, richness and diversity of insects among the categories ranged from 0.9 to 61.1, 0.6 to 6.3 and 0.2 to 0.7, respectively. The pest insects showed significantly higher abundance compared to other categories. The pollinator insects showed the highest richness followed by pest, predator and other group. Diversity index was found highest in the predator category. Relative abundance of pest, predator and pollinator insects varied from 0.7 to 40.1%, 1.1 to 77.3% and1.5 to 30.1%, respectively. Scale insect, ant and house fly revealed the highest abundance among the pest, predator and pollinator insects, respectively. Insects were most abundant at 11.00 h of the day and the landing duration of the pollinator insects ranged from 12.9 to 43.19 s flower^{-1}, and house fly spent longest duration.

Keywords: Landing duration, pest, predator, pollinator, *Psidium guajava*

Introduction

Guava *Psidium guajava,* one of the most gregarious tropical fruits of the family Myrtaceaeis rich in dietary fiber, vitamin A, B and C, and a major source of potassium, calcium, pectin,copper and manganese (Hassimotto and Genovese 2005, Anita *et al*. 2012). Guava is originated in America and now widely cultivated in India, Mexico, Brazil, Pakistan, Sri Lanka, Bangladesh, Myanmar, Malaysia, Indonesia and Philippine. In Bangladesh, it has been commercially cultivated at Gazipur, Barishal and Dinajpur districts. Cultivation area and production of guava in Bangladesh is increasing day by day but the fruit has received very limited attention specially pollination and insect pest management through conservation of natural enemies.

Information on the pest, predator and pollinator insect species associated with guava in Bangladesh is very limited, however there are plenty of reports in different countries. Al-Fwaeer *et al*. (2013) reported that the aphid, Mediterranean fruit fly, mealy bug, beetle, scale insect and thrips are insect pests of guava in Jordan. Baker *et al.* (2012) reported that nine species of scale insect are destructive to guava in Egypt. Haseeb (2007) reported 80 species of insects on guava but a few were regular occurrence and caused serious damage. Prashad (1990) reported that the insect pests of guava were attacked by numerous predatory insects. Guava is highly cross pollinated crop and pollination by honey bees result in higher fruit yield (Kumar *et al.* 1996). Keeping this prospect in mind, this study investigated the abundance and diversity of pest, predator and pollinator insects in a guava orchard at Gazipur in Bangladesh, and find out the foraging behavior of the prevailed insect pollinators.

Material and Methods

The study was conducted in the Horticulture nursery of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh during August 2016 to July 2017on variety IPSA peyara 3. The study site is located at 25°25′ North latitude and 89°5′ East longitude, which is in the middle of Bangladesh. Annual mean maximum and minimum temperatures, relative humidity and rainfall are 36.0 and 12.7 °C, 65.8% and 237.6 cm, respectively.

Insect collection: Insects were collected using a 30 cm diameter sweep net having 1.5 mm mesh, and attached with a 2 m long rod. Sweeping was done fortnightly interval during the studyin between 10.00 and 11.30 h of the day, and each sample was consisted of 40 sweeps encompassing an area from ground level to the top of the trees. Small sessile insects were collected by aspirator.

Insect identification: The collected insects were brought from the orchard to the Entomology Laboratory of BSMRAU for counting total abundance. Insects were identified to species or genus level and categorized as pest, predator, pollinator and other group. Insects were identified by the experts and comparisons were made with the specimens in a labeled collection or pictures or descriptions.

Foraging behavior of pollinators during full blooming season: Two behavioral characteristics; peak foraging time of the frequently abundant insect species, and landing duration (length of remaining time on a flower) of the pollinator insects was observed. To find out peak foraging time, weekly collection by sweep net was conducted at 7.0, 9.0, 11.0 and 13.0hof the day, and number of insects per 40 sweepswere counted. Landing duration of the pollinators on the flowers was measured using a stop watch and observations were donein between 10:00 to 11:30 h of the day. Landing durationof each pollinator species was repeated 50 times.

Statistical analysis: One-way analysis of variance was employed for analyzing abundance, richness and diversity (Simpson Index of Diversity) of thepest, predator, pollinator and other insects. Diversity was calculated following the formula of Simpson (1949). All the analyses were performed using IBM SPSS 21.0. (IBM SPSS statistics 21, Georgia, USA).

