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FLUCTUATION PATTERN OF INSECT PESTS AND NATURAL ENEMIES IN SUMMER BRINJAL ECOSYSTEM

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Abstract

A field study was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, in summer season during February to August 2014 to know the seasonal fluctuation pattern of insect pests and natural enemies in brinjal ecosystem. The major insect pests were found in brinjal field viz. jassid (136.02 per 10 leaves), whitefly (92.88 per 10 leaves), aphid (83.33 per 10 leaves) and brinjal shoot and fruit borer (20.44 male moth per trap^{-week}) and their highest population was observed at 70, 85, 70 and 116 days after transplanting (DAT). Epilachna beetle, leaf beetle, green leaf hopper and leaf roller indicated as the relatively minor pests of brinjal. Average temperature showed significant positive correlation with the population of jassid, whitefly, aphid, brinjal shoot and fruit borer and epilachna beetle. While average relative humidity had a significant negative correlation with population of jassid, whitefly and aphid. A significant negative correlation was also observed in case of rainfall for white fly and aphid. Natural enemies found in the brinjal field were spider, black ant, lady bird beetle, carabid beetle, syrphid fly and preying mantid.

Keywords: Brinjal, seasonal fluctuation, insect pest, natural enemy.

Introduction

Brinjal is a versatile and economically important vegetable to the small-scale farmers and low income consumers of the entire universe (FAO, 2000). In the brinjal field, various pests are found from seedling stage to harvesting stage and the loss caused by these pests vary from season to season depending upon environmental factors (Gangwar and Sachin, 1981). EL-Shafie (2001) observed 28 species of insect pests of 7 different orders in brinjal ecosystem, while Nayer *et al.* (1995) reported 53 species of insect pests of brinjal in India. Many arthropod natural enemies of those obnoxious pests also exist in the same ecosystem (FAO, 2003). Latif *et al.* (2009) reported 20 species of harmful arthropods and 10 species of predacious arthropods in brinjal agro-ecosystem. Regupathy *et al*. (1997) stated more than 36 insect pests infesting brinjal from the time of its planting to harvesting. The meteorological parameters play a pivotal role in the biology of insect pests. Temperature is the most crucial abiotic factor influencing the rate of growth and development of insect pests and it needs effective control measures to cheek their abundant growth. Again variation of insect pests is subjected to vary in different geographical locations associated with temporal variations. To implement Integrated Pest Management (IPM) effectively, it is necessary to monitor the seasonal variations of population of insect pests and their natural enemies. In the present study an attempt was taken to address this issue.

Materials and Methods

The study was conducted in the experimental farm of the Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, during February to August 2014 (Summer). Geographically the location lies between 24.09^0 N latitude and 90.26^0 E longitudes with an elevation of 8.50 meter from the sea level (Haider *et al.*, 1991). The study was laid out in RCB design with three replications. The row to row distance was 1 m and plant to plant 60 cm. A total of 135 seedlings were planted in 9 plots @ 15 seedlings plot^{-1} and each plot size

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was maintained at 3m × 3m. Thirty five days-old seedlings (BARI Begun-8) were transplanted in the well prepared experimental plots. No plant protection measure was applied excess pheromone trap. All the recommended agronomic practices were followed during the experimental period according to Rashid (1993). Observations were made by visual searching method and installation of pheromone trap. Data were analyzed by SPSS software.

Visual searching method

Insect species considering sessile, agile, adult, nymphs and larvae of flying insects on brinjal plants were counted from a random sample of 5 plants taken from each plot. Ten leaves were chosen randomly on each plant, four from the bottom (older leaves), two from the middle and four from the top canopy (younger leaves). The lower surface of the leaf was thoroughly examined visually with naked eye for the presence of any insects. Counting was done before 08:30 AM (local time) to avoid the excessive mobility of the adult insects. The data were pooled over the season and average was calculated to provide an overall mean density per plot. The population density of each insect was expressed as number of individuals per 10 leaves of the plant. The population of beneficial insects like spiders, lady bird beetle, ants, nymphs and larvae on brinjal plants, were counted from five branches selected randomly from 10 plants. Observations were made at fortnightly intervals throughout the cropping season i.e. ten times data were taken on insect population and natural enemies.

