STUDIES ON THE PEST STATUS AND SEASONAL ABUNDANCE OF DIFFERENT INSECT PESTS IN BRINJAL AT GAZIPUR.

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CERTIFICATE

This is to certify that the thesis entitled, 'STUDIES ON THE PEST STATUS AND SEASONAL ABUNDANCE OF DIFFERENT INSECT PESTS IN BRINJAL AT GAZIPUR' submitted to the faculty of Agriculture, sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE (M. S.) in Entomology embodies the result of a piece of bona fide research work carried out by MD. ABDUL JABBAR Roll No.54 Registration No.25262/ 00370 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has been duly acknowledged by him.

Date:
Place: Dhaka, Bangladesh

Prof. Dr. Serajul Islam Bhuiyan

Supervisor

Dedicated to

My

Beloved Parents

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ABSTRACT

Several experiments have been undertaken to determine the pest status and seasonal abundance of different insect pests in brinjal at Gazipur during November 2005 to September 2006 in the Entomology Division Experimental field, BARI, Gazipur. Five species of insect pests were recorded in the brinjal field during the study period. Among the insect pests, Brinjal shoot and fruit borer, *Leucinodes orbonalis* (Lepidoptera: Noctuiidae) was appeared first followed by jassid, *Amarasca devastans* (Homoptera: Cicadellidae), Whitefly, *Bemasia tabaci* (Hemiptera: Aleyrodidae), two species of epilachna beetle, *Epilachna vigintiocpuctata* & *E. 12-punctata* (Coleoptera:coccinellidae) and Aphids, *Aphis gossypii* (Hemiptera: Aphididae). Among the five different pests recorded in the brinjal fields at Gazipur, brinjal shoot and fruit borer (BSFB) was the predominant one followed by jassid, whitefly, epilachna beetle and aphids. Year round infestation of BSFB, both in shoot and fruit was observed in the experimental plots. The highest infestation of BSFB was observed during hot and humid periods of the year (June – September). Except the dry months of the year (February – April), the infestation of jassid was not so high. Highest infestation of epilachna adult was observed during the month of December (0.068 per leaf), while that of epilachna larvae were observed during February (0.075 per leaf), June (0.071 per leaf) and July (0.074 per leaf). Highest number of whitefly per leaf was observed during the months of July-September, while lowest infestation was occurred during the cold months November-February. Infestation of aphids was built up during February to April (0.137-0.278 per leaf). Peak infestation occurred during March (0.278 per leaf). Positive correlation was observed in case of shoot and fruit infestation of BSFB and with temperature and rainfall. Warm temperature was favorable for the growth and development of jassid population, as there was positive correlation between jassid population with rise of temperature. But rainfall is detrimental for the jassid population growth. Population growth of whitefly was positively correlated with temperature and negatively correlated with rainfall. Epilachna adult population was positively correlated with temperature and negatively correlated with rainfall. Both temperature and rainfall have negative effect on the growth and development of aphid population. Aphids liked cool and dry temperature for its continuous growth and reproductive development.

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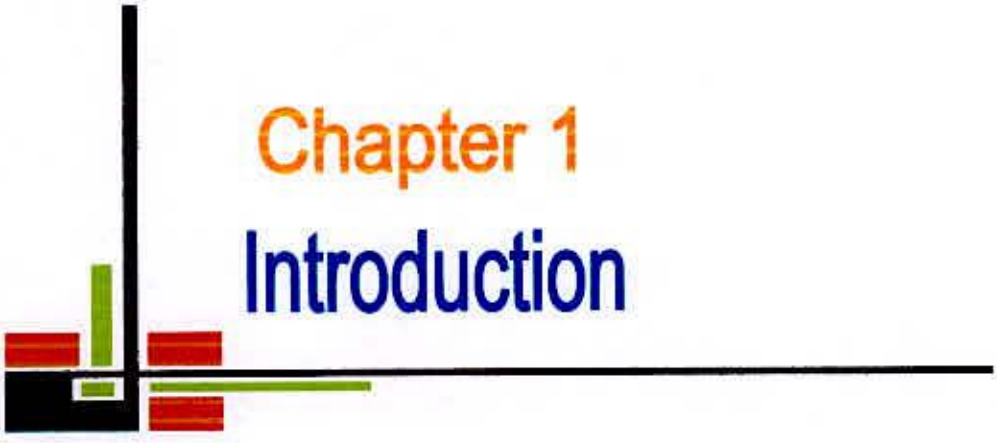
LIST OF ABBRIVIATIONS

AEZ	=	Agro-Ecological Zone
BARI	=	Bangladesh Agricultural Research Institute
cm	=	centimeter
^{0}C	=	Degree Centigrade
DAT	=	Days After Transplanting
g	=	gram(s)
Kg	=	Kilogram
LSD	=	Least Significant Difference
MP	=	Muriate of Potash
m	=	meter
ml	=	milliliter
NSKE	=	Neem Seed Karnel Extracts
No	=	Number
RCBD	=	Randomized Complete Block Design
sq-m	=	square-meter
TSP	=	Triple Super Phosphate
t/ha	=	ton/hectare
%	=	Percent
@	=	at the rate of
r	=	Correlation



Chapter 1

Introduction

CHAPTER 1

INTRODUCTION

Brinjal (*Solanum melongena* Linn) is one of the most common, popular and principal vegetable crops grown in Bangladesh and other parts of the world (Nonnecke.1989). Brinjal is locally known as 'Begoon' and its early European name is 'Eggplant'. Eggplant is also known as Guinea squash, garden egg and aubergine. Brinjal belongs to the family solanaceae and is normally a self-pollinated annual crop. Brinjal is extensively cultivated in Bangladesh, is grown in kitchen and commercial gardens in both Rabi and Kharif season and is very popular and acceptable to the people of all social status. Its cultivation helps to improve human nutrition and income generation.

Brinjal is infested by 18 different insect species of pests. Among them Brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen.), Epilachna beetle (*Epilachna vigintiocpunctata* Fab), Jassid (*Amrasca deveastanse*), White fly (*Bemisia tabaci*, Gennadius) and Aphid (*Aphis gossypii* Glover) are considered as the major ones. In Bangladesh, about eight insect species are considered as major pest causing damage to the crop (Biswas *et al.*, 1992). Hill (1983) reported 50 insect pests of brinjal. The losses caused by these pests vary from season to season depending upon environmental factors as reports by Gangwar and Sachan (1986) and Patel *et al.*, (1988). Various insect pests cause enormous losses to brinjal in every season and every year in Bangladesh (Alam, 1969).

Among the insect pests, brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen) (Lepidoptera: Pyralidae) is the most destructive to brinjal in Bangladesh (Alam 1969,

Nair 1986, Chattopadhyay, 1987). The incidence of the pest occurs either sporadically or in out break every year throughout subcontinent affecting the quality and yield of the crop adversely (Alam, 1969; Dhanker, 1988). The pest posses serious problem because of its high reproductive potential, rapid turnover of generations and intensive cultivation of brinjal both in wet and dry seasons of the year. The incidence of BSFB in brinjal could cause damage as high as 12-16 % on shoot and 20- 63 % on fruits depending on different brinjal varieties, locations and seasons (Alam, 1969). The yield loss caused by this pest has been estimated up to over 95 % in Haryana, India (Naresh *et al.* 1986), 63 % in Haryana, India (Dhanker, 1988).The crop loss caused by the pest ranged up to 86 % in Bangladesh (Ali *et al.*, 1980).

Jassid, *Amrasca devastans* (Distant) (Homoptera: Cicadellidae) is another destructive pest of brinjal in Bangladesh because of its wide range of cultivated hosts as well as wild hosts. Leafhoppers infest the lower surface of the leaves. Commonly, they move very rapidly sideways and hop. They are usually 1-3 mm long, greenish yellow with slender, tapered bodies with two distinct black sports on the posterior end of the wings. Adults and immatures are readily found on the undersides of leaves. Infested leaves curl upwards along the margins. Outer leaf areas appear yellowish or burned. Leaves remain small and show a mosaic pattern of yellowing. Defoliation may take place. Consequently, the fruiting capacities of the infested plants are badly affected.

Epilachna beetle, *Epilachna vigintioctopunctata* (Wied), (Coleoptera: Coccinellidae) is one of the serious pests of vegetables crops in Bangladesh. It is most abundant in Rabi

season than kharif season. Both the adult beetles and the grubs are injurious and feed upon the epidermis of the leaves resulting in drying and falling of the attacked foliage. Loss in yield of brinjal crop due to the attack of this pest varies from 10-20 %. (Alam 1969).

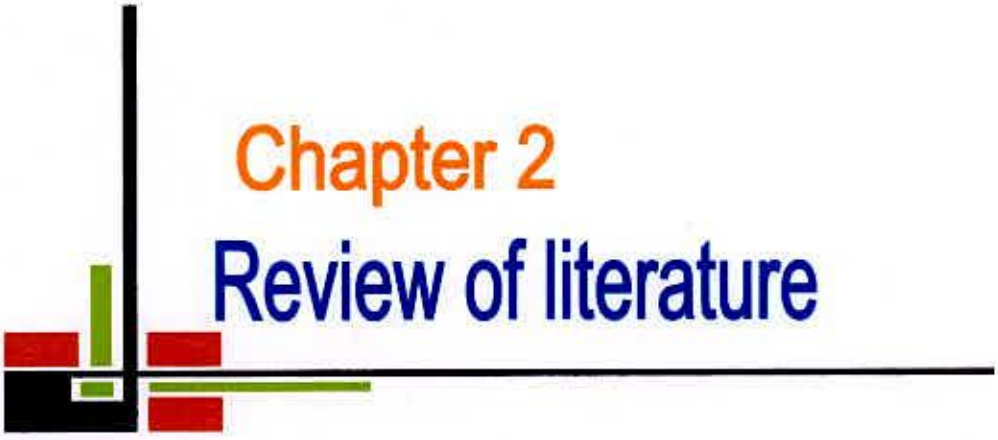
Whitefly, *Bemisia tabaci* is considering as the devastating one. It has a wide range of vegetables hosts belonging to different botanical families. However in brinjal it damages the plant by direct feeding caused by the piercing and sucking of sap from the plant foliage. This feeding cause weakening and early wilting of the plants and reduce the plant growth and yield. (Berlinger, 1986). It may also cause leaf chlorosis, leaf withering, premature dropping of leaves and plant death.

The Aphids, *Aphis gossypii* Glover (Hemiptera: Aphididae) is a phytosuccivorous pest occurring in different parts of the world. Being polyphagus, it occurs throughout the year on different host plants all over Bangladesh. Aphids are a major pest of solanaceous and cucurbitaceous vegetables (Butani and Jotwani, 1984; Mollah, 1996) and is responsible for its feeding damage and transmissions of plant viruses (Kennedy, 1976). Aphids cause damage directly by sucking cell sap of plants as a result leaf become wither and ultimately drop down and indirectly by transmitting several viral diseases (McKinley et. al., 1992). The losses on which is colossal and irreparable (Butani and Jotwani, 1984). In addition to brinjal plant, the other crops, which are usually attacked by this insect, are cotton, okra, potato, tomato, chilli, various cucurbits and papaya.

Brinjal is susceptible to a wide range of insect pests attacking from seedling to harvesting stage. The relative abundance of different species of brinjal insects is not identical in all the seasons. The severity of damage is related with the abundance of the different insects, which also effected by different weather parameters especially temperature, rainfall and humidity and also nature of food. So in order to predict seasonal abundance of various insect pests of certain crops in the field, it is necessary to study the growth and population development pattern of different insect pests at various weather conditions.

So, considering the importance of brinjal as a vegetable, seasonal abundance of different insect pests attacking brinjal were studied with the following objectives:

1. To identify the pest species attacking brinjal plants at Gazipur.
2. To study the status and seasonal abundance of insect pest species occurring on brinjal plants at different stages of growth after seedling to harvest at Gazipur.
3. To study the effect of weather parameters (temperature, rainfall, humidity) on the seasonal abundance of insect pests attacking brinjal.



Chapter 2

Review of literature

CHAPTER 2

REVIEW OF LITERATURE

2.1 Host plant

Brinjal is a native of India and is extensively grown in all the southwest Asian countries. This region account for almost 50% world's area of brinjal cultivation (Yamaguchi, 1983). It is warm season crop, requires continuous long warm weather during growth and fruit maturation. The optimum growing temperature is 22-30 ^{0}c and growth stops at temperature below 17°c. According to Shanmugavelu (1989), brinjal contains 92.7 % water, 1.1% protein, 0.02 % fat, 0.54 % ash and 5.5 % carbohydrate with calories of 130 lb having a source of vitamins A and B but poor in vitamin C. Brinjal is practically the only vegetable that is available at an affordable price for rural and urban consumers. This vegetable is cultivated largely on small, family–owned farms where weekly sales of it brings in a readily cash income. In Bangladesh, it is the 2nd most important vegetable crops after potato in relation to its total production (Anon.1996). Brinjal cultivation covers an area of 29,960 hectares, which is about 14.92 % of total vegetables areas of the country and its production is about 382000 tons during the year 2000 (BBS, 2003).

2.2 Insect pests

Brinjal is damaged by a number of inset pests that cause considerable yield loss. Among them Brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen,) Epilachna beetle (*Epilachna vigintioctopunctata)*, Aphid (*Aphis gossypii),* Jassid (*Amrasca devastanse)*, White fly (*Bemisia tabaci)* are the serious pest occurring either sporadically or as out break every year wherever the crop is grown affecting quality and quantity of brinjal

adversely. Review of the available literatures on different insect pests of brinjal is presented below under the following sub-headings.

2.2.1 Brinjal shoot and fruit borer (BSFB)

Brinjal shoot and fruit borer, *Leucinodes orbonalis* Guen is one of the most destructive insect pests of brinjal in Bangladesh. It is phytophagus in nature and belongs to the order Lepidoptera and family Pyralidae.

2.2.1.1 Infestation status

Shoot and fruit borer is very injurious to brinjal during the rainy and summer seasons. The losses incurred due to its infestation are some times reported to be more than 90% (Kalloo, 1988). The damage caused by *L. orbonalis* starts soon after transplanting of seedling and continues until the harvest of the fruits. The caterpillar after hatching begins to search for soft and tender shoots to bore. It is active from the beginning of its life. In young plants, the larvae bore into the petioles and midribs of large leaves and young shoots. After entering in to the host the larvae close the entry holes with their excreta and feed inside (Butani and Jotwani, 1984) by its mandibles. The infested shoots drop off due to disruption of vascular system and ultimately wither (Alam and Sana, 1962) and the borer continues boring the stem until it encases itself. At a later stage of plant growth, when the flower bud comes out, the larvae at first bore generally through the calyx and later in to the flower buds and the fruits without leaving any visible sign of infestation and feed inside (Butani and Jotwani, 1984). The infested flower buds dry and shed. Infested fruits show exit holes along with excreta. The caterpillar rests in a cell in the

fruits. The affected fruit, when cut open is sometimes found rotting with full of dark excreta. Moulds grow there and thus make the fruit unfit for human consumption and marketing.

The full-grown larva comes out through the hole of the infested fruits and drop on the ground for pupation in the soil or plant debris. The percent infestation of fruits is more than that of the shoots (Alam and Sana, 1962). The infestation may even reach above 60 % during the rainy season in Bangladesh. Ali *et al.* (1980) made a brief observation on the incidence of shoot and fruit borer on 12 cultivars of brinjal. They observed that the cultivars Baromashi showed no shoot and fruit infestation. Lowest percentage of fruit infestation (25%) occurred in Singnath and highest (86 %) in Jhumki. Butani and Jotwani (1984) reported that the brinjal shoot and fruit borer cause 1 to 16 % damage to shoots and 16 to 64 % to fruits in Bangladesh.

2.2.1.2 Seasonal abundance

The seasonal history of shoot and fruit borer varies considerably due to different climatic condition throughout the year. Hibernation does not take place and the insects are found active in summer months, especially in rainy season. Shukla (1989) reported that the population *of L. orbonalis* began to increase from the first week of July and peaked (50 larvae per 2 sq. m) during the first week of August. The population of this pest was positively correlated with average temperature, mean relative humidity and total rainfall.