Results and Discussion

The abundance, richness and diversity of pest, predator, pollinator and other insects varied from 0.9 to61.1, 0.6 to 6.3 and 0.2 to 0.7 per 40 replicates, respectively and differed significantly (Table 1; abundance: $F_{3,88}$=107.7; richness: $F_{3,88}$=100.3; diversity: $F_{3,88}$= 19.9). Richness was highest for pollinator followed by pest and diversity index was highest for predator.

Insect abundance, richness and diversity interrupt crop production technology as well as crop yield and quality of a habitat. Abundant and healthy populations of pollinators can improve fruit setand quality, and increase fruit size. On the contrary, enormous population of predators suppresses pest abundance and the natural enemy complex is the potential pest management options without the use ofharmful chemical insecticides (Paul and Lalnunsangi 2011). In the current study, in total 9 species of insects belonged to 8 families in 4 orders (Hemiptera, Thysanoptera, Coleopteraand Diptera) were found as

Table 1. Average abundance, richness and diversity of insects in guava orchard during August 2016 to February 2017

	Pests	Predators	Pollinators	Others
Abundance	61.1	28.8	27.3	0.9
Richness	5.8	3.4	6.3	0.6
Diversity	0.3	0.7	0.3	0.2

Means per insect group are taken from 40 replicates (sweep or suctionor leaf observation).

Table 2. Insect pests along with their abundance in guava orchard during August 2016 to February 2017

Pest	Taxonomic profile	Abundance (%)
Mealy bug	*Ferrisiavirgata*(Hemiptera :Pseudococcidae)	16.9
White fly	*Bemisiatabaci* (Hemiptera:Aleurodidae)	31.7
Scale insect	*Phyllotretavittula* (Hemiptera: Coccidae)	40.1
Carabid beetle	*Pterostichusmelanarius*(Coleoptera: Carabidae)	1.5
Tea mosquito bug	*Helopeltisantonii*(Hemiptera: Miridae)	1.1
Thrips	*Selenothripsrurocinctus*(Thysanoptera:Thripidae)	0.7
Stink bug	*Nezaravirridula* (Hemiptera: Pentatomidae)	1.0
Fruit fly	*Bactroceradorsalis* (Diptera:Tephritidae) *Bactroceratryoni*(Diptera:Tephritidae)	7.0

Table 3. Insect predators along with their abundance in guava orchard during August 2016 to February 2017

Predator	Taxonomic profile	Abundance (%)
Dragon fly	*Aeshnaverticalis* (Odonata: Aeshnidae)	12.6
Damsel fly	*Enallagmacyathigerum*(Odonata:Aeshnidae)	6.1
Syrphid fly	*Syrphid sp.* (Diptera : Syrphidae)	1.1
Tiger beetle	*Cicindelahudsoni* (Coleoptera: Cicindelinae)	2.9
Ant	*Formica rubra* (Hymenoptera: Formicidae)	77.3
	Camponotuscompressus(Hymenoptera:Formicidae)	-
	Solenopsis geminate (Hymenoptera: Formicidae)	-

Table 4. Insect pollinator along with their abundance in guava orchard during August 2016 to February 2017

Pollinator	Taxonomic profile	Abundance (%)
Honey bee	*Apismellifera* (Hymenoptera: Apidae)	1.5
Wasp	*Vespa vulgaris* (Hymenoptera: Vespidae)	8.2
Sulphur butterfly	*Coliaseurytheme* (Lepidoptera: Pieridae)	5.1
Cabbage butterfly	*Pierisrapae* (Lepidoptera: Pieridae)	18.6
Brush footed butterfly	*Nymphalisantiopa*(Lepidoptera,Nymphalidae)	23.6
Lemon butterfly	*Papiliodemoleus*(Lepidoptera,Papilionidae)	5.8
House fly	*Muscadomestica* (Diptera: Muscidae)	30.1
Horse fly	*Tabanuseggeri* (Diptera, Tabanidae)	3.5
Blow fly	*Calliphoraerythrocephala*(Diptera: Calliphoridae)	3.5

pest andtheir abundance varied from 0.7to 40.1% (Table 2). Among the pests, scale insect showed the highest abundance. 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.