Pheromone trap

Trapping is a relative insect population density monitoring method. To catch adult moth of Brinjal shoot and fruit borer (BSFB) one sex pheromone trap was placed in the center of each plot (Plate 1). Brinjal shoot and fruit borer moths were collected at seven days interval.

Plate 1. Female sex pheromone traps set at plant canopy level in the centre of a brinjal plot.

Results and Discussion

Population fluctuation of insect pests

First appearance of jassid on brinjal plant started at 25 days after transplanting (DAT) i.e., at the crop age of 60 days, on 15 March 2014 (48.59 per 10 leaves) and there was a gradual increase in jasssid population and the highest population (136.02 per 10 leaves) at 40 DAT on 30 March 2014. The lowest population (13.12 per 10 leaves) found at 115 DAT on 13 June 2014 (Table 1). Mid growth aged brinjal plant was possessed the maximum circumference and found the highest population of jassid.

The highest population (92.88 per 10 leaves) of whitefly on brinjal plant was found at 85 DAT on 14 May 2014. Then, there was gradual decline in whitefly population and reached to a lowest population of 16.67 per 10 leaves at 130 DAT on 28 June 2014. Incidence of aphid on brinjal plant was first noticed at 25 DAT on 15 March 2014 (32.33 per 10 leaves) and there was a gradual increase in aphid population and the highest population at 70 DAT on 29 April 2014 (83.33 per 10 leaves) and then decline and reached to a lowest population of 3.12 per 10 leaves at 145 DAT, 13 July 2014 (Table 1). The highest population of whitefly and aphid was also found at the mid growth stage of brinjal plant due to that stage was possessed the maximum circumference.

Infestation of epilachna beetle on brinjal plant started at 25 DAT, i.e., 60 days crop age, 15 March 2014 (9.13 beetle per 10 leaves) and the highest population was recorded at 40 DAT, 30 March 2014 (10 beetle per 10 leaves) and the lowest number population (2.78 beetle per 10 leaves) was found at 160 DAT on 28 July 2014 (Table 1). However, epilachna population was low and sporadic throughout the entire cropping season. The results of the present study were not as par reported by Bharadiya and Patel (2005) who found that epilachna beetle *Epilachna vigintioctopunctata* (28 black spots) damaged brinjal from first week after transplantation and its incidence peaked from 7 to 9 weeks after transplantation with 23.70 - 27.60 adults per three leaves. They also reported that it was higher (21.80 - 27.60 beetles per three leaves) during March - April but declined thereafter.

The highest population of leaf beetle and green leaf hopper on brinjal plant was found 8.67 per 10 leaves and 6.43 per 10 leaves at 25 DAT and at 70 DAT, respectively. Then, there was gradual decline and reached to least 1.20 and 0.97 at 145 DAT and 130 DAT, respectively (Table 1).

Attack of leaf roller on brinjal crop started from 40 DAT 0.67 per 10 leaves and the highest population was recorded at 85 DAT 2.33 per 10 leaves (Table 1). However, the population of epilachna beetle, leaf beetle, green leaf hopper and leaf roller were very low and sporadic throughout the whole cropping season and such incidence indicated that they were minor pests of brinjal at BSMRAU, Gazipur during summer (March to August 2014) but it does not mean that it could not be a major pest in some other regions of Bangladesh.

The present finding is in agreement with the findings of Patel *et al.* (2015), who reported that the jassid population was started from third week of February and reached to its peak level (9.53 jassids leaf $^{-1}$) on first week of May, the population of whitefly was reached to peak level (15.33 whiteflies leaf $^{-1}$) coinciding with the last week of April and aphid reached to peak level (5.33 aphids leaf $^{-1}$) coinciding with the 2nd week of May. Alam *et al.* (2003) reported that pest damage was the highest during July to October, decreased gradually after that and there was very little damage during November to December. The insect was active throughout the year at places having moderate climate but its activity was adversely affected by severe cold, but were less active during February to April.

Table 1. Incidence of different insects in brinjal ecosystem at different DAT per 10 leaves.