Patel *et al.* (1988) showed that brinjal (CV. Doli-5) transplanted in May was damaged by *L. orbonalis* than the crops transplanted in January, July, September and November. They also observed that among environmental factors, low variation in minimum and maximum temperatures, high relative humidity and suitable rainfall enhanced the population of this pest.

Alam, (1969b) showed that Brinjal shoot and fruit borer are less active during February – April. During winter month, different stages of this pest last for longer periods and overlapping generation were observed. Pawar *et al.* (1986) reported that infestation of shoots began 30 days after transplanting, peaked in the 2nd week of September and reached zero on the 1st week of November. Fruit was infested form the 3rd week of September and the infestation peaked in the 2nd week of January and the infestation peaked in the 2nd week of November. On the summer crop, shoots were infested from the 3rd week of January and the infestation peaked in the 2nd week of February. Infestation of fruit peaked in the first week of April. Infestation levels were lower during summer than during kharif.

Saeed and Khan (1997) reported that an infestation of brinjal shoot and fruit borer was monitored throughout the growing season in Pakistan by picking infested and healthy fruits at ten days intervals. Infestation began soon after brinjal fruits were formed, peaking on 25 August then declining but remaining constant (50-70%) during September-November, finally disappearing in the first week of December.

2.2.1.3 Life history

Adult: The adults are medium sized white moths with 22 to 26 mm long at wing expanse (Butani and Jotwani 1984). The white fore wings have conspicuous black and brown patches and dots; the hind wing are opalescent with black dots along the margins (Butani and Jotwani, 1984).

Egg: Alam and Sana (1962) reported from their study that the female moth lays 11 to 68 eggs singly on shoots, flower buds and on the ventral surface of leaves during later part of night till early hours of morning. However, Butani and Jotwani (1984) showed that female moth lays on an average of 250 eggs. Eggs are creamy white and 0.44 mm long.

Larvae: The newly hatched larvae are about 1.5 mm long and dull–white in colour, whereas the full grown larvae are15 to18 mm long, light pink in colour and have prominent tubercles with hair on each thoracic and abdominal segments. The full-grown larvae showed a pre pupal period of 3-4 days before pupation.

Pupa: The full-grown larvae come out from the infested shoots and fruits for pupation on the stems, dried leaves and shoots or in debris on the soil surface under the plants (Alam and Sana, 1962). The pupa is formed within a boat shaped cocoon of dirty brown silk, which is spun by the full-grown larvae before pupation. The anal segment of the male pupa is devoid of bristles, whereas the female pupa has eight bristles with incurred tips at the anal segment (Alam and Sana, 1962).

The incubation, larval and pupal periods are 3 to 5, 12 to 15 and 7 to 10 days during the summer and 7 to 8, 14 to 22 and 13 to 15 days in the winter, respectively (Alam and Sana 1962 ; Butani and Jotwani, 1984). The life cycle is completed in 34 to 60 days with five or more generations per year (Alam and Sana, 1962; Alam, 1969b).

2.2.2 Jassid:

Jassid, *Amarasca divastans* (Distant) is considered as one of the major pest of brinjal, which causes significant damage to the crop. The incidence of this pest occurs sporadically or in epidemic form every year throughout Bangladesh and affecting adversely the quality and yield of the crop. In the favorable weather severe infestation may occur and total crop may be damaged.

2.2.2.1 Infestation status

Jassid, *A. devastans* infestation are manifested by some characteristic symptoms. The primary symptom is characterized by leaf edge curling and the secondary symptom is characterized by leaf edge curling along with reddish colouring of leaves and the late symptoms are characterized by leaf edge curling along with leaf edge and vein colouring and drying of the leaves. From the initial infestation, these symptoms develop in sequence leading to 'hopper burn' and shedding of leaves incase of severe infestation, which ultimately causes the retraction of plant growth, reduction of yield (Afzal and Ghani, 1953).

Nair (1986) reported that the nymphs and adults of *A. devastanse* can attack host leaves at all stages of development. The adults and nymphs feeding on the sap and injected saliva into the tissues, which toxemia, cause injury of the leaves. The edges of the infested leave turn pale – green, then yellow and finally brick red or brown in colour. The colour changes are accompanied by severe crinkling and curling of the leaf. The whole of the leaf gradullay dries up and drops. The plant becomes stunted; quality of fruit is also affected.

2.2.2.2 Seasonal abundance

Jassid was formally considered to be an early season pest attacking plants in Bangladesh Although Ali (1987) reported that *Amrasca deveastans* has been found to attack plants through out the season. The incidence of jassid on brinjal planted at various dates from 20 July to 20 December was higher on early-planted crop than on late-planted crops. High temperature (30-36°c), evening relative humidity (below 80%) and low rainfall period coupled with bright sunshine hours are favourable for the development of cotton jassid population (Inee *et al.*, 2000). Muthukumar and Kalyanasundaram (2003) observed that *A. devastans* had a negative association with minimum temperature and rainfall.

2.2.2.3 Life history

Adults: Adults are small, elongate, and wedge-shaped; about 2.5mm long, body pale green with semi-transparent, shimmering wings; very active, having a sideways walk like the nymphs, but quick to hop and fly when disturbed. They have a life span of up to 2 months.

Egg: Curved, greenish–yellow eggs (0.7-0.9 X0.15-0.2 mm) are laid deeply embedded in the midrib or a large vein on either surface of the leaf or in a petiole or young stem, but never in the leaf lamina. Depending on species, 29-60 eggs can be laid singly and they hatch in 4-11days.

Nymph: Nymphs are pale green, wedge–shaped, 0.5-2.0mm long, have a characteristics crab like, side ways movement when disturbed. They are confined to the undersurface of leaves during the daytime but can be found anywhere on the leaves at night (Evans1965). The nymphal period can vary from7 to 21, depending on food supply and temperature.

2.2.3 Epilachna beetle

Epilachna beetle, *Epilachna vigintioctopunctata* is also considered as one of the major pests of brinjal crop. The incidence of this pest occurs sporadically or epidemic form every year throughout Bangladesh and affecting adversely the quality and quantity of the crop. In the favorable weather severe infestation may occur.

2.2.3.1 Infestation status

Rajagopal and Trivedi (1989) reported that *Epilachna vigintioctopunctata*, *E. ocellata* and *E. sparsa* commonly attack Solanaceous plants. Especially the pest also feeds on brinjal, tomato, tobacco, pumpkin and bitter gourd. The larvae and adults scarp the green matter from leaves and damage up to 80% of plants.

2.2.3.2 Seasonal abundance

Ghosh and Senapati (2001) reported that in west Bengal, India, during the seasonal incidence, population fluctuation and biology of *H. vigintioctopunctata* (*Epilachna vigintioctopunctata*) on brinjal cv. Pusa purple long. The beetles were recorded from April to mid October, and the highest population (8.14 beetles per plant) was observed in mid September. Beetle population showed significant positive correlation with average temperature, relative humidity and rainfall. The peak period of infestation varies with region, but the peak is generally in July–August (Rajagopal and Trivedi, 1989).

Tilavov (1981) found that Epilachna beetles feed most actively in the morning and evening during the summer and feeding declines rapidly in the middle of the day and after midnight. The daily fluctuation in the rate of feeding depends mainly on the temperature of the environment, which determines the level of metabolism.

2.2.3.3 Life history

Sumon *et al.* (1987) studied that egg masses of *Epilachna vigintiocpunctata* were randomly distributed with a tendency toward aggregation at high densities. The larval and pupal population had aggregated distributions.

2.2.4 Whitefly

Whitefly, *Bemisia tabaci* is an important pest of wide range of different vegetables including brinjal. It causes both direct and indirect damage to the plants. Direct damage occurs by feeding whereas indirect damage comes out with its heavy secretion of

honeydew on the plants, which serves as a growing medium for sooty mold fungus (Byrne *et al.*, 1990).

2.2.4.1 Infestation status

Bemisia tabaci continues to be an economically important pest of greenhouse and field crops throughout equatorial areas of the world (De Barro, 1995). Three types of damage may be caused by the whitefly (Berlinger, 1986):

Direct damage: Direct feeding damage is caused by the piercing and sucking of sap from the plant foliage. Both nymph and adult cause direct damage by feeding sap from the underside of the leaves. This feeding cause weakening and early wilting of the plants and reduces the plant growth rate and yield. It may also cause leaf chlorosis, leaf withering, premature dropping of leaves (Berlinger, 1986). Young plants even may be killed in case of severe infestation (Scalan, 1995).

Indirect damage: It results by the accumulation of honeydew produced by the whitefly. This honeydew serves as substrate for the growth of black sooty mold fungus on leaves and fruits. The mold reduces photosynthesis and lessens the market value of the plant (Berlinger, 1986).

Virus transmission: This type of damage is caused as the vector of plant viruses. It is the main damage caused by the *Bemisia tabaci* (Cohen and Berlinger, 1986). Whitefly borne viruses of six or seven morphological classes have been demonstrated so far, namely

geminivirus, carla-like, clostero like, poty like, luteo like and nepo or como like viruses (Duffus, 1987; Cohen, 1990). Of these, the geminivirus group is by far the most important, both in terms of number of diseases and their economic impact in various parts of the world (Brown and Bird, 1992). Diseases caused by whitefly transmitted Geminiviruses are: tomato yellow leaf curl (Navot *et al.*, 1991), Eggplant yellow mosaic (Honda *et al.*, 1986), Squash leaf curl (Cohen *et al.*, 1983).

2.2.4.2 Seasonal abundance

Whitefly population has the potential for rapid, perhaps exponential increase under favorable conditions of climate and host plant availability. *B. tabaci* is a weak flier and dispersed mainly by the action of the wind. Most movements within a crop occur at a low level to locate fresh feeding or oviposition sites (Gerling and Horowitz, 1984). When the crops as a whole become unfavorable due to maturity or harvesting, a large-scale dispersal to search for suitable hosts take place (Basu, 1995).

Kranz *et al.* (1977), found a sharp increase in whitefly population in September and October in Sudan which was directly correlated with higher relative humidity (80 to 90%) and increasing temperature (36 to 38°C). These conditions favour the development of the juvenile stages by shortening the duration of each stage. They indicated that the population decreases due to high mortality rates at eggs and free juvenile stages in March, April and May when the temperature is high (43 to 45°C) and RH is low (8 to 17 %)..

Gameel (1970) attributed the occasional population in the Sudan to high temperatures (43 to 45°C) and low humidity levels. High humidity and rainfall and relatively low temperature during July to October in Southern India were found to be uncongenial to the whitefly population development (Muniyappa, 1983).

Patel and Jhala, (1992) reported that the population increased from August and peaked in December. Thereafter, numbers feel gradually and aleyrodid was absent during May–July. November–January was the most favourable months for the reproduction and survival of *B.tabaci*. Sunflowers, brinjal, sesame, and mustard were the most preferred host plants, whereas black gram (*Vigna mungo*), cowpea, sweet potato and groundnuts were the least preferred host plants.

2.2.4.3 Life history

Adults: The adult emerges leaving the empty pupal case. Under a constant temperature of 29.5°C ± 0.6°C and a photoperiod of 14: 10 LD, 90% of the *B. tabaci* emerged from their pupal cases between 0600 and 0930 hours (Lights occurred at 0600 hours). Adults are small, soft and pale yellow, change to white within a few hours due to deposition of wax on the body and wings. Antennae are long and slender and mouthparts are constructed for piercing and sucking. The forewings are slightly longer than the hind wings. At rest, the wings cover the abdomen like a roof (Berlinger, 1986). Byrne and Houck (1990) reported sexual dimorphism in wing forms: the fore and hind wings of females are larger than those of males. The mean wing expanses of females and males are 2.13 mm and 1.81 mm respectively (Byrne and Bellows, 1991). Adult longevity of males was 4 days in summer

and 7 days in winter, corresponding female life span was 8 and 12 days respectively in India (Pruthi and Samuel, 1942).

Eggs: White eggs generally are pyriform or ovoid and posses a pedicel that is a peg like extension of the chorion (Byrne and Bellows, 1991). Eggs are pear shaped and 0.2 mm long. They are laid indiscriminately almost always on the underside of the young leaves (Hirano *et al.*, 1993). Basu (1995), reported that eggs are laid indiscriminately usually on the undersurface of the leaves, anchored by the labium, which remain closely apposed to the leaf surface. The female can lay 119 eggs in cotton captivity (Hussain and Trehan, 1933) and 300 eggs on brinjal under field conditions (Avidov, 1956). Initially the eggs are translucent, creamy white and turn into pale brown before hatching. The incubation period varies widely mainly due to varying environmental conditions especially temperature. Under outdoor condition, the incubation period has been reported to be ranged between 3-5 days in summer and 7-33 days during winter (Hussain and Trehan, 1933 and Azab *et al.*, 1970). The egg dimensions observed by Lopez-A. (1986) are: length 0.22 ± 0.005 mm; width at the broadest part 0.096 ± 0.002 mm and length of pedicel 0.024 ± 0.003 mm.

Immature stages: After completion of development, the egg cracks at the apical end along a longitudinal line of dehiscence. As the first instar nymph of *B. tabaci* begins to emerge, it bends in half until its forelegs can clasp the leaf, after which nymph walk away from the spent chorion (Poinar, 1965). First instar nymph is often called crawler (Basu, 1995). The first instar nymphs move a very short distance over the leaf surface once settled, they

remain sessile until they reach the adult stage, except for brief periods during molts (Hirano *et al.*, 1993). The first nymphs are pale, translucent white, oval with a convex dorsum and flat ventral side. They measure 0.267 ± 0.007 mm in length and 0.144 ± 0.010 mm in width (Lopez-A. 1986). The second instars nymphs are quite distinct from first instar for its size. These nymphs are 0.218 ± 0.012 mm wide at the broadest part of the thoracic region. The body of the third instar nymph is more elongated than the early instars, measuring 0.489 ± 0.022 mm in length and 0.295 ± 0.018 mm in breadth. The fourth instars nymphs have elliptical body measuring 0.662 ± 0.023 mm broad. This fourth instar has red eyespots, which become eyes at the adult stage, are characteristic of this instar (Hirano *et al.*, 1993). This instar is commonly referred to as a pupa (Gill, 1990). Hinton (1976) reported that certain whiteflies have pupal stage in the sense that this stage serves as a mold for some of the imaginal muscles.

2.2.5 Aphid

Aphid, *Aphis gossypii* is considered as the minor pest of brinjal in Bangladesh. Schmutterer (1977) stated that *Aphis gossypii* is wide spread in the tropics and in warm temperate regions and a highly polyphagous insect pest. It is often confined to glasshouses (Butani and Jotwani, 1984; York, 1992). *Aphis gossypii* is reported to feed on 220 crop plants of 46 families, including 30 crops in solanaceae (e.g., brinjal, okra, pepper, tomato etc.) and 19 crops in cucurbitaceae (e.g., Muskmelon, watermelon, squash, pumpkin etc) (Roy and Behura, 1983).

2.2.5.1 Infestation status

According to Butani and Jotwani (1984), the nymphs and adults are found on tender twigs and shoots as well as on the ventral leaf surface sucking the vital sap from the tissues. The affected parts turn yellow, get curbed, wrinkled and deformed in shape and ultimately dry and die away. Fruit size and quality is also reduced. The aphids also exude copious quantity of honeydew that invites infection of shooty mould, which hinders the photosynthetic activity resulting in stunted growth. The fruits are also covered by shooty mould and make them unattractive and reduce its market value. Besides, aphids transmit viruses of both persistent and non-persistent types. The loss on this account is colossal and irreparable.

Nayar *et al.* (1989) reported that the aphids are found in colonies of hundreds on tender shoots and under surface of tender leaves. In case of severe attack, the leaves curl up, fade gradually and finally dry up. Black sooty mould develops on honeydew-excreted plants parts.

Maniruzzaman (1981) found that thousands of nymphs and adults attacks leaves and tender parts of the plants and suck sap, causing the leaves to wrinkle. They may even attack the fruits and cause the discoloration.