Seven species of insects belonged to 4 families in 4 orders (Odonata, Diptera, Coleoptera and Hymenoptera) were found as predator and their abundance varied from 1.1 to 77.3% (Table 3). Among the predators, ant and syrphid fly revealed the highest and lowest abundance, respectively. Abundance of the predators isrelated with their prey sources and theplant species may be visualized as a secure habitat for many of the predatory components. In the present study, seven species of insects were found as predator but Baker *et al*. (2012) reported two species of insects namely *Rodalia cardinalis* and *Chilocorus bipustulatus* (Coleoptera: Coccinellidae) were associated with guava scale in Egypt. The pollinators species ranged

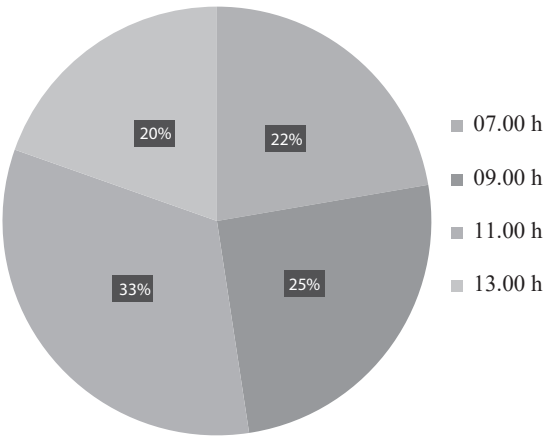

Figure 1. Distribution of foraging insects at different hours of the day during full blooming period of guava.

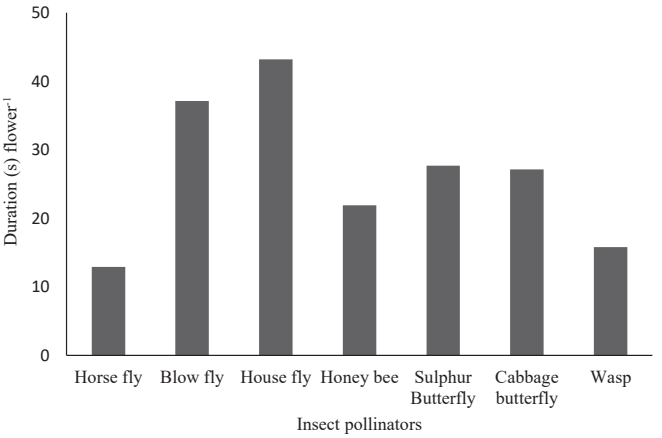

Figure 2. Landing duration (s) of different insect pollinators associated with guava flowers.

from 1.5 to 30.1% and they were under 10 species in 8 families and 3 orders (Lepidoptera, Diptera and Hymenoptera) (Table 4) and among the pollinators house fly showed the highest abundance.

Insect foraging activity varies with opening period of flower, temperature and light intensity. Foraging pollinators at different hours of the day varied from 19.6 to 32.8% (Figure 1). The peak foraging activity was observed at 11.00 h of the day because at that time, air temperature and light intensity were sufficient for insect activity.Ahmad and Aslam (2002) studied the foraging behavior of some Hymenoptera, Diptera, Coleoptera and Lepidoptera pollinators on blooming carrot and found peak foraging at 8.0 - 9.0 h of the day.

Landing duration of the abundant pollinators (Figure 2) ranged from 12.9 to 43.19 s flower^{-1} and the results differed significantly ($F_{6,91}$=3.9). House fly spent significantly longer duration flower^{-1} compared to other insects and it indicated that other pollinator insects are rapid flier. Saeed *et al*. (2008) observed the syrphid fly as a rapid visitor of loquat flowers. Amin *et al*. (2015) studied the landing duration of different pollinators and reported that horse fly and sulphur butterfly spent longest duration on mango flower.

Occurrence of different insect species in significant numbers in a guava orchard could influence on the productivity and sustainability of guava fruit production. This study finds out the abundance, richness and diversity of pest, predator and pollinator insects in a guava orchard. This information could be helpful for growers taking proper measures for conservation of the pollinators and predators, and development of IPM program to manage pest.

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