DAT*	Crop age**	Jassid (No.)	White fly (No.)	Aphid (No.)	Epilachna beetle (No.)	Leaf beetle (No.)	Green leaf hopper (No.)	Leaf roller (No.)
25	60	48.59	28.33	32.33	9.13	8.67	5.47	0.00
40	75	136.02	41.75	57.00	10.00	7.43	6.42	0.67
55	90	107.32	72.92	60.22	7.10	6.22	5.20	1.00
70	105	134.63	86.54	83.33	5.80	5.43	6.43	0.60
85	120	102.48	92.88	46.67	4.34	3.19	4.15	2.33
100	135	58.56	51.25	24.67	6.00	2.00	2.23	0.33
115	150	13.12	22.08	10.00	4.32	0.00	0.97	0.52
130	165	0.00	16.67	9.00	3.12	0.00	1.63	0.72
145	180	0.00	0.00	3.12	2.89	1.20	0.00	0.57
160	195	0.00	0.00	0.00	2.78	3.66	2.96	0.00
MEAN±SE	-	60.11±17.80	41.15±10.73	32.62±8.94	5.55±0.81	3.78±0.97	3.55±0.73	0.47±0.21

**DAT-Days after transplanting, ** Crop age=Seedling age +DAT*

Incidence of male brinjal shoot and fruit borer (BSFB) moth

Incidence of BSFB was monitored through sex pheromone traps. Pheromone trap started catching of BSFB (2.90 trap^{-1}) on 15 March 2014 (25 DAT, i.e., 60 days crop age,). There was a gradual increase in BSFB population and the highest number captured was 20.44 trap^{-1} at 116 DAT on 14 June (Fig. 1). The present finding partially is in agreement with the findings of Rashid *et al.* (2013) who captured male BSFB of 3.9 trap^{-1} on 29 February 2012. The seasonal history of brinjal shoot and fruit borer varies considerably with varying climatic conditions throughout the year. Hibernation does not take place and the insect are found active in summer months, especially in rainy season. FAO (2003) reported that the insect was active in summer months, especially during the rainy season and peak population was observed in June to August. They were less active during November to February and the population was reported to increase with average temperature and relative humidity.

Alam *et al.* (2003) reported that pest damage was the highest during July to October, decreased gradually after that and there was very little damage during November to December. At the peak period, the pest damage in many areas exceeded 60% of total fruit whereas in December nearly 5% had BSFB damaged. The insect was active throughout the year at places having moderate climatic condition but its activity was adversely affected by severe cold. They are less active during February to April.