2.2.5.2 Seasonal abundance

The population density of aphid had two peak periods of activity and highest density. EL-Defrawi *et al.* (2000) found in Egypt, the highest density during third week of December

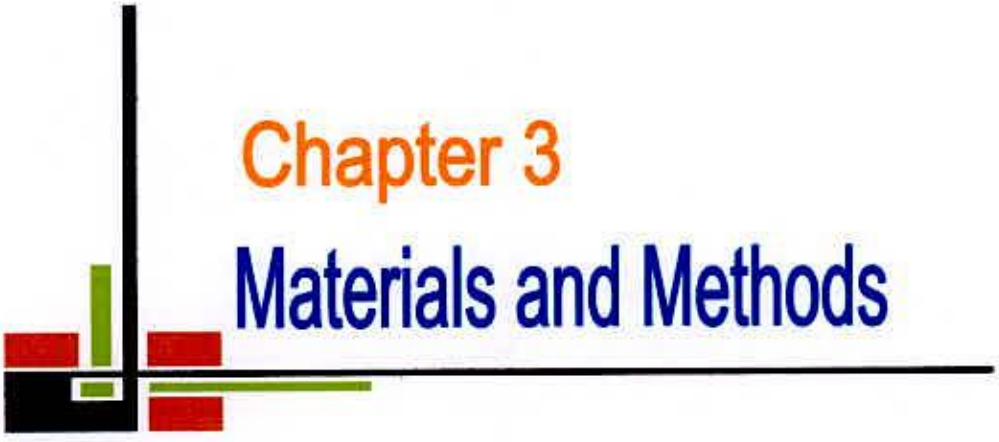
and third week of March in 1995-1996, and during the fourth week of December and third week of March in 1996-1997.

Bari and Sardar (1997) found that *A. cracivora* was the most serious pest of country bean from seedling to pod bearing stage. They also concluded that the infestation by the *A. craccivora* on vegetative stage was higher than the flowering stage.

Ciampolini and Maiulini (1990) also presented same report and found that the greatest density of aphids (*A. craccivora, A. gossypii and Macrosiphuni euphorbia*) occurred during flowering and the beginning of fruit set stage.

Charoenredhi e*t al.* (1979) and Salmon and Mohamed (2000) found that the peak population of aphids in December. Banerjee and Ghosh (1986) has studied the development of *Aphis gossypii* populations in the field in west Bengal from October to April in 1980–81 and 1981 -82. In both years, population first appeared in October and peaked in February, when the plants are 5 to 8 months old. The percentage of alate viviparous females in the population declined from October until December, then increased again, and reached in peak in April. It was suggested that the incidence of this aphid is related to relative humidity.

Reddy (1968) observed that humidity and cloudy weather with a little rainfall is favourable for rapid multiplication of this pest. On the other hand, York (1992) reported that the aphid population builds up rapidly in dry weather.



Chapter 3

Materials and Methods

CHAPTER 3

MATERIALS AND METHODS

The present study "Studies on the pest status and seasonal abundance of different insect pests in brinjal at Gazipur" was carried out at the experimental field of the Entomology Division, Bangladesh Agricultural Research Institute (BARI) Gazipur, Bangladesh during October 2005 to September 2006. The materials and methods adopted in the study are discussed in the following sub-heading:

3.1 Experimental site

The research works were undertaken in the experimental field of the Entomology Division, Bangladesh Agricultural Research Institute (BARI) Gazipur, Bangladesh located at 24.09 N latitude and 90.26 East longitudes with a elevation of 8.4 meter from the sea level.

3.2 Soil

The soil of the experimental area was under Modhupur tract, AEZ NO. 28 with clay loam soil and texture having low organic matter (1.12%), moderately slow permeability and deficient in nitrogen, potassium, and sulphur in comparison with the standard nutrient status but having good irrigation and drainage facilities The soil is acidic in nature having pH between 5.9 to 6.1 (Anonymous, 2001).

3.3 Climate

The experimental area was under the sub tropical climate, which is characterized by high temperature, high humidity, and heavy precipitation with occasionally gusty winds in kharif season and scanty rainfall associated with moderately low temperature during the Rabi season (October to march). Data on weather condition viz. temperature, relative humidity (RH), sunshine and rainfall during experimental period were collected from weather yard located in the eastern side less than one kilometer from the experimental field. However, The climatic condition of Gazipur has unimodal rainfall pattern; most of the rainfall occurs during the months of May to September. The average rainfall is usually higher than 200 mm during November to March. The warmer months are April, May and June with mean maximum temperature of 31- 34°c and the cold months are November, December and January when the temperature ranges from 10-19°C.

3.4 Land preparation

A tractor drawn disc plough followed by harrowing opened the land. For ensuring good tilth, power tiller was used. Tractor drawn labeler was used to level the land. In all the studies, cow dung and other chemical fertilizers were applied as recommended by Rashid (1999) for brinjal cultivation @ 15 tons of cow dung and 250, 150 and 125 kg of Urea, TSP and MP, respectively per hectare. The half of cow dung and TSP were applied as basal dose during land preparation. The remaining cow dung, TSP and, one-third of MP were applied in the pits at transplantation of brinjal seedlings. The entire dose of urea and the rest of MP were applied as top dressing. The first top dressing of urea (one third) was made at 15 days after transplanting. One third of urea and one-third of MP at the time of

flower initiation and rest of urea and MP at the time of fruit initiation were applied to keep the plants at normal growth and production.

3.5 Raising of seedlings and transplanting

Brinjal seeds (cultivar: chega, a Jessor local cultivar) were collected from Horticulture Division, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. A small seedbed measuring 5 m x 1 m was prepared and seeds were sown there. Standard seedling raising practice was followed (Rashid, 1999). The plots were lightly irrigated regularly for ensuring proper and development of the seedlings. The seedbed was mulched for ensuring seed germination, proper growth and development of the seedlings. Thirty-six day-old (3/4 leaf stage) healthy seedlings were transplanted in the experimental field. Seedlings were transplanted twice, once during 2nd week of October for winter season and during 3rd week of March for summer season.

3.6 Cultural operation

After transplanting, light irrigation was given to each pit. Dead or damaged seedlings were replaced immediately by new ones from the stock. Supplementary irrigation was applied at an interval of 2-3 days. Propping of each plant using bamboo sticks (1m height) was done for providing extra support to avoid lodging of the plants. Weeding and mulching were given whenever necessary. The MP and urea were top dressed in 3 splits as described earlier. To enhance the natural population of different insect pests, no plant protection measure was undertaken during the whole study period.

3.7 Identification of insect pest attacking brinjal

The insect pests attacking brinjal crop during the study period were identified with the help of suitable keys, reference books, Journals, handbooks, booklets, scientific articles etc. Help was also undertaken from the specialized persons of Bangladesh Agricultural Research Institute, Gazipur to identify the insect pests.

3.8 Studies on the pest status of different insects

Pest status of different insect pests on brinjal was studied during both winter and summer season. For that reason seedlings were transplanted twice, once during 2nd week of October for winter season and during 3rd week of March for summer season in an experimental plot of 10m x 10m with a spacing of 70 x 50 cm. There were four plots of same size. Each plot was considered as one replication.

3.9 Data collection

Weekly observation was done to determine the status of different insect pests of brinjal from the studied plots. Although the data recording procedures differed among the insect pests. The procedures are described as follows:

Brinjal shoot and fruit borer (BSFB):

Shoot infestation: After two weeks of transplantation, ten plants from each plot were randomly selected. Number of total shoots as well as infested shoots were counted and recorded from those selected 10 plants. Percent infestation of shoot was calculated according to the following formula:

$$\text{Percent shoot infestation} = \frac{\text{No. of infested shoots}}{\text{Total no. of shoots}}$$

Fruit infestation: At weekly interval, number of healthy and infested fruits as well as their weight was recorded from ten randomly selected plants. Percent infestation of fruit was then calculated according to the following formula:

$$\text{Percent fruit infestation} = \frac{\text{No. of infested fruits}}{\text{Total no. of fruits}}$$

Both shoot and fruit infestation data was recorded from four plots, thus replicated 4 times.

Jassid:

Number of jassids from upper five leaves of randomly selected ten plants per replication were counted and recorded at seven days interval. The number of both nymph and adult jassids were counted carefully after 15 days of transplanting and continued till their senescence.

Epilachna beetle:

After two weeks of transplantation, ten plants were randomly selected per replication. Number of epilachna beetle (adult, larvae, pupae) were counted and recorded at seven days interval by direct visual observation.

Whitefly:

The population of white fly was recorded in two ways, by direct count of it from the 3rd leaves of 10 plants/plot and by using yellow traps. Yellow plastic pots coated with mobil oil were set in the plot (2 pots/replication). The pots were carefully examined just after one days of setting and the number of whiteflies were counted and recorded. The observations were started from 15 days after transplantion of the crop and continued till senescence. Data was recorded at weekly interval.

Aphid:

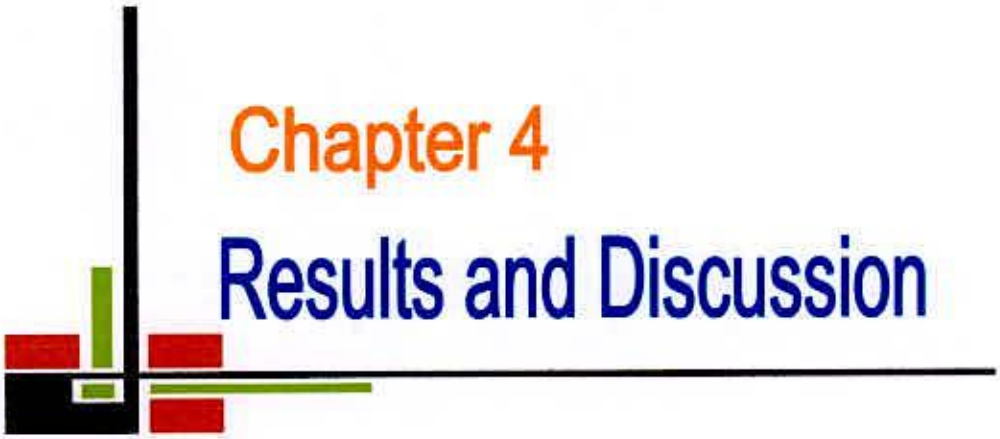
Like whitefly, aphid number was also counted in two ways, by direct count of it from the 10 randomly selected plants/plot of and by using yellow traps. Yellow plastic pots coated with mobil oil were set in the plot (2 pots/ replication). The pots were carefully examined just after one day of setting and the number of aphids were counted and recorded. The observations were started at 15 days after transplantation of the crop and continued till senescence of the crop. Data was recorded at weekly interval.

3.9 Seasonal abundance of different insect pests on brinjal

Weekly infestation data (recorded following the procedures adopting in pest status study) of different insect pests attacking brinjal throughout the year were plotted in a graph to determine the seasonal abundance of those pests. The correlation of different weather parameter especially temperature and rainfall with the infestation of different insect pests of brinjal were also calculated to determine their effect on those pest populations.

3.10 Meteorological data

Different metrological data viz. daily maximum, minimum and average temperature, relative humidity and rainfall were recorded from the Metrological Department situated at Bangladesh Agricultural Research Institute, Gazipur campus about 500m away from the experimental field. Weekly mean temperature and rainfall were calculated and presented Appendix I.



Chapter 4

Results and Discussion

CHAPTER 4

RESULTS AND DISCUSSION

Results of different studies on the pest status and seasonal abundance of different insect pests in brinjal at Gazipur have been presented and discussed under the following sub-heading:

4.1 Identification of insect pest attacking brinjal

Five species of insect pests were recorded in the brinjal field during the study period of both winter and summer season at Gazipur. Those insect pests were collected from the field and identified on the basis of their characters. The identified insect pest belongs to the order Lepidoptera, Hemiptera and Coleoptera. Among the insect pests, Brinjal shoot and fruit borer, *Leucinodes orbonalis* (Lepidoptera: Noctuiidae) was appeared first followed by jassid, *Amarasca divastans* (Hemiptera: Cicadellidae), Whitefly, *Bemasia tabaci* (Hemiptera: Aleyordidae), two species of epilachna beetle, *Epilachna vigintiocpuctata* & *E. 12-punctata* (Coleoptera:coccinellidae) and Aphids, *Aphis gossypii* (Hemiptera: Aphididae).

Plate 1. Infested fruits of brinjal with brinjal shoot & fruit borer

Plate 2. Adult brinjal shoot and fruit borer

Plate 3. Adult jassid

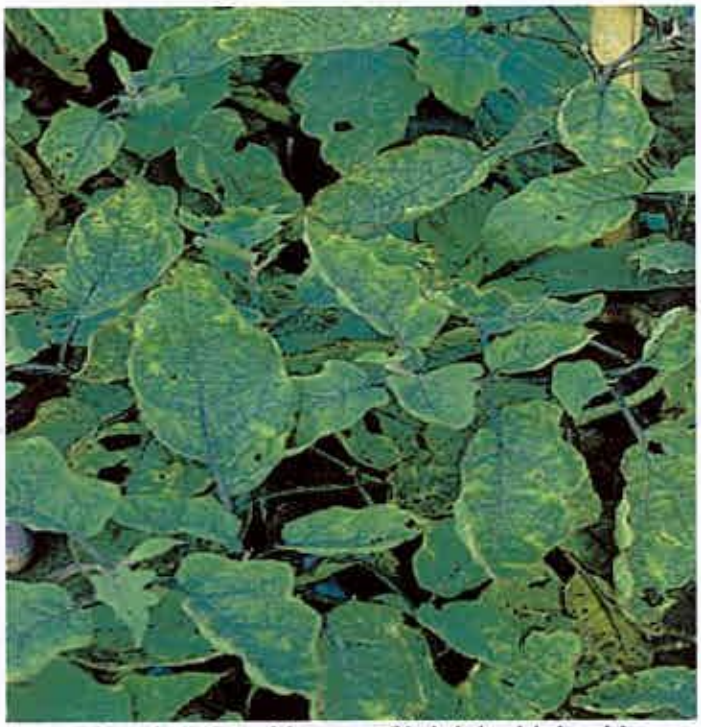


Plate 4. Infested leaves of brinjal with jassid

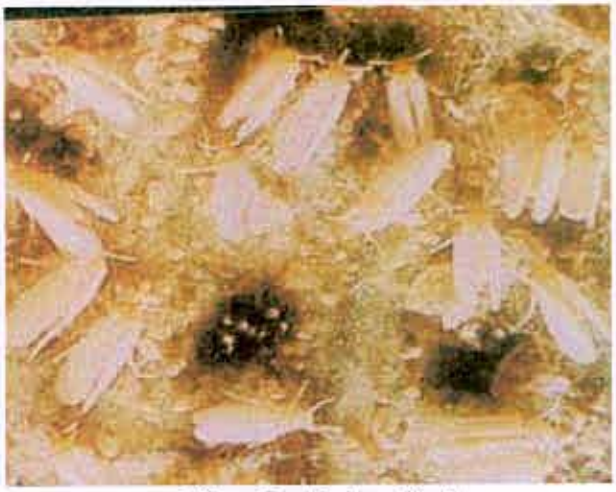


Plate 5. Adult whitefly

Plate 6. Adult epilachna beetle (*E. 12-punctata*)

Plate 7. Adult epilachna beetle *(E. vigintiocpuctata)*

Plate 8. Infested leaves by epilachna beetle

Plate 9. Aphid infested leaf

Plate 10. Adult aphid

4.2 Study on pest status of different insects on brinjal

Among the five different pests recorded in the brinjal fields at Gazipur, brinjal shoot and fruit borer (BSFB) was the predominant one followed by jassid, whitefly, epilachna beetle and aphids (Table 1). Year round infestation of BSFB, both in shoot and fruit was observed in the experimental plots. The highest infestation of BSFB was observed during hot and humid periods of the year (June – September). Highest shoot infestation was observed in the month of July (26.25% infestation occurred) and lowest shoot infestation happened in the month of November (4.73%). In case of fruits, highest (65.32%) BSFB infestation was recorded during the month of September and lowest was observed in the month of December (11.94%).

Except the dry months of the year, February, March and April, the infestation of jassid was not so high. During those three months the infestation of jassid became very high (Table 1). The peak infestation of jassid was in the month of March (1.60 jassid /leaf). The number of epilachna adult varied from 0.0 to 0.068 per leaf during the study period, while epilachna larvae per leaf varied from 0.023 to 0.075. Highest infestation of epilachna adult was observed during the month of December (0.068 per leaf), while that of epilachna larvae were observed during February (0.075 per leaf), June (0.071 per leaf) and July (0.074 per leaf).

