ISSN 0258-7122 (Print), 2408-8293 (Online)
Bangladesh J. Agril. Res. 43(4): 647-653, December 2018

FUNCTIONAL AND GROUP ABUNDANCE OF INSECTS ON EGGPLANT

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Abstract

The eggplants (*Solanum melongena* L.) were cultivated in the field to investigate the abundance and diversity of insects. In total 488 insects were collected from the eggplant field during May to August 2016, which belonged to 20 species in 21 families and 10 orders. Among the taxonomic orders, Hemiptera was the most dominant followed by Coleoptera, Hymenoptera, and Diptera. The order Thysanoptera revealed the lowest abundance. The abundance, richness and diversity of pest, predator, pollinator and other categories of insects differed significantly and the pest revealed the highest abundance and richness compared to others. In total 9 species of insects belonged to 7 families of 4 orders were found as pest and their abundance varied from 0.1±0.1 to 4.6±0.9 /30 sweeps. In total 8 species of insects belonged to 8 families of 7 orders were found as predator and their abundance varied from 0.3±0.1 to 2.0±0.3/30 sweeps. Among the predator insects, lady bird beetle showed the highest abundance. In eggplant field, insects were highest and lowest abundant at 11.00 and 13.00 h of the day, respectively.

Keywords: Abundance, richness, diversity, pest, predator, pollinator, *Solanum melongena.*

Introduction

Eggplant is one of the widely grown Solanaceous vegetables incredibly contains various constituents belonging to the category of the flavenoid, alkaloid, oleic, palmitic and linoleic acids (Yadav *et al.,* 2010). It is extensively cultivated in Bangladesh throughout the year. But the major constraint to sustainable productivity is the high incidence of insect pests.

Eggplants are infested by a number of pests such as brinjal shoot and fruit borer, aphid, jassid, whitefly, epilachna beetle, leaf hopper etc. Among them brinjal shoot and fruit borer is the most devastating pest in many parts of the world which may cause more than 60% loss of yield (Kapoor, 1993). Nayer *et al.* (1995) reported 53 species of insects pests cause damage to eggplant in India. Bhadauria *et al*. (1999) reported that shoot and fruit borer, jassid, aphids, leaf roller and stem borer were the most common pest of eggplant in Madhay Pradesh, India.

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Predator species play significant role in reducing pest population and they are free living organisms in both their immature and adult stages. About 167 families of 14 orders contain predatory insects. However, the orders Coleoptera, Neuroptera, Hymenoptera, Diptera and Hemiptera provide a very large number of individuals which frequently control the pest population. The lady bird beetles are well known beneficial arthropods found in many habitats (Ali and Rizvi, 2009). The adults and larvae of lady bird beetles found to be an effective predatory fauna in eggplant ecosystem (Ali *et al.,* 2009). El-Shafie (2001) reported that Coleoptera had occupied 60 % of the total plant dwelling predators in brinjal agroecosystem in Sudan.

Different categories or species of insects in certain habitat interact among them for food and shelter, and eventually influence on their abundance, richness and diversity. Vergara and Badano (2009) reported that 12 species of insects are found as pollinators in eggplant field and they are linked as the functional component of the eggplant ecosystem. Functional diversity is an important component of diversity which is a common approach to test the effects of diversity on ecosystem. In the present study insect pest, predator and pollinator abundance and diversity were investigated to find out their functional group status in eggplant ecosystem.

Materials and Method

The study was conducted during March to August 2016 in the Field Laboratory of the Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, Bangladesh.

Study location and climatic conditions: The study site is located at 25°25′ North latitude and 89°5′ East longitude, which is in the middle of Bangladesh. The study area has a subtropical *climate having* mean maximum and minimum temperatures 36.0 ^{o}C and 12.7 ^{o}C, respectively, and relative humidity and rainfall are 65.8% and 237.6 cm, respectively (Amin *et al.,* 2015).