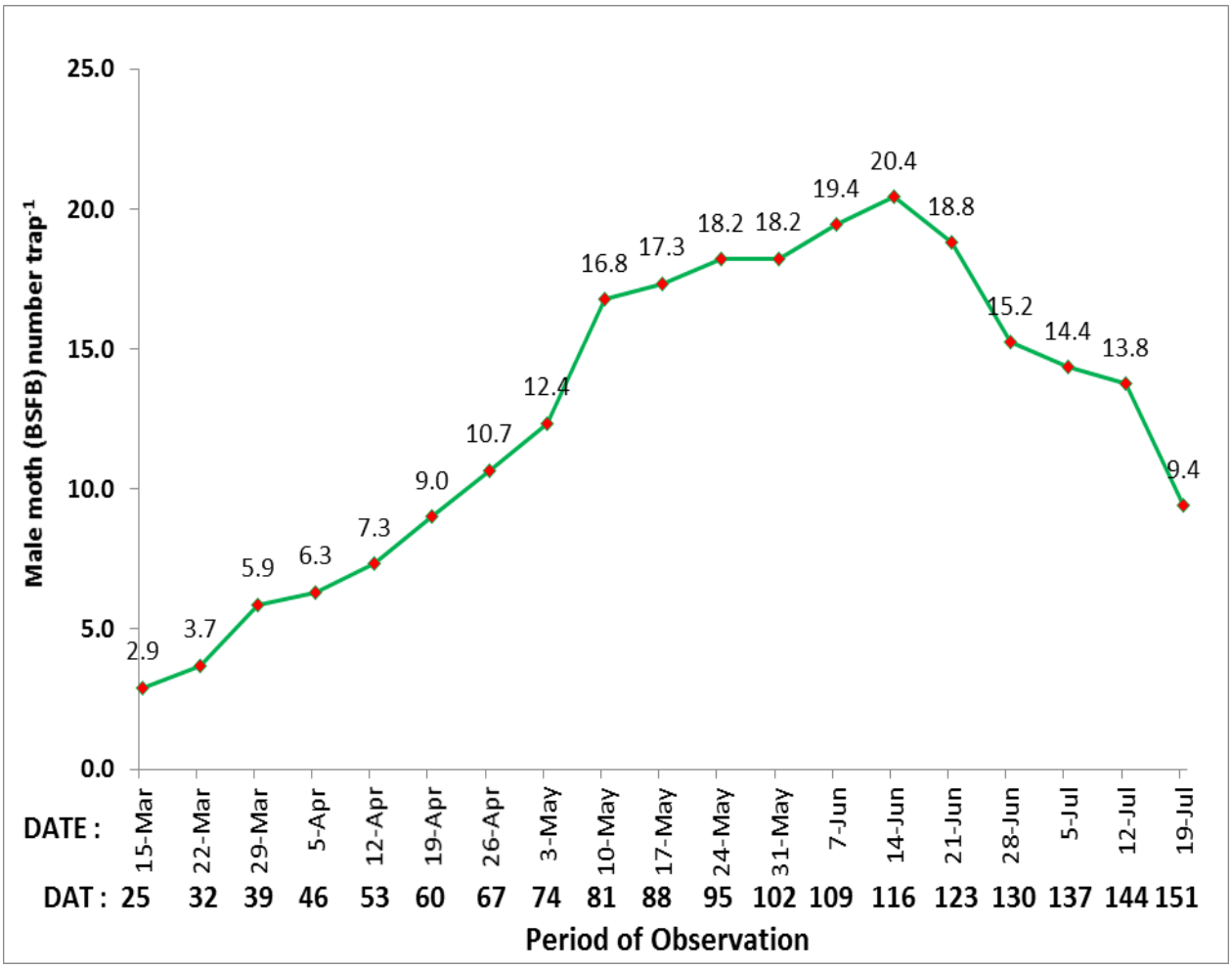

Fig. 1. BSFB captured at different DAT (Days after transplanting) by female pheromone trap in brinjal field during summer (March to August 2014).

Influence of weather parameters on insect pests of brinjal

Correlation coefficient (Table 2) between different weather parameters and population of insect pests revealed that, average temperature had significant positive correlation with population of jassid, whitefly, aphid, BSFB and epilachna beetle with a correlation coefficient of r = +0.88, r = +0.82, r = +0.87 and r = +0.77, respectively. With average relative humidity had significant negative correlation with population of jassid, whitefly and aphid with a correlation coefficient of r = -0.95, r = - 0.67 and r = - 64, respectively and rest of other insects had non-significant correlation. The present findings are in agreement with the reports of Patel *et al.* (2015) who reported that the increase in temperature was significantly conducive for jassid, whitefly, aphid, BSFB and epilachna beetle multiplication. In case of rainfall significant negative correlation was observed for whitefly (r = -0.88) and aphid (r = -0.82). In the present study the correlation of epilachna beetle is in agreement with Bharadiya and Patel (2005) who reported that population of epilachna beetle showed significant positive correlation with average temperature, relative humidity and weekly rainfall. FAO (2003) reported that the insect was active in summer and during the rainy season and peak population was observed in June to August. They were less active during November to February and the population was reported to increase with the increase in average temperature and relative humidity.

Table 2. Correlation between weather parameters and insects population in brinjal field during summer (March to August 2014).

Correlation	Jassid	White fly	Aphid	Brinjal Shoot and Fruit Borer	Epi-lachna beetle	Leaf beetle	Green leaf hopper	Leaf roller
Temperature	0.88**	0.82**	0.87**	0.77**	0.65*	0.39	-0.29	0.37
Relative Humidity	-0.95**	-0.67*	-0.64*	-0.58	0.44	-0.28	0.04	-0.3
Rainfall	-0.56	-0.88**	-0.82**	-0.43	88**	-0.17	0.007	-0.31

***Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed)*

Population fluctuation of natural enemies

Observation at 15 days interval revealed that activity of spiders (all species) in brinjal field started at 25 DAT, i.e. when the crop age was 60 days (0.33 per 5 branches) and the highest population was found (12.83 per 5 branches) at 130 DAT (Table 3). Spider was more on the upper canopy of brinjal plant. Ooi (1998) identified that spider (*Lycosa pseudoannulata)* had high propensity to control plant hopper. Kamal *et al*. (1992) reported that wolf spiders (*Lycosa pseudoannulata),* lynx spiders (*Oxyopes javanus*) and orb spider (*Argiope catenulate)* has good predatory potentiality to control borer and most of the sucking pests like jassid (leaf hopper), whitefly and aphid.