Highest number of whitefly per leaf was observed during the months of July (0.76 per leaf), August (0.79 per leaf) and September (0.94 per leaf), while lowest infestation was occurred during the cold months November-February. In the study plots aphid population

per plant was very minimum. Infestation of aphids was built up during February to April (0.137-0.278 per leaf). Peak infestation occurred during March (0.278 per leaf). Population of aphids declined there after (Table 1).

4.3 Seasonal abundance of different insect pests on brinjal

Population pattern (weekly)

Brinjal Shoot and Fruit Borer (BSFB): It is revealed from the Figure 1, that percent shoot infestation by BSFB was less November to January. Even during that period the infestation went beyond 5%. From third week of January the population started to increase and reached to the peak during third week of March. The shoot infestation was more or less in an equilibrium position during April-July. From third week of July population increased and reached to the peak on first week of August.

Table 1. Status of different insect pests of brinjal during November 2005 – September 2006 at Entomology Division experimental field, BARI, Gazipur

Months	Status of different pests on brinjal						
	Brinjal shoot & fruit borers		No. of jassids /leaf	No. of epilachna beetles / leaf		No. of whiteflies/ leaf	No. of aphids/ leaf
	% shoot infestation	% fruit infestation		Adult	Larvae		
November '05	4.73	18.46	0.18	0.0	0.023	0.02	0.0
December .05	6.75	11.94	0.69	0.068	0.051	0.17	0.067
January '06	17.33	31.02	0.95	0.033	0.031	0.03	0.079
February '06	15.54	42.55	1.28	0.023	0.075	0.04	0.137
March '06	19.05	47.75	1.60	0.027	0.036	0.11	0.278
April '06	19.24	52.53	1.25	0.028	0.065	0.14	0.226
May '06	19.03	49.82	0.59	0.043	0.051	0.17	0.008
June '06	23.22	55.78	0.63	0.033	0.071	0.25	0.009
July '06	26.25	60.86	0.57	0.057	0.074	0.76	0.017
August '06	24.61	63.68	0.47	0.054	0.055	0.79	0.009
September '06	15.39	65.32	0.45	0.033	0.034	0.94	0.012
Mean	17.38	45.42	0.79	0.036	0.051	0.313	0.077

Fruit infestation by BSFB was less during the cold months of December – January (Figure 2) and the population increased thereafter. A steady increase of fruit infestation was observed throughout the year. No distinct peak was observed in whole study period. However the highest infestation was observed during third week of August.

Jassid: Population of jassid was less during the month of November and May to September (except one peak of last week of July) (Figure 3). Highest jassid population was recorded during February-April. Highest peak was observed during third week of March.

Whitefly: Population of whiteflies was less than 2.0 per trap/plot during November to April. Population then built up and during May to September prevalence of whitefly in the brinjal fields were considerably high (Figure 4).

Epilachna beetle (adult and larvae): Number of epilachna beetle (larvae and adult) /leaf did not follow any distinct pattern. However, two distinct peaks in case of epilachna larvae and one distinct peak in case of adult were observed (Figure 5 & 6). Highest infestation of epilachna larvae was observed during second week of December and third week of July. On the other hand highest infestations of epilachna adults were recorded during second week of February. During dry period high epilachna beetle infestation was observed.

Aphids: Except the month of March, the population of aphids in the study area was less throughout the season. Only one peak of aphid population in the brinjal field was observed (Figure 7). From first week of February population of Aphids started to increase and reached to the peak during last week of March. Population again declined thereafter and reached to almost nil during the months of May to September.

Population pattern (season wise)

Brinjal shoot and fruit borer: More or less same trend have been observed in case of shoot infestation by BSFB during both winter and summer season (Figure 8). In both seasons shoot infestation gradually increased till the last harvests. During summer the increase rate was higher than the winter crop. During the early cropping period (till 79 days after transplanting) shoot infestation was almost in an equilibrium position (infestation was around 5%) in the winter season. However infestation increased thereafter. While during summer infestation increased from 31 DAT. Shoot infestations during winter was always less than that of summer one. Same trend was also observed in case of fruit infestation. Fruit infestation during winter was significantly lower than the summer. In both the season fruit infestation gradually increased and reached to the peak during the last harvests.

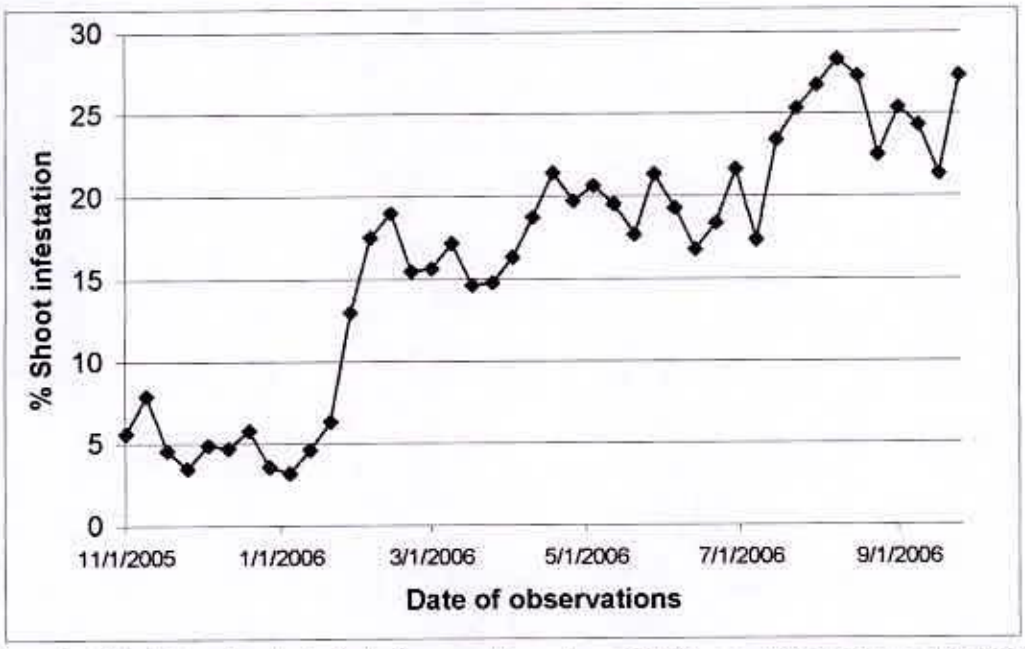


Fig. 1. Weekly shoot infestation pattern by BSFB at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

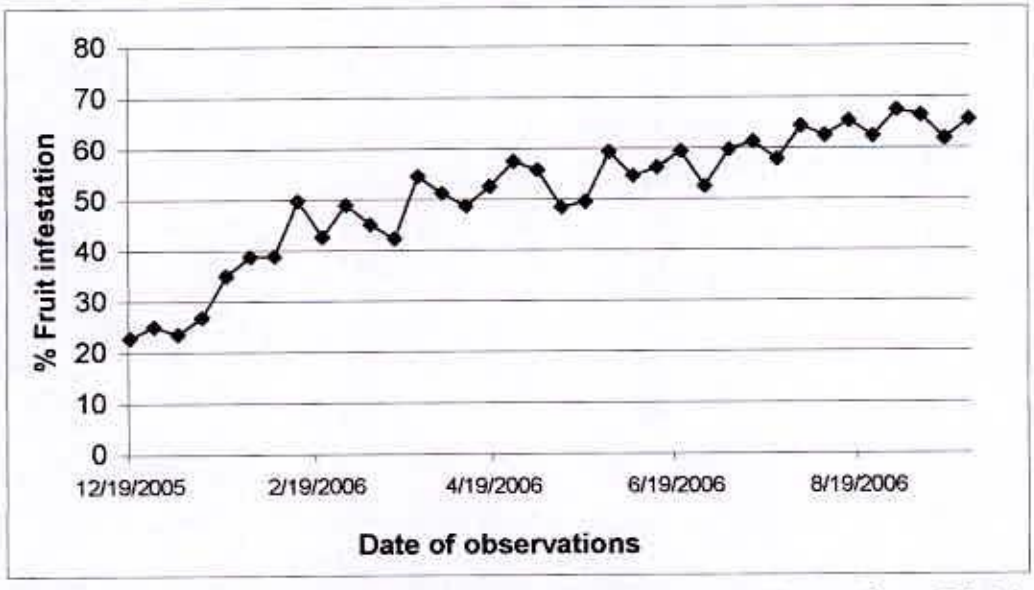


Fig. 2. Weekly fruit infestation pattern by BSFB at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

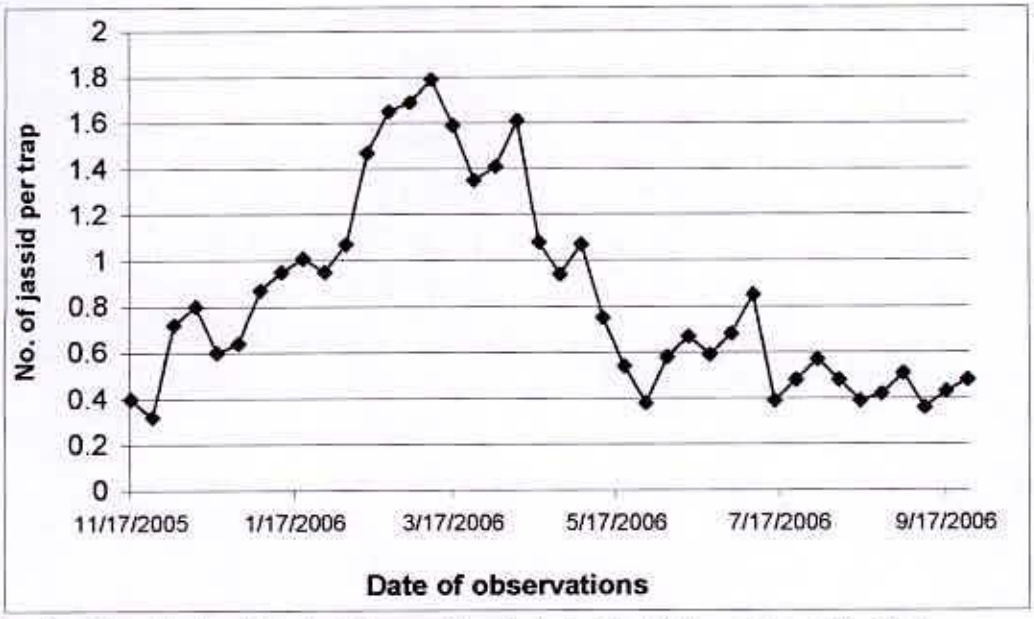


Fig. 3. Weekly jassid infestation pattern in brinjal at Entomology Division Experimental field, BARI, Gazipur November 2005-September 2006

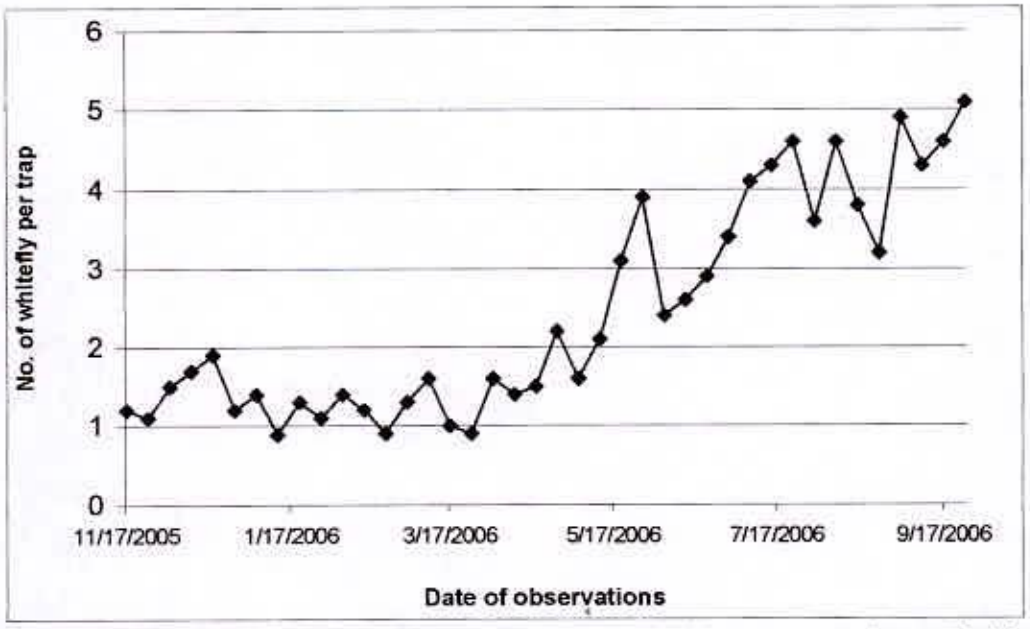


Fig. 4. Weekly whitefly infestation pattern in brinjal at Entomology Division Experimental field, BARI, Gazipur November 2005-September 2006

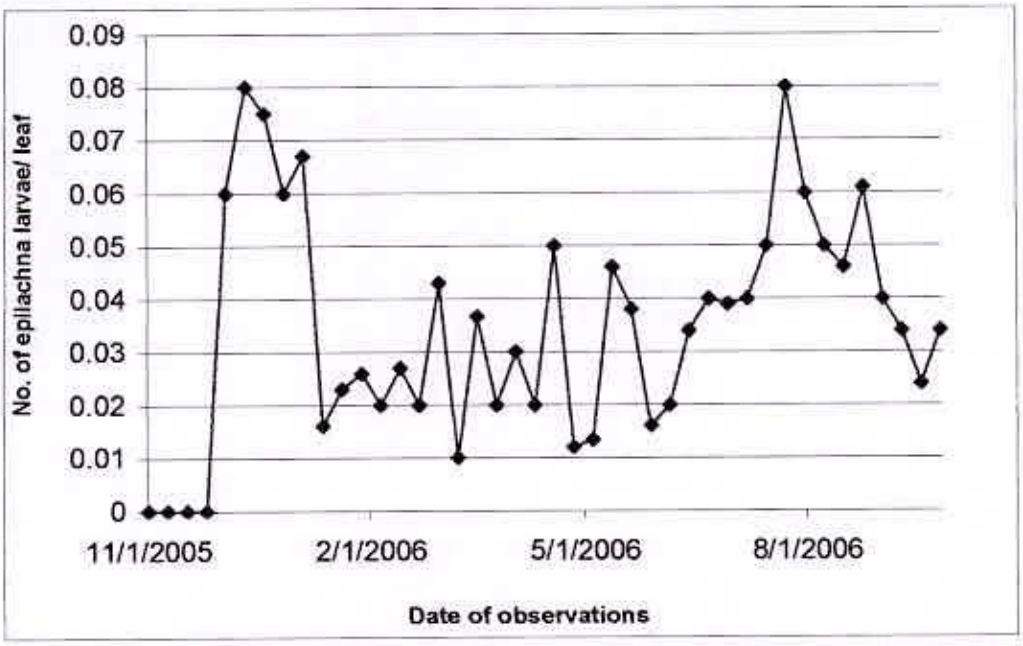


Fig. 5. Weekly epilachna larvae infestation pattern in brinjal at Entomology Division Experimental field, BARI, Gazipur November 2005-September 2006