Collection of eggplant seeds and cultivation of crop: Seeds of eggplant namely BARI begun 8 were collected from the Horticulture Research Center, Bangladesh Agricultural University, Gazipur, Bangladesh and were sown on 2 March 2016 in poly bags. For transplanting seedlings, plots having 4.0 m × 4.0 m followed by randomized complete block design were used. The spacing between block to block and plot to plot were 60 cm × 60 cm. Eggplant seedlings were transplanted 60 cm apart on 21 March 2016, in rows. The distance from row to row was 60 cm. Each plot has five rows and each row contained 5 plants. Fertilizers were applied according to Fertilizer Recommendation Guide (N- 78 kg, P- 36 kg, K- 66 kg, S- 17 kg per hectare). Intercultural operations such as irrigation and weeding were done whenever necessary.

Insect collection and identification: Free-living insects were collected from flower initiation to fruit maturation stage using a 30 cm diameter sweep net having 1.5 mm mesh, and attached with a 2 m long rod. Every week sweeping was done in between 09.00 to 11.00 am, and each sample was consisted of 30 sweeps covering an area from ground level to the top of the trees. The collected insects were brought to the Entomology Laboratory of BSMRAU for identification and counting. They were killed by storage in a freezer for a few hours, mounted on points, dried and morphotyped. Insects were identified to species or genus level and also was separated as pest, predator, pollinator and other categories. Identified specimens were deposited in the insect museum of BSMRAU.

Observation of insect abundance and foraging behavior of pollinators: Peak foraging time of the frequently abundant insect species was observed. To find out peak foraging time, weekly collection was conducted at 7.0 h, 9.0 h, 11.0 h and 13.0 h in a day, and number of insects per sample were counted. The insects collected at 11.0 am were grouped as pest, predator, pollinator and other category. Landing duration of the pollinators on eggplant flowers were measured using a stop watch. Observations were done in between 10:00 to 11:30 am and data were recorded 7 times for each species.

Statistical analysis: One way analysis of variance (ANOVA) followed by Tukey HSD posthoc test was employed for analyzing richness (total number of species), abundance (total number of individuals), diversity (Simpson Index of Diversity), abundance of pest and predator, and distribution of the insects. Diversity was calculated following the formula of Simpson (1949). Chi statistics was applied to find out significant difference in percent of insects among various orders. All the analyses were performed using IBM SPSS 21.0. (IBM SPSS statistics 21, Georgia, USA).

Results and Discussion

In the present study, in total 488 insects were collected from the eggplant field. The collected insects belonged to 20 species of 21 families and 10 orders. The percent of insects in different taxonomic orders varied from 0.4 to 33.6 (Fig. 1). Among the taxonomic orders, Hemiptera(33.6) was the most dominant followed by Coleoptera (28.3%), Hymenoptera (12.7%), Diptera (8.8%), Lepidoptera (7.6%), Odonata (2.6%) and Dermaptera (2.5%). Other orders namely Orthoptera (2%), Dictyoptera (1.2%) and Thysanoptera (0.4%) showed very lower percentages of abundance.

Table 1 showed that the abundance, richness, and diversity of pest, predator, pollinator and other categories of insects varied from 5.2±0.6 to 14.4±1.1, 1.5±0.1 to 5.0±0.2, 0.2±0.03 to 5.0±0.2 /30 sweeps, respectively and the results differed significantly (abundance: $F_{3,80}$=39.1, $P < 0.001$; richness: $F_{3,80}$=43.3, $P < 0.001$; diversity: $F_{3,80}$= 3.9, $P<0.01$). The abundance and richness of insect pest

was higher compared to predator, pollinator and other categories. The insects in other categories revealed the lowest abundance, richness but showed highest diversity.

