HOST PREFERENCE AND INTEGRATED MANAGEMENT OF JASSID, *Amrasca devastans* (DISTANT), HOMOPTERA: CICADELLIDAE

BY

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REGISTRATION NO. 23935/00177

A Thesis
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

IN

ENTOMOLOGY

SEMESTER: JANUARY-JUNE, 2006

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CERTIFICATE

This is to certify that the thesis entitled, "Host preference and integrated management of jassid, *Amrasca devastants* (Distant), Homoptera: Cicadellidae" 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 IN ENTOMOLOGY,** embodies the result of a piece of bona fide research work carried out by **Md. Mamun-Ur-Rashid,** Roll No. 33, Registration No. 23935/00177 under my supervision and my 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.

Dated: 06.03.2006

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Dedicated to

My

Beloved Parents & Brothers

ACKNOWLEDGEMENTS

All praises, gratitude and thanks are due to the omniscient, Omnipresent and omnipotent Allah who enabled the author to complete this thesis successfully.

The author expresses his deepest sense of gratitude, sincere appreciation and immense indebtedness to his supervisor Dr. Syed Nurul Alam, Senior Scientific officer, Entomology Division, BARI, Joydebpur Gazipur for his guidance, constructive criticism and valuable suggestion in successful completion of the research work and preparation of this thesis. Profound gratitude is expressed to his honorable co-supervisor Assoc. Prof. Mohammed Ali for the scholastic guidance and constant inspiration throughout the research work and preparation of this thesis.

The author is highly grateful to Prof. Dr. Md. Serajul Islam Bhuiyan, Prof. Jahanara Begum, Assist. Prof. Md. Abdul Latif, Assist. Prof. Razzab Ali and Lecture Md. Rashedul Islam teachers of the Dept. of Entomology, SAU, for valuable suggestions and cooperation they extended during the study period.

The author also expresses his heartfelt thanks to all the teachers of the Dept. of Entomology SAU, for their help, valuable suggestions and encouragement during the period of the study.

Thanks are extended to his friends Md. Shahin, Arfan, Md. Tanvir, Tariq, Arafath, Sujon, Humahun, Rokon, Arif, my roommate Atik, Bidyut, Nuid, Sumon, Sobuj and other friends for their help and inspiration.

The author also expresses his heartfelt thanks to Most. Rokeya Khatun, Scientific officer, Soil science Division, BARI, Joydebpur, Gazipur.

Mere diction is not enough to express his profound gratitude and deepest appreciation to his parents, brothers, brothers' wife, and sisters for their ever ending prayer, encouragement, sacrifice and dedicated efforts to educate me to this level.

The Author

HOST PREFERENCE AND INTEGRATED MANAGEMENT OF JASSID, *Amrasca devastans* (DISTANT), HOMOPTERA: CICADELLIDAE

ABSTRACT

Several studies were carried out at the experimental field of the Entomology Division, Bangladesh Agricultural Research Institute (BARI) Gazipur, Bangladesh during September 2004 to July 2005 to determine the host preference as well as to develop management tactics of jassid, *Amarasca devastans*. Among the six host plants viz. tomato, sweet gourd, country bean, brinjal, okra and cotton, okra is observed as the most preferred host of jassid (number of jassid/leaf was 13.49 ± 7.94), followed by brinjal (4.26 ± 2.18) and cotton (3.94 ± 0.88). Infestation of jassid was significantly less in two brinjal lines, ISD006 and BL114 producing highest yield among the tested lines. Those two lines can be considered as the resistant brinjal lines against jassid, *A. devastans*. Spraying of neem based bio-rationales, neem oil (@ 5 ml /liter of water mixed with 1 ml detergent) or neem seed karnel extract (@ 500 gm crushed kernel dissolved in 10 liters of water for 24 hours) can effectively control the jassid population on brinjal.