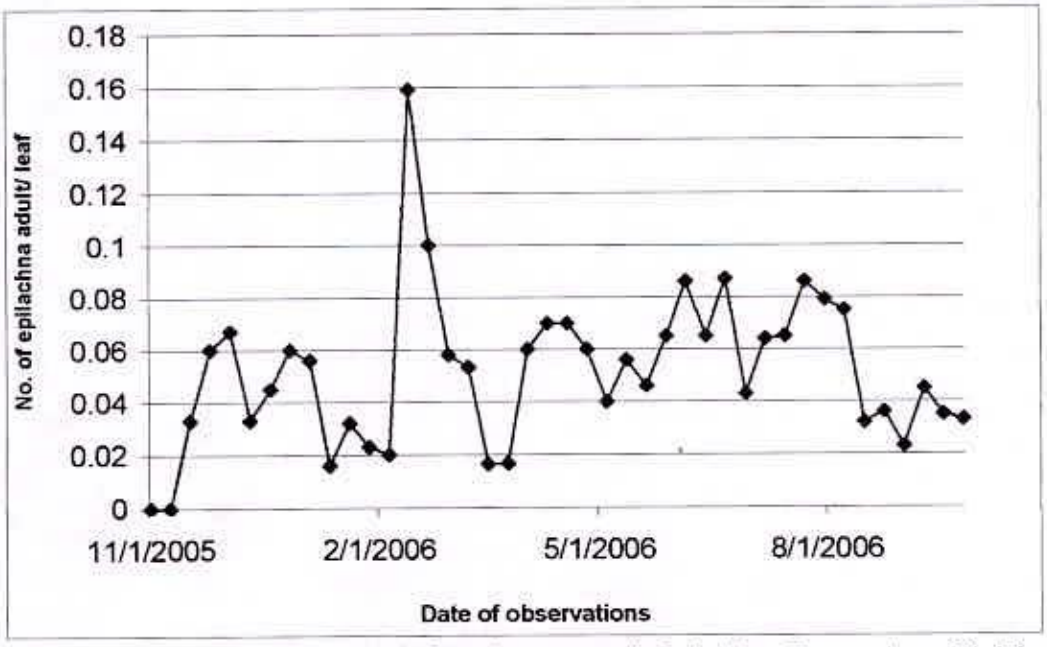


Fig. 6. Weekly epilachna adult infestation pattern in brinjal at Entomology Division Experimental field, BARI, Gazipur duringNovember 2005 –September 2006

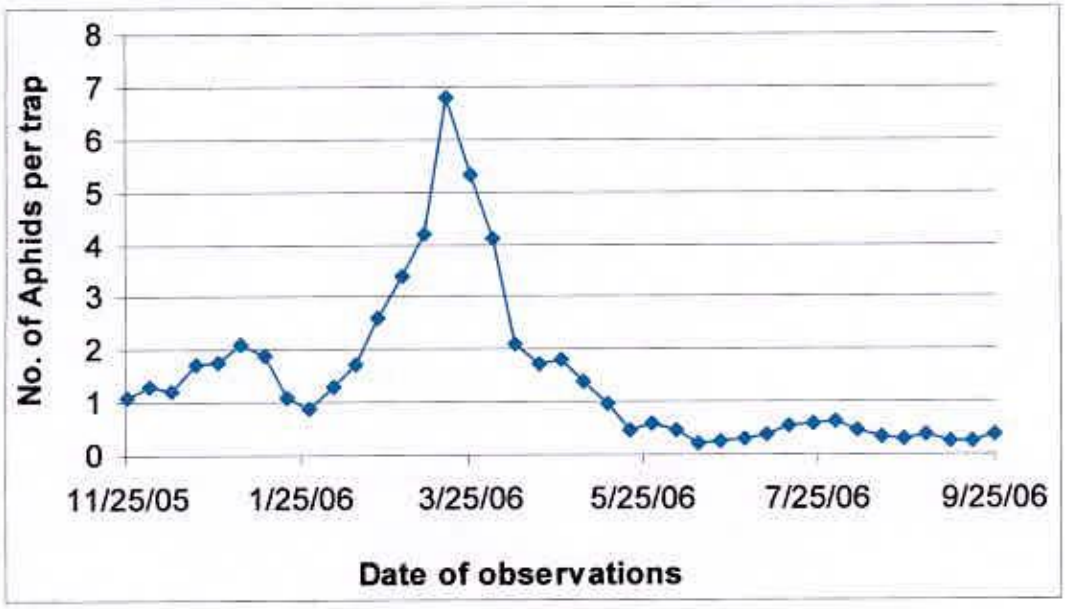


Fig. 7. Weekly aphids infestation pattern in brinjal at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

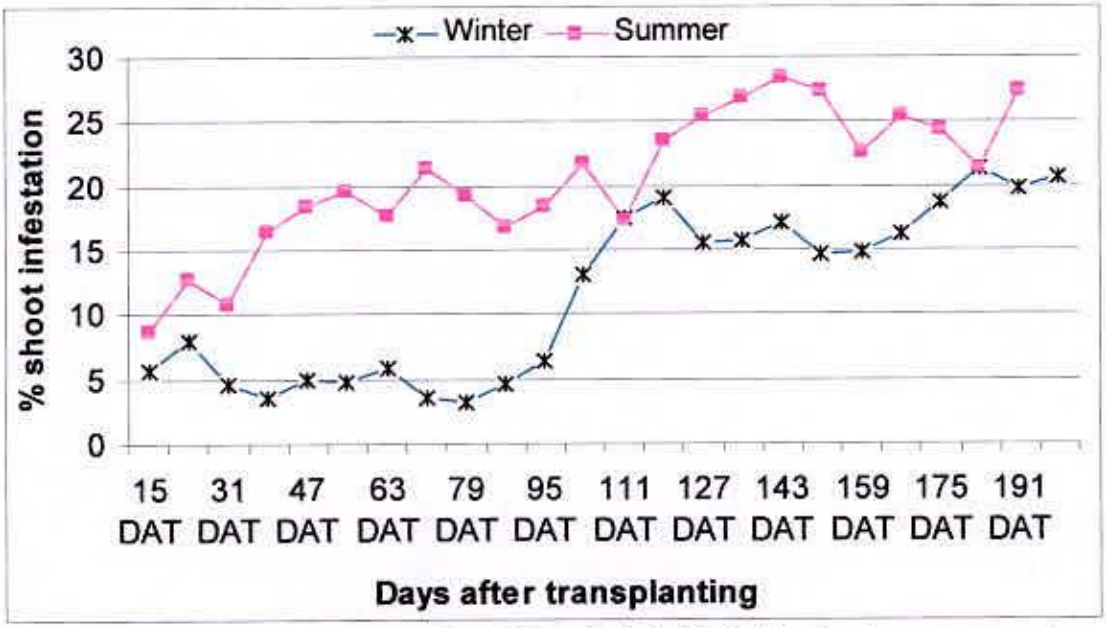


Fig. 8. Shoot infestation pattern by BSFB in brinjal during both summer and winterseason at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

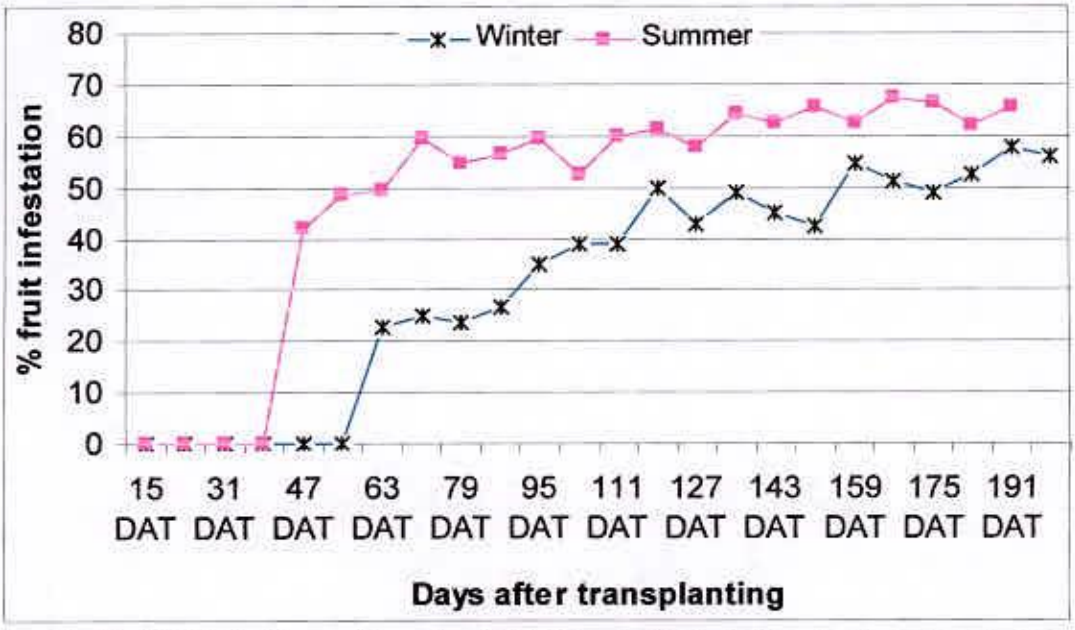


Fig. 9. Fruit infestation pattern by BSFB in brinjal during both summer and winterseason at Entomology Division Experimental field,BARI, Gazipur during November 2005-September 2006

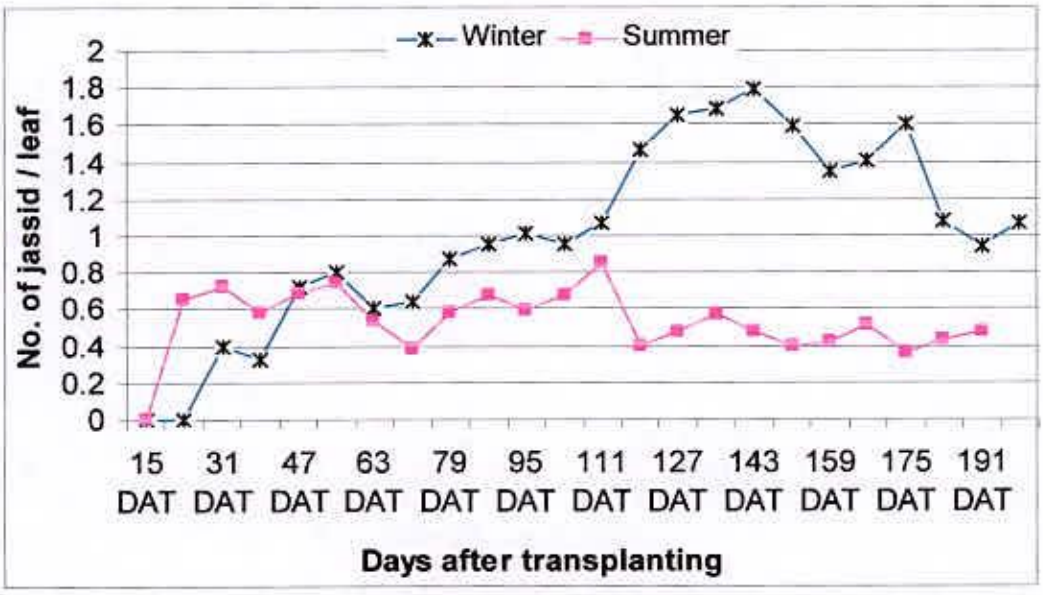


Fig. 10. Jassid infestation pattern in brinjal during both summer and winter season at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

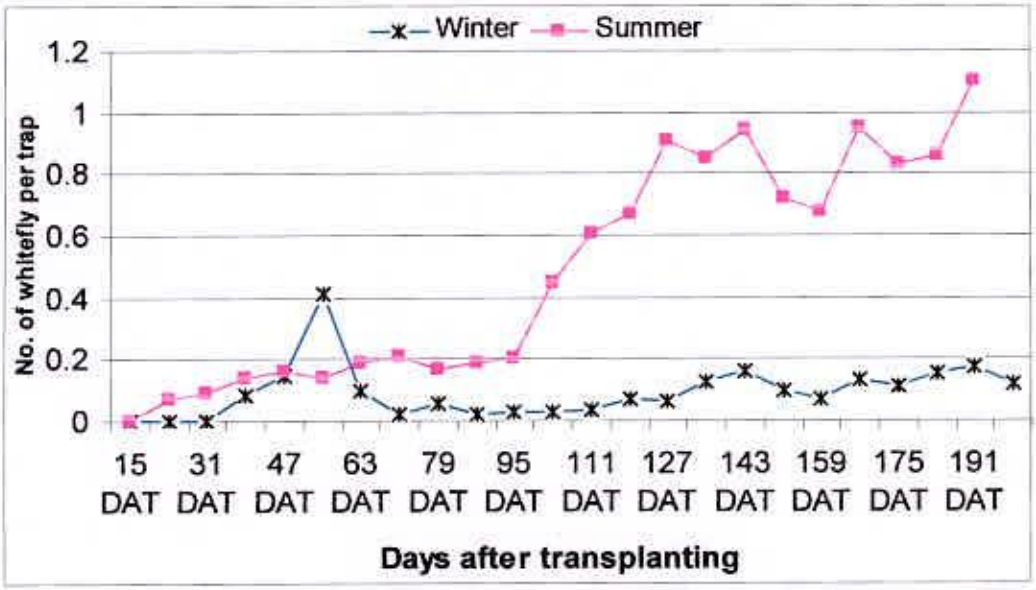


Fig. 11. Whitefly infestation pattern in brinjal during both summer and winter season at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

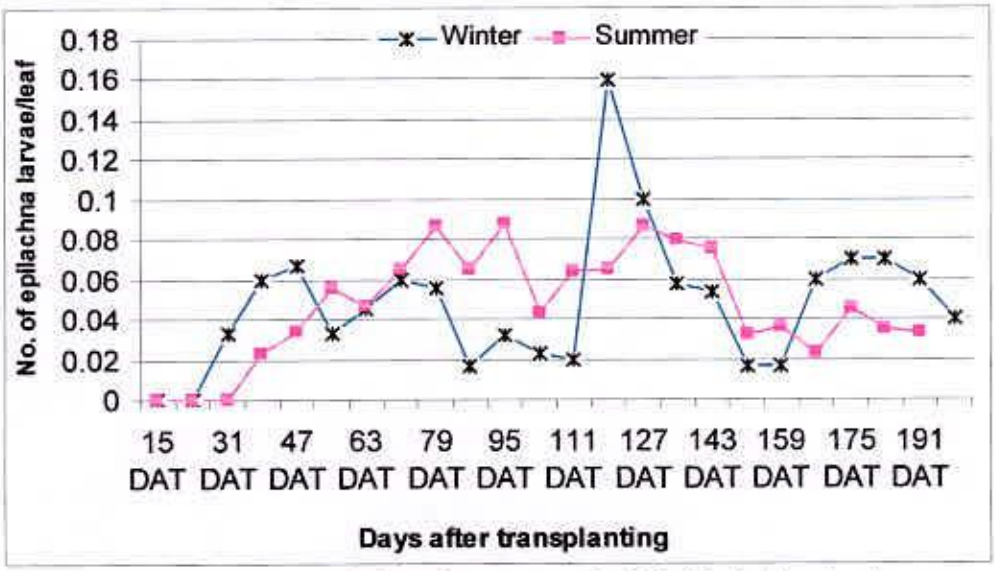


Fig. 12. Epilachna larvae infestation pattern in brinjal during both summer and winter season at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

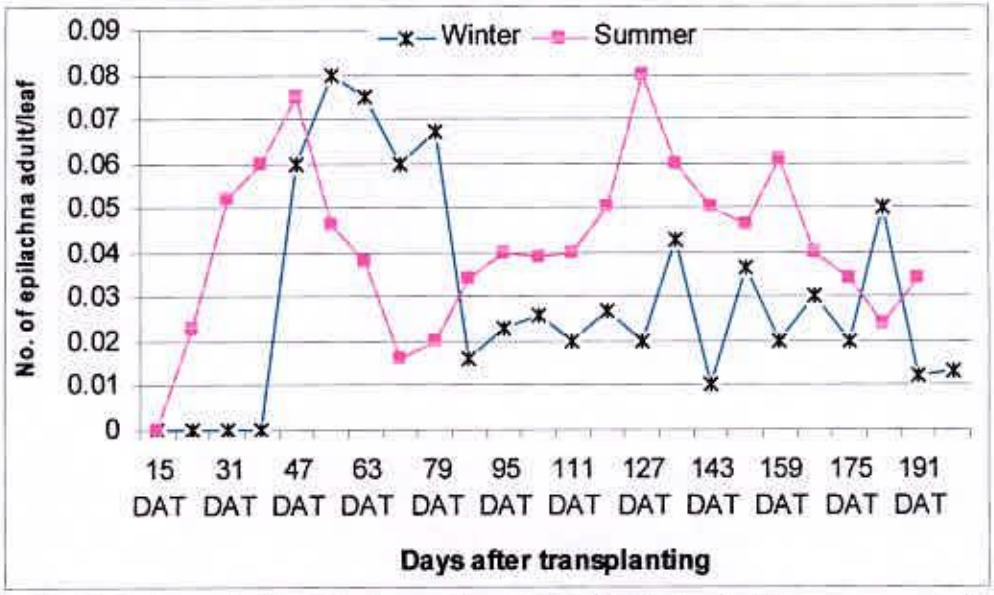


Fig. 13. Epilachna adult infestation pattern in brinjal during both summer and winter season at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