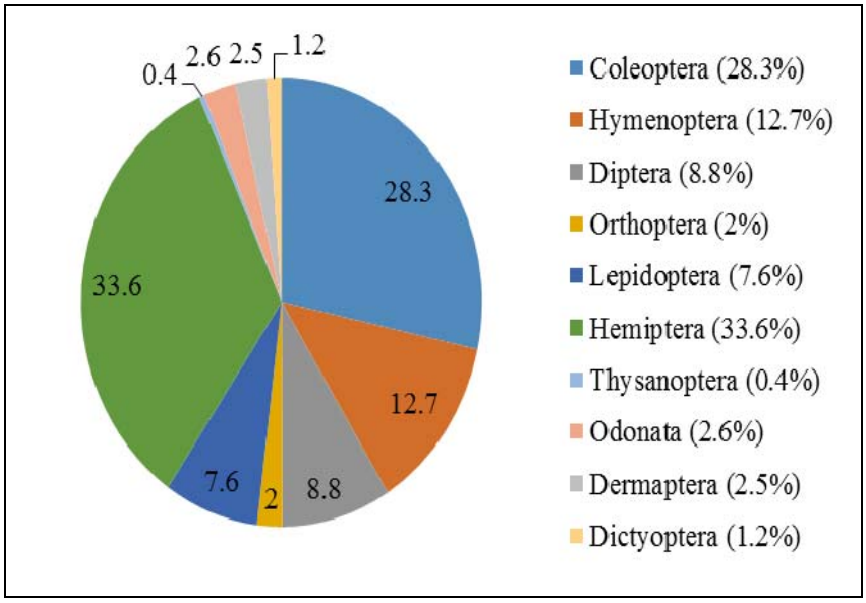

Fig. 1. Insects (%) belong to different taxonomic orders found in the eggplant field

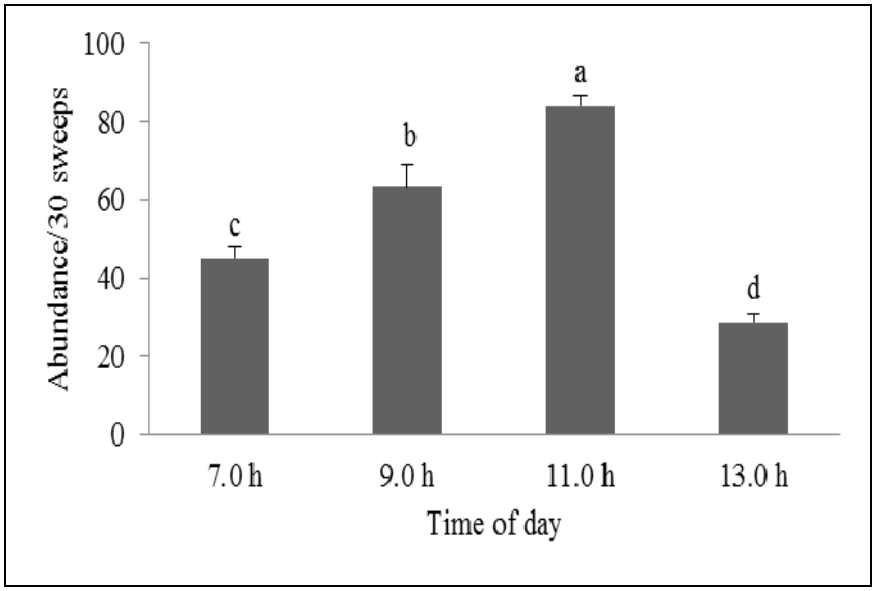

Fig. 2. Distribution of insect counts (mean ± SE) in eggplant field during full blooming period. Bars with common letter(s) are not significantly different by Tukey HSD posthoc statistic at $P < 0.05$.

Klein *et al.* (2007) reported the abundance, richness and diversity of insect pest, predator and pollinators and found significant variations. Insect species in eggplant field in different climatic and habitat conditions varied significantly. Vergara and Badano (2008) reported the richness of pollinator species in eggplant field and found the highest richness in rustic shaded site followed by commercial poly culture sites, and the lowest species richness was recorded in the specialized shaded plantations

Table 1. Average abundance, richness and diversity of insects in eggplant field

	Insect Pests	Predators	Pollinators	Others
Abundance	14.4±1.1 a	5.8±0.6 b	5.4±0.5 b	5.2±0.6b
Richness	5.0±0.2 a	3.4±0.3 b	3.7±0.3 b	1.5±0.1 c
Diversity	0.4±0.2 ab	0.2±0.04b	0.2±0.03 b	5.0±0.2 a

Data expressed as mean ± SE. Means per insect group are taken from 30 sweeps per total collection. Means within a row followed by same letter(s) are not significantly different by Tukey HSD posthoc statistic at < 0.05.