The highest population of black ant (9.53 per 5 branches) was found at 70 DAT and lowest population (1.47 per 5 branches) was recorded at 25 DAT (Table 3). Incidence of lady bird beetle in brinjal field was first noticed at 40 DAT (1.33 per 5 branches) and the highest population (8.73 per 5 branches) was observed at 85 DAT (Table 3) and the *Menochilussex maculatus* species was more frequent in brinjal field. Lady bird beetle are most regulatory feeder of aphid. Srinivasan (2009) reported that inundated release of ladybird beetles @ 200 pairs ha^{-1} at fortnightly can suppress the aphid population successfully in the brinjal field. The current study is supported by Rahman (2013) who observed 3.37 adult lady bird beetles $plant^{-1}$ during summer season.

The plant and surface dwelling carabid beetle in brinjal crop appeared in the field at 25 DAT, i.e., 60 days crop age showing 4.07 carabid beetle per 5 branches and the highest population was recorded at 55 DAT having 6.73 per 5 branches. However, its population was low and intermittent throughout the cropping season (Table 3). The highest population of syrphid fly and preying mantid in brinjal field was found 2.93 per 5 branches and 1.54 per 5 branches at 70 DAT, respectively. Though Shepard *et al.* (1987) reported that carabid beetle, syrphid fly and preying mantids have good potentiality to control leaf folder larvae, aphids, thrips and many caterpillars.

The present finding are more or less in conformity with the findings of El-shafie (2001) who reported that Coleoptera had occupied maximum of the plant dwelling predators and Formicidae as the most frequently appear

surface dwelling predators in brinjal agro-ecosystem. Das and Islam (1984) found many species of ants as good predators of insects, of which black ant (*Camponotus compressus* Fab.) was a good predator of BSFB.

Awal (2012) found that among natural enemies the highest abundance (126.67) was recorded for the species black ant followed by spider (18.33), lady bird beetle (12.33) and other available natural enemies were carabid beetle, mirid bug, staphylinid beetle and syrphid fly etc. The present findings partially agree with those of Latif *et al.* (2009), who reported that order Arachnid and Coleoptera had occupied 42.44% and 30.23 % of the total plant dwelling predators, respectively.

Table 3. Incidence of spider, back ant and lady bird beetle in brinjal field during summer (March to August 2014).

DAT*	Crop age**	Spider (No.)	Black ant (No.)	Lady bird beetle (No.)	Carabid beetle (No.)	Syrphid fly (No.)	Preying Mantid (No.)
25	60	0.33	1.47	0.00	4.07	1.33	0.00
40	75	1.67	3.93	1.33	2.20	1.27	0.00
55	90	6.93	7.40	5.13	6.73	2.80	0.33
70	105	8.07	9.53	6.53	2.67	2.93	1.54
85	120	7.33	8.60	8.73	1.07	1.13	0.67
100	135	8.56	7.07	3.65	3.87	1.67	1.50
115	150	11.40	6.03	2.34	1.67	0.00	0.00
130	165	12.83	3.57	3.83	4.20	1.22	1.04
145	180	10.40	5.00	1.56	2.33	0.00	0.00
160	195	12.38	3.80	2.40	3.87	0.00	0.00
MEAN±SE	-	7.99±1.09	5.64±0.69	3.55±0.78	3.27±0.54	1.24±0.36	0.51±0.21

**DAT-Days after transplanting ** Crop age=Seedling age +DAT*

It can be concluded that seasonal population fluctuation of insect pests and natural enemies on brinjal crop is greatly influenced by a number of environmental factors. It means that management of brinjal pest is a complex one and it is a necessary to monitor the seasonal variations of insect pest populations as well as it's natural enemies for taking appropriate controlling measures.

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