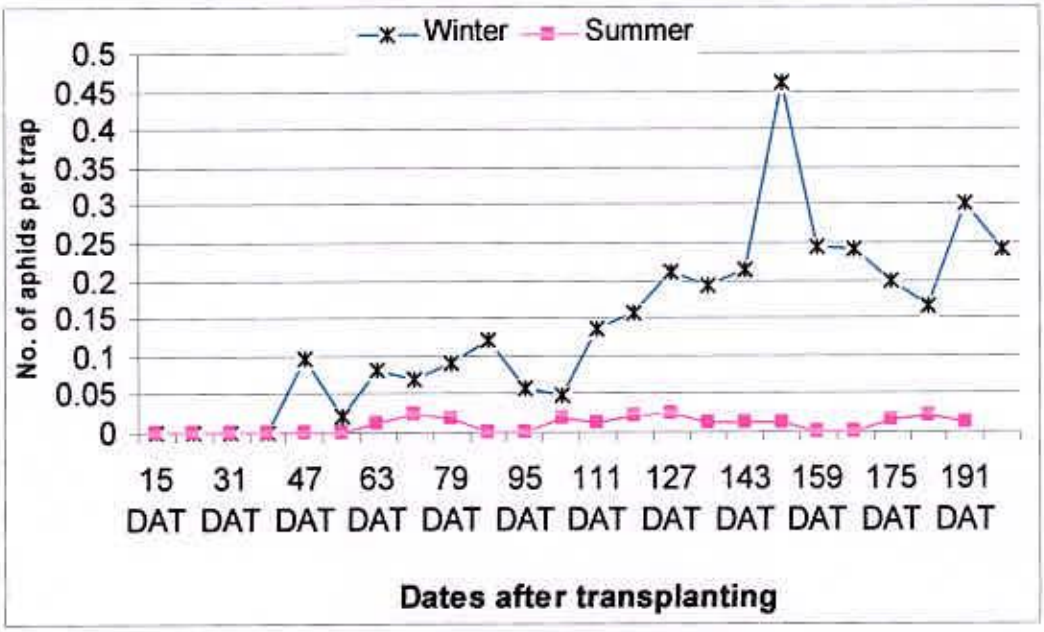


Fig. 14. Aphids infestation pattern in brinjal during both summer and winter season at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

Jassid: Number of jassid on the brinjal leaf during whole summer season were not fluctuated too much. The number varied from 0.0 to 0.8 per leaf (Figure 10) during summer. On the other hand during winter, numbers of jassid varied from 0.0 to 1.8 per leaf. Especially during 127 DAT to 175 DAT the jassid population was very much high.

Whitefly: Like jassid there was a significant difference between winter and summer whitefly population in the brinjal fields (Figure 11). During winter the whitefly population was always low (less than 0.4 per trap). In summer up to 95 DAT whitefly population was around 0.2 (number) per trap, after that population started to increase and reached to the peak at 191 DAT (1.1 number per trap).

Epilachna beetle: No distinct population peak was observed in case of epilachna larvae population during summer. However in winter during 127 DAT there was sharp increase of larval population of epilachna, except that the trend was almost similar to that of summer (Figure 12). On the other hand it is observed from the Figure 13 that, the trend of adult population increase of epilachna beetle in both summer and winter have some similarity. During summer peak populations were observed during 38, 127 and 159 DAT, while peak populations in winter were observed during 47, 136 and 175 DAT. The number of larval populations was more than the adult populations.

Aphids: During summer the population of aphids on the brinjal leaves in the study area was very low in comparison to the winter. No distinct population peak was

observed during summer. On the other hand during winter aphids population was higher. Especially from 111 DAT population started to build up and reached to the peak at 151 DAT (Figure 14).

Effect of temperature & rainfall:

Brinjal shoot and fruit borer: Positive correlation was observed in case of shoot and fruit infestation of BSFB and with the temperature and rainfall (Figures 15-18). It meant that the hot and humid temperature was favorable for the growth and development of BSFB. Highest shoot and fruit infestation was recorded during the months of July-September (Table 1).

Jassid: Warm temperature is favorable for the growth and development of jassid population, as there was a positive correlation between jassid population and rise of temperature (Figure 19) (r= 0.233768). On the other hand rainfall

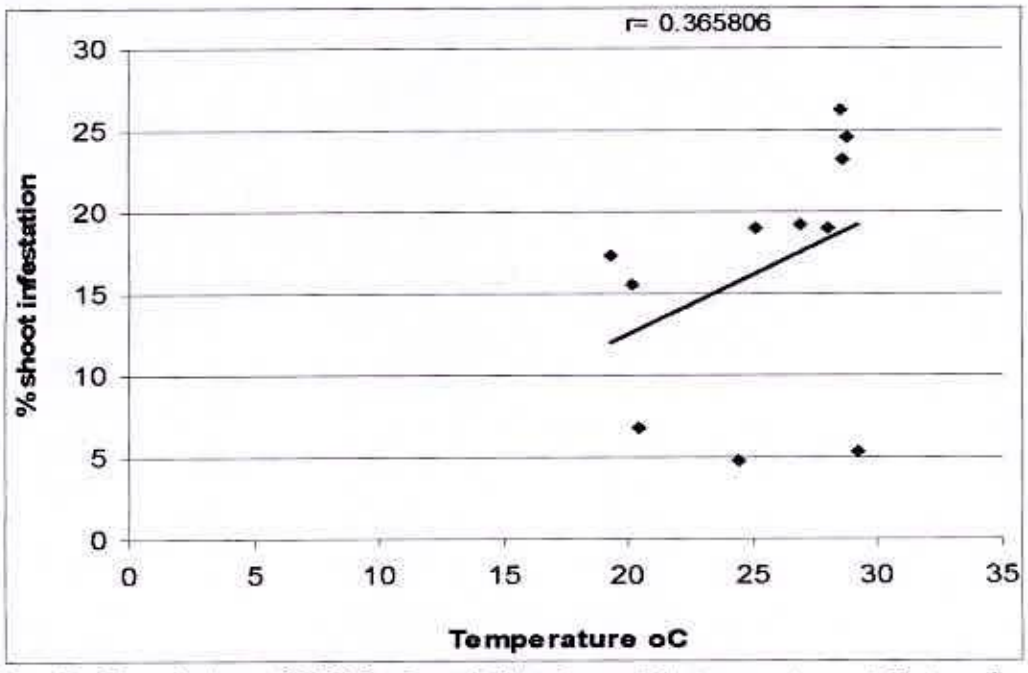


Fig. 15. Correlation of BSFB shoot infestation with temperature at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

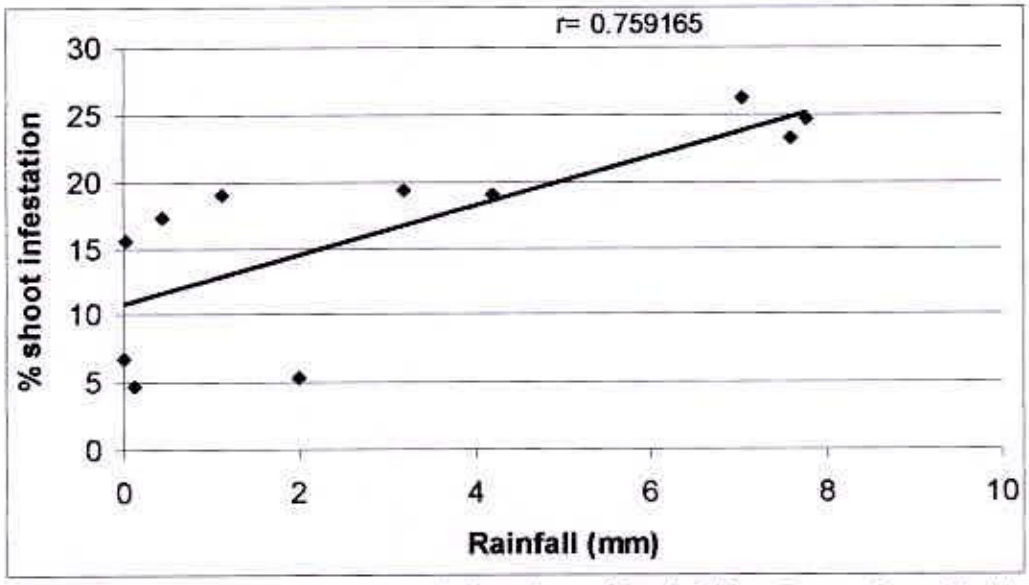


Fig. 16. Correlation of BSFB shoot infestation with rainfall at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

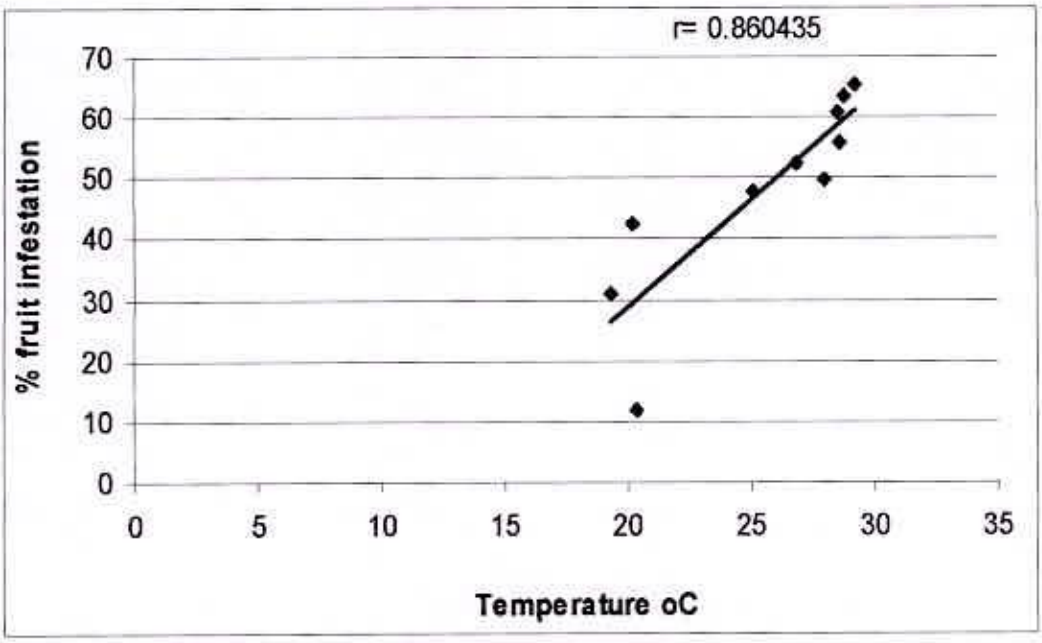


Fig. 17. Correlation of BSFB fruit infestation with temperature at Entomology Division Experimental field, BARI, Gazipur during November2005-September 2006

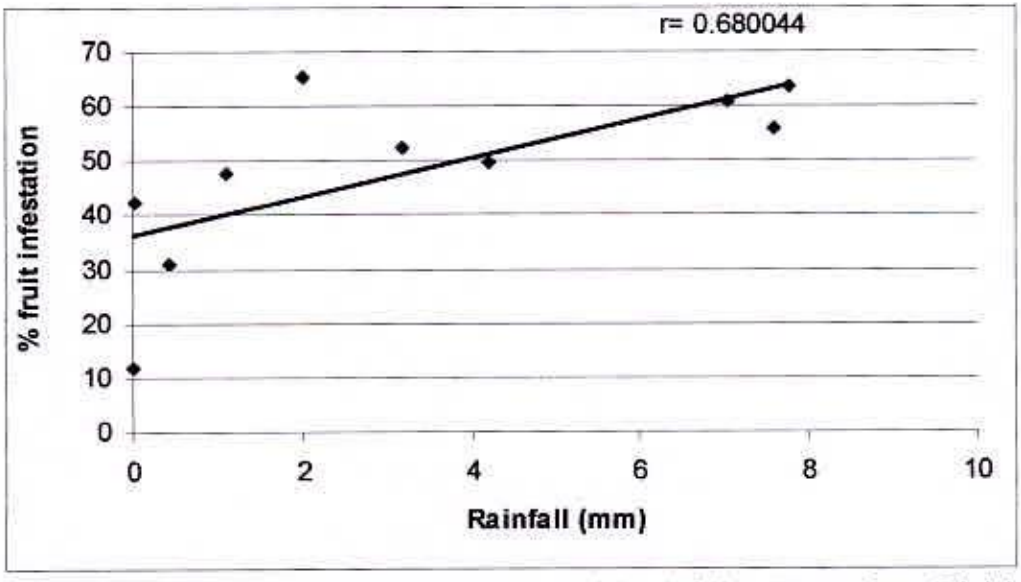


Fig. 18. Correlation of BSFB fruit infestation with rainfall at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

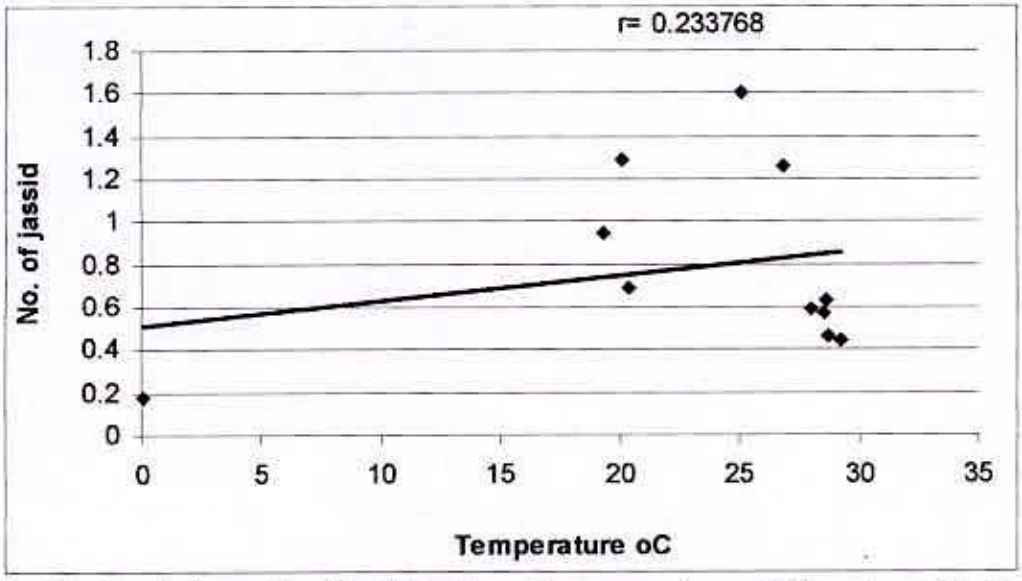


Fig. 19. Correlation of jassid infestation with temperature at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