Table 2. Insect pests along with their abundance in eggplant field

Pest	Taxonomic profile	Abundance
Epilachna beetle	*Epilachna dodecastigma* (Coleoptera:Coccinellidae)	4.6±0.9 a
Jassid	*Amrasca biguttula* (Hemiptera:Cicadellidae)	4.6±0.4 a
White fly	*Bemisia tabaci* (Hemiptera:Aleurodidae)	2.6±0.2 b
Shoot and fruit borer	*Leucinodes orbonalis* (Lepidoptera: Pyralidae)	1.0±0.2 bc
Rice bug	*Leptocorisa acuta* (Hemiptera:Coriedae)	0.2±0.1c
Aphid	*Aphis gossypii* (Hemiptera: Aphididae)	0.9±0.2c
Thrips	*Thrips hawaiiensis* (Thysanoptera: Thripidae)	0.1±0.1 c
Leaf hopper	*Amrasca devastans* (Hemiptera: Cicadellidae)	0.3±0.1 c

Data expressed as mean ± SE. Mean of each pest was taken from 30 sweeps per total collection. Means in the column followed by same letter(s) are not significantly different by Tukey HSD posthoc statistic at < 0.05.

In total, 9 species of insects belonged to 7 families of 4 orders (Coleoptera, Lepidoptera, Hemiptera and Thysanoptera) were found as pest (Table 2). Their abundance varied from 0.1±0.1 to 4.6±0.9 /30 sweeps and the results differed significantly ($F_{7, 160} = 24.2$, $p < 0.001$). Among the pest insects, epilachna beetle showed the highest abundance while thrips showed the lowest abundance. In India, 53 species of insects were reported as pest of eggplant of which shoot and fruit borer was the most destructive (Nayer *et al.,* 1995). Aganon *et al*. (1997) reported that shoot and fruit borer, jassid (leaf hopper) and thrips (*Thrips tabaci*) were the common pests of brinjal in the field. Several researchers reported the severity of attack of jassid and white fly in brinjal (Bhadauria *et al.,* 1999, Alam *et al*., 2004).

Table 3. Insect predators along with their abundance in eggplant field

Predator	Taxonomic profile	Abundance
Preying mantid	*Mantis regiosa* (Dictyoptera:Mantidae)	0.3±0.1 c
Dragon fly	*Aeshna verticalis* (Odonata:Aeshnidae)	0. 3±0.1 c
Short horn grasshopper	*Oxya velox*(Orthoptera: Acrididae)	0.5±0.1 c
Ichneumonid wasp	*Megarhyssa macrurus*(Hymenoptera :Ichneumonidae)	0.4±0.2c
Ant	*Formica rubra* (Hymenoptera:Formicidae)	1.3±0.2 ab
Lady bird beetle	*Coccinella septempunctata* (Coleoptera:Coccinellidae)	2.0±0.3 a
	Coccinella transversalis (Coleoptera:Coccinellidae)	-
Earwig	*Forficula auricularia*(Dermaptera :Forficulidae)	0.6±0.1bc
Damselfly	*Coenagrion puella* (Odonata :Coenagrionidae)	0.3±0.1c

Data expressed as mean ± SE. Mean of each pest was taken from 30 sweeps per total collection. Means in the column followed by same letter(s) are not significantly different by Tukey HSD posthoc statistic at < 0.05.

In total, 8 species of insects belonged to 8 families of 7 orders (Dictyoptera, Odonata, Orthoptera, Hymenoptera, Coleoptera, Dermaptera, Odonata) were found as predator (Table 3). Their abundance varied from 0.3±0.1 to 2.0±0.3/30 sweeps and the results differed significantly ($F_{7, 160} = 12.1$, $p < 0.001$). Among the predator insects, lady bird beetle showed the highest abundance, while preying mantid, dragon fly, damselfly, short horned grasshopper and ichneumonid wasp showed the lowest and statistically similar abundance. Latif *et al*. (2009) reported that predaceous arthropods in brinjal field were grouped in 10 families under 7 taxonomic orders of which Coleoptera was the most important which occupied 42.4% of the total predators under 3 different families such as Coccinellidae, Carabidae and Staphylinidae. The plant dwelling insects in the brinjal field of Bangladesh other than Coleoptera were Hymenoptera, Hemiptera, Neuroptera, Diptera and Dictyoptera which contributed 27.3% of the total arthropods (Latif *et al.,* 2009).

References

Aganon, T. M., M. G. Patricio, J. I. Calderon, J. S. Soriano and M. L. J. Sison. 1997. Development of vegetable IPM program in a rice-based cropping systems. *Kasetsart J. Natl. Sci.* **32:** 32-36.

Alam, S. N., G. J. U. Ahmed, A. K. M. Khorseduzzaman, A. N. M. R. Karim and E. G. Rajotte. 2004. Survey of vegetable insect pests in rice-vegetable cropping system in Bangladesh. Annual Research Report. 2003-2004. Entomology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, Bangladesh. PP. 44-46.

Ali, A. and P. Q. Rizvi. 2009. Life table studies of *Menochilus sexmaculatus* Fabr. (Coleoptera: Coccinellidae) at varying temperature on *Lipaphis erysimi* Kalt. *World Appl. Sci. J.* **7:** 897-901.

Amin, M. R., S. Namni, M. R. U. Miah, M. G. Miah, M. Zakaria, S. J. Suh and Y. J. Kwon. 2015. Insect inventories in a mango-based agroforestry area in Bangladesh: foraging behavior and performance of pollinators on fruit set. *Ent. Res.* **45:** 217-224.

Bhadauria, N. K. S., N. S. Bhadauria and S. S. Jakmola. 1999. Insect pest complex of brinjal, Solanum melongena Linn. In north-west Madhya Pradesh. *Adv. Plant Sci.* **12:** 607-608.

El-Shafie, H. A. F. 2001. The use of neem products for sustainable management of homopterous key pests on potato and eggplant in the Sudan. Ph. D. Thesis, University of Giessen, Germany.

Kapoor ,V. C. 1993. Indian Fruit Flies. Oxford and IBH Publishing Co. Ltd. New Delhi, India. pp. 228-277.

Klein, A. M., B. E. Vaissiere, J. H. Cane, I. Steffan-Dewenter, S. A. Cunningham, C. Kremen and T. Tscharntke. 2007. Importance of pollinators in changing landscapes for world crops. *Proc. Royal Soc. Lond. B Biol. Sci.* **274:** 303-313.

Latif, M. A., M. M. Rahman, M. R. Islam and M. M. Nuruddin. 2009. Survey of arthropod biodiversity in the brinjal field. *J. Entomol*. **6:** 28-34.

Nayar, K. K., T. N. Ananthakrishnan and B. V. David. 1995. General and Applied Enotmology. 11th edn. Tata MeGraw-Hill Publ. Co. Ltd. 4/12, Asaf Ali Road, New Delhi-110002. pp. 557.

Simpson, E. H. 1949. Measurement of diversity. *Nature*. **163,** 688.

Vergara, H. C. and E. I. Badano. 2009. Pollinator diversity increases fruit production in Mexican coffee plantations: The importance of rustic management systems. *Agric. Ecosyst. Environ.* **129:** 117-123.

Yadav, M., S. Jain, R. Tomar, G.B. Prasad and H. Yadav. 2010. Medicinal and biological potential of eggplant: an updated review. *Nature.* **23:** 184-190.