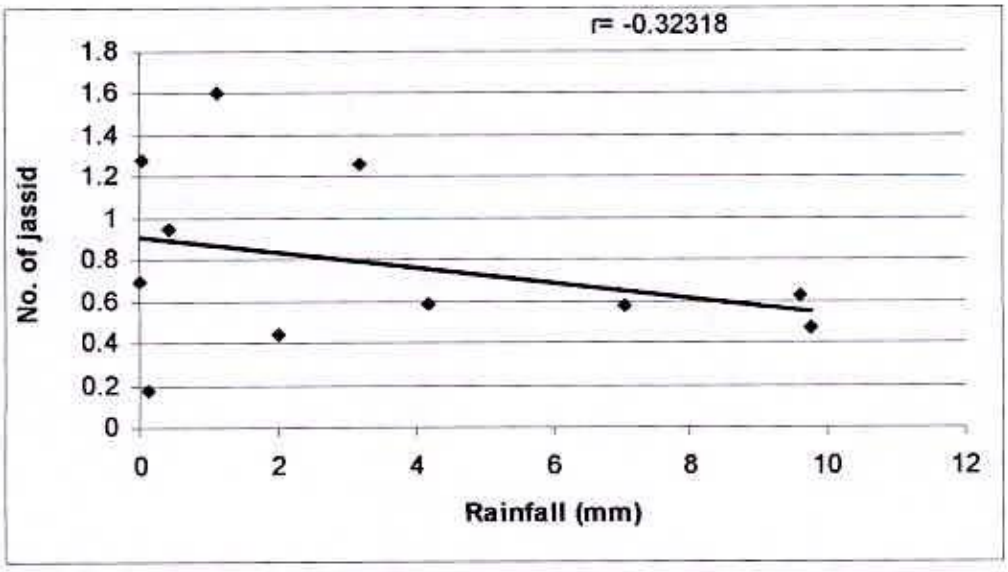


Fig. 20. Correlation of jassid infestation with rainfall at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

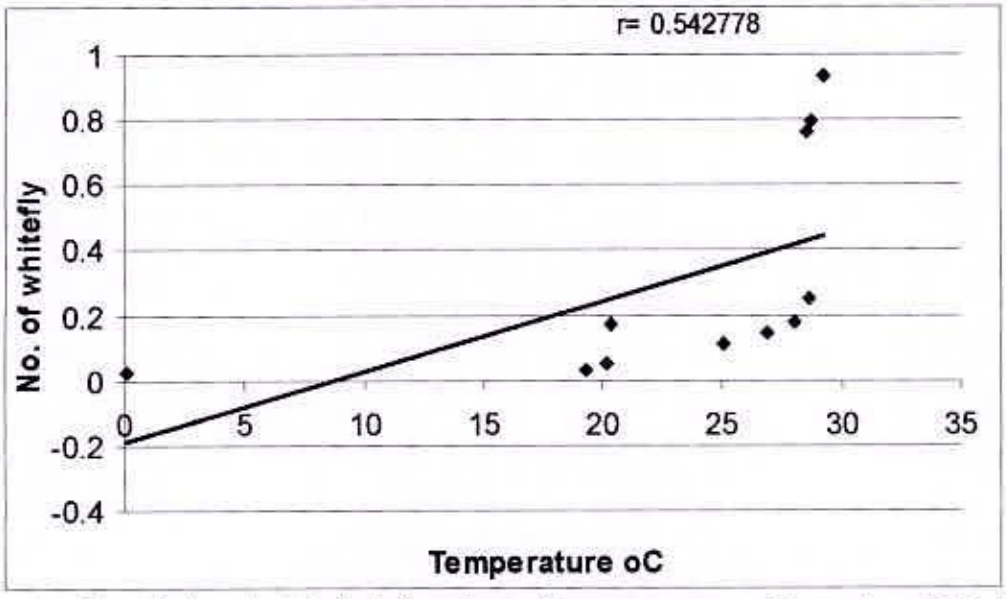


Fig. 21. Correlation of whitefly infestation with temperature at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

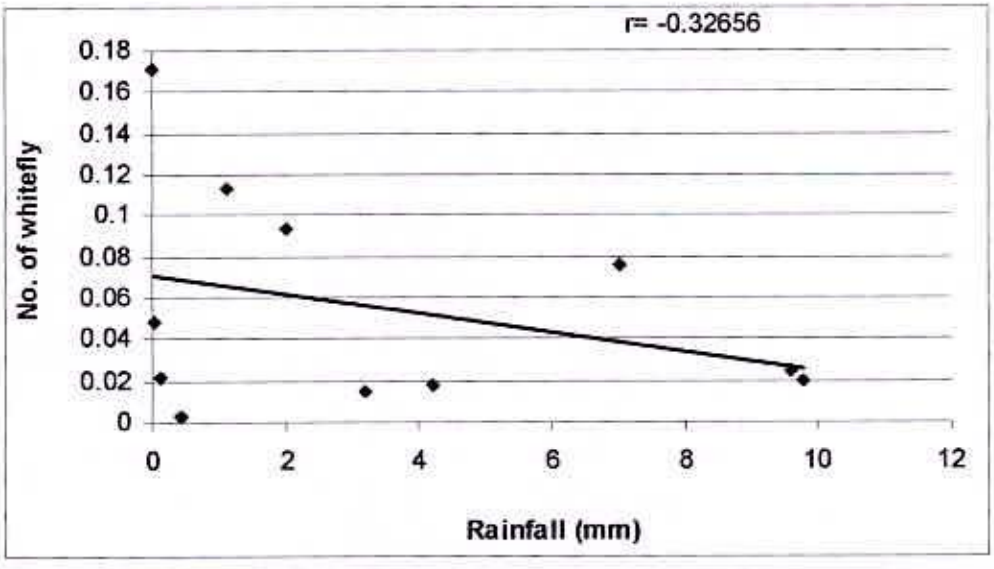


Fig. 22. Correlation of whitefly infestation with rainfall at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

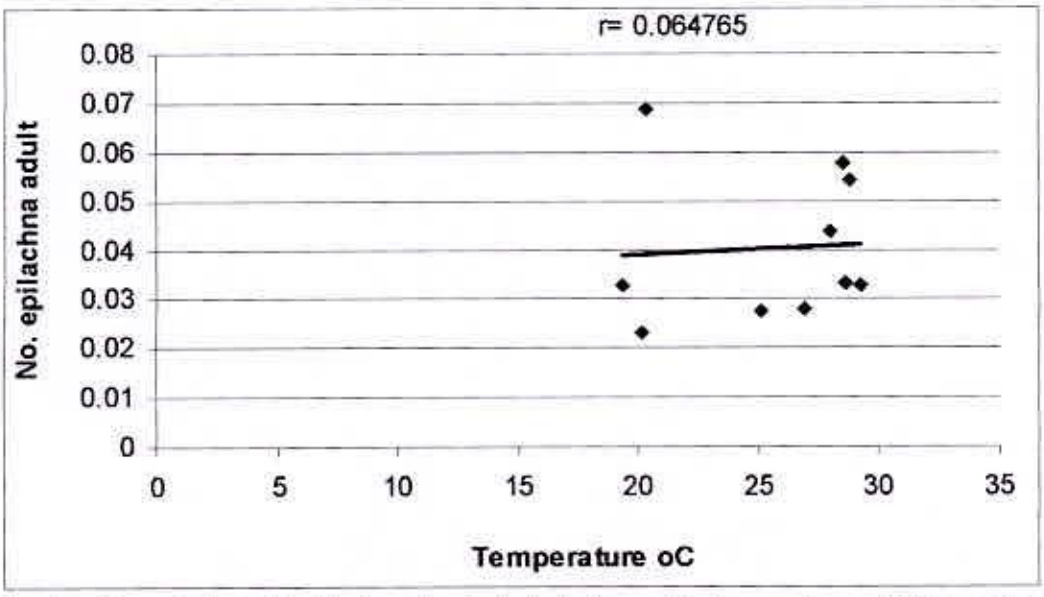


Fig. 23. Correlation of epilachna beetle infestation with temperature at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

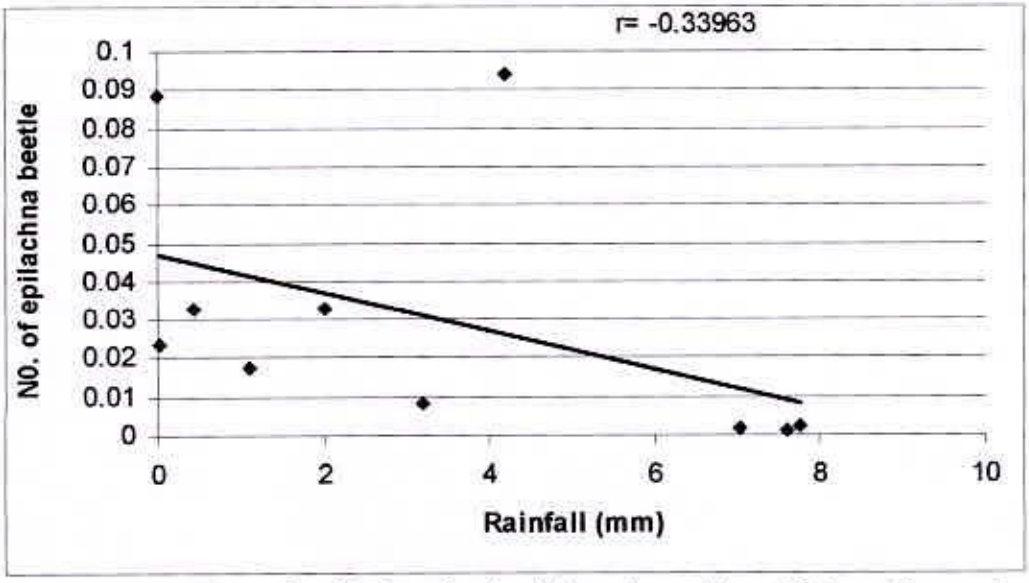


Fig. 24. Correlation of epilachna beetle infestation with rainfall at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

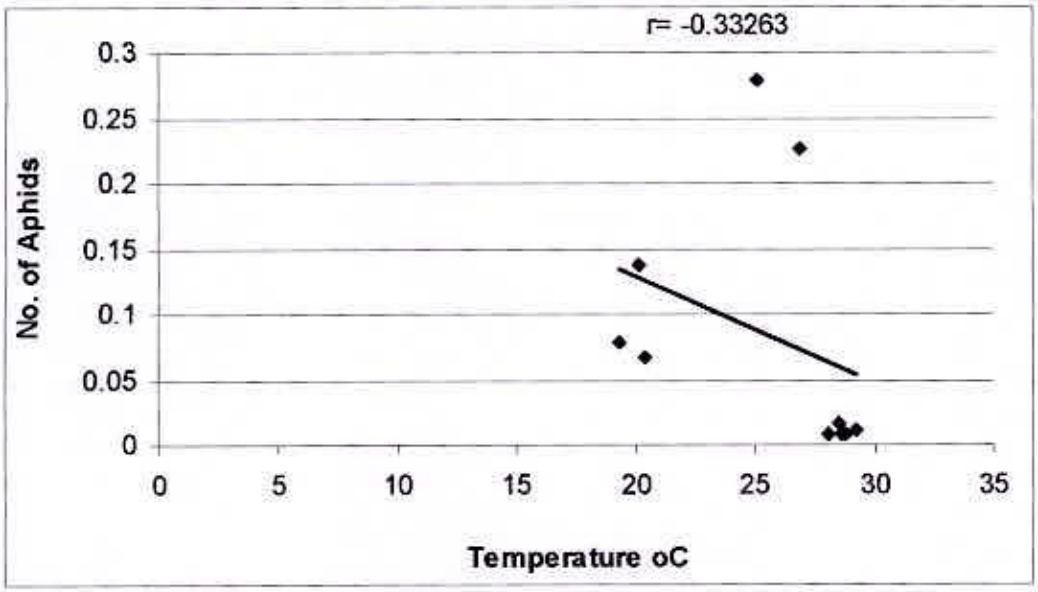


Fig. 25. Correlation of aphid infestation with temperature at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

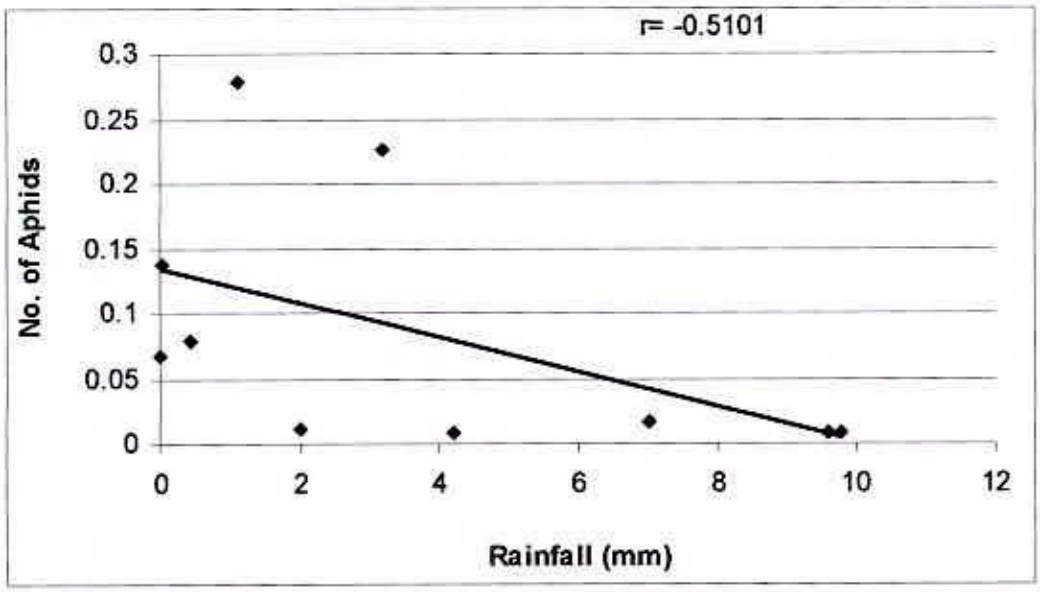


Fig. 26. Correlation of aphid infestation with rainfall at Entomology Division Experimental field, BARI, Gazipur during November 2005-September 2006

is detrimental for the jassid population growth. Negative correlation was observed between jassid population growth and development and rainfall (r= -0.32318) (Figure 20).

Whitefly: Like jassid, population growth of whitefly was positively correlated with temperature (r= 0.542778) (Figure 21) and negatively correlated with rainfall (r = -0.32658) (Figure 22). So, whitefly population grows up during warm dry period.

Epilachna beetle: It is observed from Figure 23 and 24 that epilachna adult population was positively correlated with temperature (r= 0.064765) and negatively correlated with rainfall (r = -0.33963). So, epilachna adult population will grows up in warm weather but rainfall will be detrimental to it.

Aphids: Both temperature and rainfall have negative effect on the growth and development of aphid population (Figure 25-26). Aphids like cool and dry temperature for its continuous growth and reproductive development. Which reflects the populations build up pattern of Aphids in brinjal? Population started to increase from and reached to the peak during last week of March and again again declined thereafter (Table1).

Chapter 5

Summary and Conclusion

CHAPTER 5

SUMMARY AND CONCLUSION

Several experiments have been undertaken to determine the pest status and seasonal abundance of different insect pests in brinjal at Gazipur during November 2005 to September 2006 in the Entomology Division Experimental field, BARI, Gazipur.

Five species of insect pests were recorded in the brinjal fields during the study period of both winter and summer season at Gazipur. The identified insect pest belongs to the orders Lepidoptera, Hemiptera Homoptera and Coleoptera. Among the insect pests, Brinjal shoot and fruit borer, *Leucinodes orbonalis* (Lepidoptera: Noctuiidae) was appeared first followed by jassid, *Amarasca devastans* (Hemiptera: Cicadellidae), Whitefly, *Bemasia tabaci* (Hemiptera: Aleyordidae), two species of epilachna beetle, *Epilachna vigintiocpuctata* & *E. 12-punctata* (Coleoptera: coccinellidae) and Aphids, *Aphis gossypii* (Hemiptera: Aphididae).

Among the five different pests recorded in the brinjal fields at Gazipur, brinjal shoot and fruit borer (BSFB) was the predominant one followed by jassid, whitefly, epilachna beetle and aphids. Year round infestation of BSFB, both in shoot and fruit was observed in the experimental plots. The highest infestation of BSFB was observed during hot and humid periods of the year (June – September). Highest shoot infestation was observed in the month of July (26.25% infestation occurred) and lowest shoot infestation happened in the month of November (4.73%). In case of

fruits, highest (65.32%) BSFB infestation was recorded during the month of September and lowest was observed in the month of December (11.94%). Except the dry months of the year, February, March and April, the infestation of jassid was not so high. During those three months the infestation of jassid became very high. Highest infestation of epilachna adult was observed during the month of December (0.068 per leaf), while that of epilachna larvae were observed during February (0.075 per leaf), June (0.071 per leaf) and July (0.074 per leaf). Highest number of whitefly per leaf was observed during the months of July (0.76 per leaf), August (0.79 per leaf) and September (0.94 per leaf), while lowest infestation was occurred during the cold months November-February. In the study plots aphid population per plant was very minimum. Infestation of aphids was built up during February to April (0.137-0.278 per leaf). Peak infestation occurred during March (0.278 per leaf).

Positive correlation was observed in case of shoot and fruit infestation of BSFB and with temperature and rainfall. That indicates hot and humid temperature is favorable for the growth and development of BSFB. Warm temperature was favorable for the growth and development of jassid population, as there was positive correlation between jassid population and rise of temperature. On the other hand rainfall is detrimental for the jassid population growth. Negative correlation was observed between jassid population growth and development and rainfall. Population growth of whitefly was positively correlated with temperature and negatively correlated with rainfall. So, whitefly population grows up during warm dry period. Epilachna adult population was positively correlated with temperature ($r = 0.064765$) and negatively

correlated with rainfall (r = -0.33963). So, epilachna adult population will grows up in warm weather but rainfall will be detrimental to it. Both temperature and rainfall have negative effect on the growth and development of aphid population. Aphids like cool and dry temperature for its continuous growth and reproductive development. That reflects the population build up pattern of Aphids in brinjal.

References

REFERENCES

Alam, M. Z. (1969). Insect pests of vegetables and their control in East Pakistan. E.P. G. P., Dhaka, East Pakistan.pp. 1-7.

Alam, M. Z. (1969b). Insect pests of vegetables and their control in East Pakistan. The Agricultural Information Service, Department of Agriculture. 3, R. K.Mission Road, Dhaka- 3, East Pakistan. 146p.

Alam, M. Z. and Sana, D. L. (1962). Biology of the brinjal shoot and fruit borer *Leucinodes orbonalis* G. (Pyralidae: Lepidoptera) in East Pakistan. The Scientist. 5 (1-4): 13-24.

Ali, M. I., Ali, M. S. and Rahman, M. S. (1980). Field evaluation of wilt diseases, shoot and fruit borer attack of different cultivars of brinjal. Bangladesh J. of Agril. Sci. 7 (2): 193-194.

Anonymous (1996). Statistical pocket book of Bangladesh. Bangladesh Bureau of statistics, Statistics Division, Ministry of planning, Government of Bangladesh, p191.

Anonymous. (2001). Mrittika Sampad Bavoharer Nirdeshika, Gazipur Sadar Upazila, Gazipur, Soil Resource Development Institute, Ministry of Agriculture, Krisi Khamar Sarak, Dhaka -1215.

Avidov, Z. (1956). Bionomics of tobacoo whitefly (*Bemisia tabaci* Gennad) in Israil. .Ktavim (English Edition). 7 (1): 25-41.

Azab, A. K., Megahed M. M and El-Mirsawi, D.H. (1970). On the biology of *Bemisia tabaci* (Genn.).Bull.Soc.Entomol. Egypte. 55: 305-315.

Banerjee, T. K.and Ghosh, M. R. (1986).Population fluctuation of *Aphis gossypii* Glover over Solanum melongena in West Bengal. Indian Agriculturist. 30(4):287-292.

Bari, M. N. and Sardar, M. A. (1997). Control strategy of bean aphid with predator, *Menochilus sexmaculalus* (F) and insecticides. Bangladesh *J. Ent.* **8** (1): 2, 21-29.

Basu, A. N. (1995*). Bemisia tabaci* (Gennadius) – Crop pest and principle whitefly vector of plant viruses. Oxford and IBH pub. Co. Pvt. Ltd. New Delhi. P.183.

BBS. (2003). Year Book of Agricultural Statistics of Bangladesh , 2000.Bangladesh Bureau of Statistics , Planning Divission, Ministry of planning, Government of the peoples Republic of Bangladesh Dhaka, Bangladesh .350p.

Berlinger, M. J. (1986). Host plant resistant of *Bemisia tabaci*, Agric. Ecosyst. Environ. 17: 69-82.

Biswas, G. C., Sattar, M. A. and Seba, M. C. (1992). Survey and monitoring of insect pests of brinjal Khagrachari Hilly Region. Pp 40-42. Annul Report, 1991-92, Ent. Div., BARI, joydebpur, Gazipur.

Brown, J. K.and Bird J. (1992). Whitefly transmitted Gemini viruses and associated disorders in the Americas and the Caribbean Basin. Plant diseases 76(3): 220-225.

Butani, D. K. and Jotwani, M. G. (1984). Insect and vegetables. Periodical Experiment Agency. D-42, Vivek Vihar, Dlehi-110032, India, 356p.

Byrne, D. N.and Bellows, T. S. (1991). Whitefly biology. Ann. Entomol.Soc.Amer.36:421-451.

Byrne, D. N.and Houck, M. A. (1990). Morhpometric identification of wing polymorphism in *Bemisia tabaci* (Homoptera: Aleyrodidae). Annals of the Entomological Society of America. 83: 487-493.

Charoenredhi, S., Banzeger, I.I., Suebbhongsung, S. and Linkinajul, M. (1979). Frequency and fluctuation of 6 species of aphids trapped in a potato field at Fang, Northern Thailand. Thai J. Agril. Sci. **12** (7): 309-316.

Chattopadhyay, P. (1987). Entomology, pest control and crop protection (In Bangla).West Bengal State Book Board, Arjo Mansion (9thfloor), 6a. Raja Subodh Mollick Square, Calcutta -700013, India. 304p.

Ciampolini, M.and Maiulini, C. (1990). Attacks by aphids on grapes in Lazio. Informe alore Agranio. 46 (8): 123-127.

Cohen, S Duffus, J. ELarsen, R. C. Liu, H. Y and Flock, R. A. (1983).Purification Serology, and vector relationships of squash leaf curl virus, a whitefly transmitted geminivirus. Phytopathology. 73: 1669-1673.

Cohen, S.and berlinger M.J. (1986). Transmission and cultural control of whitefly borne viruses. Agriculture, Ecosystem and Environment. 17, no.12: 89-97.

De Barro, P. J. (1995). *Bemisia tabaci* biotype B: a review of its biology, distribution and control. Division of Entomol. Technical paper no. 33. Commonwealth Scientific and Industrial Research Organization, Canberra, Australia.

Dhankar, B. S. (1988).Progress in resistance studying in Egg plant (Solanum melongena L.)against shoot and fruit borer (Leucinodes orbonalis Guen.) infestation. Tropical pest management .34: 343-345.

Duffus, J. E. (1987). Whitefly transmission of plant viruses. In Harris, ed, Current topics in vector research. Vol.4. Srpinger Verlag, New work .inc 4: 73 -91.

EL- Defrawi, G. M; Emam, A.K., Marzouk, I. A. and Rizkalla, L. (2000). Population dynamics and seasonal distribution of *Aphis crassivora* Koch and associated natural enemies in relation of virus disease incidence in faba been fields. Egyptian I. Agric. Res. 78 (2): 627-641.

Evans, D. E.(1965). The distribution of *Empoasca limbic* (Debarg) (Hemiptera: Cicadellidae) on cotton in the Sudan. Bull. Entomol.Res.56:635-647.

Gangwar, S. and Sachan, K. (1986). Insect complex in brinjal (*Solanum melongena*) Ann. Agril. Res. 16 (1): 93-94.

Gerling, D. and Horowitz (1984). Autecology of *Bemisia tabaci* Agric. Ecos. Environ. 17: 501-509.

Gill, R. J. (1990).The morphology of whiteflies, In: D. Gerling (ed.), Whiteflies: their bionomics, pest status and management. Intercept, Andover, U.K.

Gosh,S. K.and Senapati, S. K.(2001). Biology and seasonal fluctuation of Henosepilachna vigintioctopunctata Fabr. Brinjal under Terai region of West Bengal. Indian-J.of Agricultural Reasearch.2001, **35:**149-154.

Hill, D. S. (1983). Agricultural insect pests of the tropics and their control second edition, Cambridge University Press. Pp. 619-634.

Hinton, H. E. (1976). Notes on the neglected phases of nematomorphosis and a reply to J. M. Whitten. Ann. Entomol. Soc. Am. 69: 560-566.

Hirano, K.,E. Budiyanto and S. Winarni. (1993). Biological Characteristics and forecasting outbreaks of the whitefly, *Bemisia tabaci,* a vector of virus diseases in soybean fields. Food and Fertilizer Technology Centre. Technical Bulletin No. 135.

Honda, Y., kiratiya–Angul, K., Sriihonchai, W and kiratiya –Angul, S. (1986). Virus diseases of solanaceous plants transmitted by whitefly. In: Plant virus diseases of Horticultural Crops in the Tropics and subtropics. Taipei, Taiwan, Food and fertilizer technology for the Asian and pacific Region. Pp.51-59.

Hussain, M. A. and K. N. Trehan. (1933). Observation of the life history, bionomics and control of the whitefly of cotton (*Bemisia gossypii* perda M.and L.) Indian J. Agric. Sci.3:701-753.

Kallo.(1988). Solanaceous corps.pp. 520-570. In: Vegetables Breeding Vol. 11. CRC. Press. INC BOCA Raton, Florida.

Kennedy G.G. (1976). Host plant resistant and spread of plant viruses. Environ. Entomol. 5: 827-832.

Kranz, J., .Schumutterer, H and Koch, W. (1977). Disease, pest and weeds in tropical crops. John Wiley and son Ltd. Chichester, New York, Brisbane, Toronto.pp.320.

Lopez Avila, A. (1986). Bionomics of the tobacco whitefly *(Bemisia tabaci)* in Israel. Ktavim (English edition). 7(1): 25-41.

Maniruzzaman, F.M. (1981). Plant protection of Bangladesh. National Book center, Bangladesh, purana paltan, Dacca, 246p.

Mckinlay, R. G. ., Spaull, A.M. and Straub, R.W. (1992). Pest of solanaceous crops, pp. 263-326. In: Mckinlay, R.G. (ed.) Vegetable crop pests. McMillan Press, Houndmills- Basingstoke–Hampshire-London.

Mollah, M.A.H. (1996). Chemical control and genotypic tolerance against aphids on ashgourd. M.S. Thesis, Department of Entomology, IPSA, Salna, Gazipur, 72p.

Muniyappa, V.(1983). Epidemiology of yellow mosaic disease of horegram (*Macrotyloma unifolrum*). In Southern India. In plant virus epidemiology. The spread and control of Insect borne viruses (R. T. Plumb and J. M. Thresh, Eds.). Blackwell Scientific Publications, Oxford, U. K. pp. 331-335.

Muthukumar-M; Kalansundoram-M (2003). Influence of abiotic factors on the incidence of major insect pests in Brinjal. Department of Agricultural Entomology,Agricultural college and Reaserch Institute, India, South Indian-Horticulture. 51(1/6):214-218.

Nair, M.R.G.K. (1986).Insect and mites of crops in India. Revised Edition. Indian council of Agricultural Research, New Delhi.408p.

Naresh, J. S., .Mallik, V.S., J.S. Balan, J. S. and Khokar, K.S. (1986). A new record of *Trathala sp.* a larval endoparasite attacking brinjal fruit borer, *Leucinodes orbonalis* Guen. Bull. Entomol. New Delhi.27 (1): 74.

Navot, N., Pichersky, M., Zeidan, D.Zamir and Czosnek, H. (1991). Tomato Yellow leaf curl virus: a whitefly transmitted geminivirus with a single genomic component. Virology: 151-161.

Nayar, K. K., Ananthakrisnan and David, B.V. (1989).Genaral and applied Entomology. Tata Mcgraw- Hill publishing Co.Ltd.,New Delhi,pp162-169.

Nonnecke, J.L. (1989). Vegetables production. Van Nostrand Reinhold, New York .247p.

Patel, H.M.and Jhala, R.C. (1992).Studis on host range , preference and population dynamics of whitefly, *Bemisia tabaci* (Gennadius) .Gujrat Agricultural University Res. J. 17 : 2, 76-81.

Patel, J.R., Korat .D. M.and Patel, V. B. (1988). Incidence of shoot and fruit borer (Luecinodes *orbonalis*) Guen. and its effect on yield in brinjal. India J. Ent. 16 (2): 143-145.

Pawar, D. B., Kale, P. N., Choudhari, K. G. and Ajri, D. S. (1986). Incidence of brinjal shoot and fruit borer *(Leucinodes orbonalis* Guen.) in kharif and summer season. Current Research Report. Mahtma Phule Agril. Univ. 2 (2): 286-288.

Poinar, G. O. (1965). Observations and ovipositional habits of *Aleurocybotus occiduus* (Homoptera: Aleyrodidae) attacking grasses and sedges. Ann. Entomol. Saoc. Am. 58:618-620.

Pruthi, H. S. and C. K. Samuel. (1942). Entomological investigation on the leaf curl disease of tobacco in Northerbn India. V. Biology and population of the whitefly vector (*Bemisia tabaci* Genn.) in relation to the incidence of the disease. Indian J. Agric. Sci. 12:35-57.

Rajgopal, D. and Trivedi, T. P. (1989). Status bioecology and management of Epilachna beetle *Epilachna viginctiopunctata*, Fab. (Coleoptera: Coccinelidae) on potato in India. Tropical Pest Management. 35 (4 0): 410-413.

Rashid(1999). Bangladesh phal. Rashid Publishing House, Bangladesh Agricultural Research Institute Campus, Joydebpur, Gazipur,pp.119-124.

Reddy, D.B. (1968). Plant protecton in india .Allied publishers, Calcuta, 267p.

Roy, D.K.and Behura B.K.(1983).Notes of host plants, feeding behaviour,infestation and ant attendance of cotton aphid ,Aphis gossypii Glover .Bombay Nat.Hist.Soc.80:654-656.

Saeed, M. Q and Khan, I.A. (1997) .Population abundance and chemical control of brinjal shoot and fruit borer Leucinodes orbonalis Guen. (Pyralidae: Lepidoptera).Sarhad J.of Agriculture. 13(4): 4, 399-402.

Salmon F.A.A. and Mahomed, A (2000). Occurrence and abundance of cowpea, *Aphis craccivora* Koch infesting faba bean plants at different sites of the fiaeld , in aupper Egypt,Assiut J. Agric .Sci.31(4): 299-310.

Scalan, F. M. (1995). Fruit production manual. Development of Agricultural Extension, BADC, Dhaka .pp. 116-117.

Schumutterer, H. (1977). Pests in tropical crops, pp.237-541. In: Kranz, J., Schumutterer, H.and Koch, W. (eds.) Diseases, weeds and pest in tropical crops. John Willey and sons, Chichester-New York – Brisbane –Toronto.

Shanmugavelu, K.G.(1989).Production technology of vegetables crops.Moheein primlari for oxford and IBH publishing co.Pvt. Ltd.66janpath, New Delhi 110001.69p.

Shukla, R. P. (1989). Population fluctuation of *Leucinodes orbonalis* and *Amrasca biguttula* in brinajal (*Solanum melongena*) in relation to abiotic factors in Meghalaya. India J. agric .Sci. 59 (4 0): 260-264.

Singh, S.V., Singh, K.S.and Mallik Y.P. (2000).Seasonal abundance and economic losses of shoot and fruit borer, Leucinodes orbonalis on Brinjal. Indian J.of Entomol. 62 (13): 247-252.

Sumon, C. L. Peter, C., Nagarkatti, S. and Wahi, S. D. (1987). Distribution pattern of immature stages of epilachna beetle , *Hanosepilachna vigintiopunctata* Fab. On brinjal. Hort. Res. 12 (4): 295-300.

Tilavov, T. T. (1981). The daily and seasonal feeding rhythm of the adult of the cucumber beetle . *Epilachna chrysomelia* Fab. Uzbekhii Biologiceskii- Journal. 8 (5): 49-51.

Yamaguchi, M. (1983). Solanaceous fruits. pp. 298-304. In: World vegetables Principles, production nutritive values. AVI Publishing Company, INC, Westport, Connecticut.

York, A. (1992). Pest of cucurbits crops: marrow, Pumpkin, Squash, Melon and Cucumber, pp. 139-161. In: McKinley, R. G. (ed.) Vegetable crop pests. Houndmills – Basingstoke – Hampshire- London.