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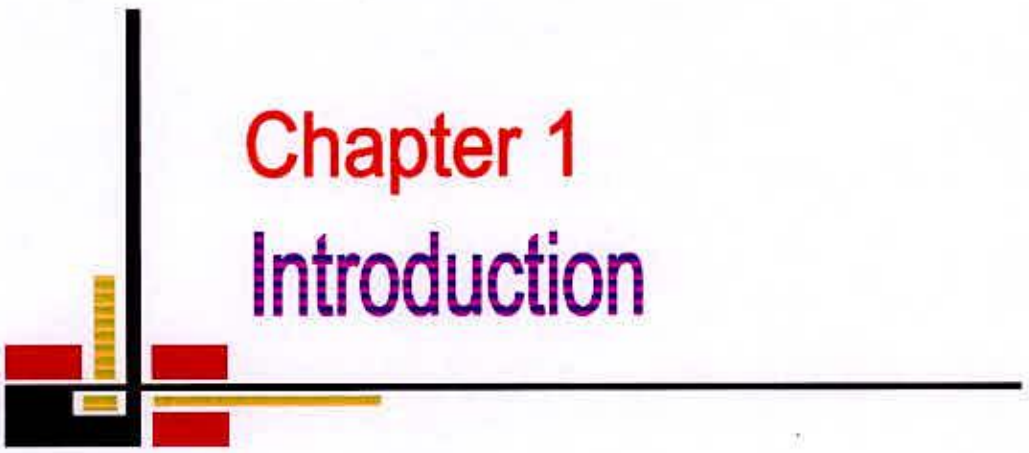
AEZ	=	Agro-Ecological Zone
BARI	=	Bangladesh Agricultural Research Institute
BCR	=	Benefit Cost Ratio
cm	=	centimeter
^0C	=	Degree Centigrade
DAT	=	Days After Transplanting
et al.	=	and others (at elli)
g	=	gram(s)
ha^{-1}	=	per hectare
Kg	=	Kilogram
LSD	=	Least Significant Difference
MP	=	Muriate of Potash
m	=	meter
ml	=	milliliter
NSKE	=	Neem Seed Karnel Extracts
No	=	Number
P^H	=	Hydrogen ion conc.
q/ha	=	quintal/hectare
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

Bangladesh became near to self sufficient in the production of cereal crops since last few years, but still there is a serious deficiency in vegetable production. Vegetables are important sources of vitamins, minerals and plant proteins in human diet. The annual production of vegetables in Bangladesh is only 2.5 million tons including potato and sweet potato (Anonymous 1993). The optimum requirement of vegetable for a full growth person is 285g, but the per capita consumption is only 32g in Bangladesh (Hossain *et al.*, 1990; Ramphall and Gill 1990). So, Bangladesh is facing a serious crisis in vegetables production. As a result, chronic malnutrition is commonly evident in Bangladesh. There are several reasons for the lower production of vegetables in Bangladesh and severe infestations of different insect pests is an important one among them.

Among the different insects pests attacking vegetables crops, cotton jassid, *Amrasca devastans* (Distant) is considering as the destructive one. The nymphs of cotton jassid are pale green, wedge-shaped and have a characteristic crab-like, side ways movement when disturbed. They are confined to the under surface of leaves during the day time but can be found any where on the leaves at night. The adults are small, elongate, wedge-shaped, body pale green with semi-transparent, shimmering wings. They are very active and having a side way walk likes the nymphs, but quick to hop and fly when disturbed.

The nymphs and adults of *A. devastans* can attack host leaves at all stages of development. It infests the lower surface of the leaves. Injury of the leaves is caused by the adults and nymphs feeding on the sap and injected saliva into the tissues, which causes toxemia. Infested leaves curl upwards along the margin. Outer leaf area appears yellowish or burned. 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 leaf gradually dries up and drops. The plant becomes stunted; quality of fruit is also affected (Nair, 1986). Due to sever infestation fruit set hampered seriously. It also transmitted viral disease like mosaic virus. Ali (1990) reported that the younger plants were found susceptible to jassid attack than the older plants. As the plants grew older, they become less susceptible to jassid infestation.

Jassid has wide ranges of hosts. The important hosts are okra, potato, brinjal and also some wild plants, like hollyhock, kangi buti (*Abutlon indicus*) etc. (Atwal, 1986). It is also one of the key pests of cotton and is the major limiting factor of cotton yield in Bangladesh. The host range often has regional characteristics and some plant species subjected to serve infestations in one area, may be relatively free from other. So, host range studies should be done region wise to identify most preferred host of Jasssid of that region.

Among the vegetables crops, brinjal is severely attacked by jassid. Especially during the cool dry period of the year the infestation reaches to the peak. So, to

develop management tactics against jassid in brinjal is a prime need. Although despite the importance of jassid as a devastating pest to several crops especially brinjal, its management practices are still limited to frequent sprays of toxic chemical pesticides. For vegetable in general, Sabur and Mollah (2000) observed an increase in use of pesticides by farmers in combating pests through out Bangladesh. Meanwhile, inappropriate pesticides, incorrect timing of application, and improper doses all have resulted in high pesticides costs with little of no appreciable reduction in target pest populations. Farmers choose insecticides because they are readily available, highly promoted, inexpensive, easy to apply and quick acting. The increasing use of synthetic insecticides has led to a number of problems such as development of resistance to insecticides, high insecticide residues in market produce, resurgence or increased infestation by some insect species due to the destruction of natural predators and parasitoids, changing pest status of mites and other minor insect pests, ecological imbalance and danger to health of the pesticide applicator and also to consumers.

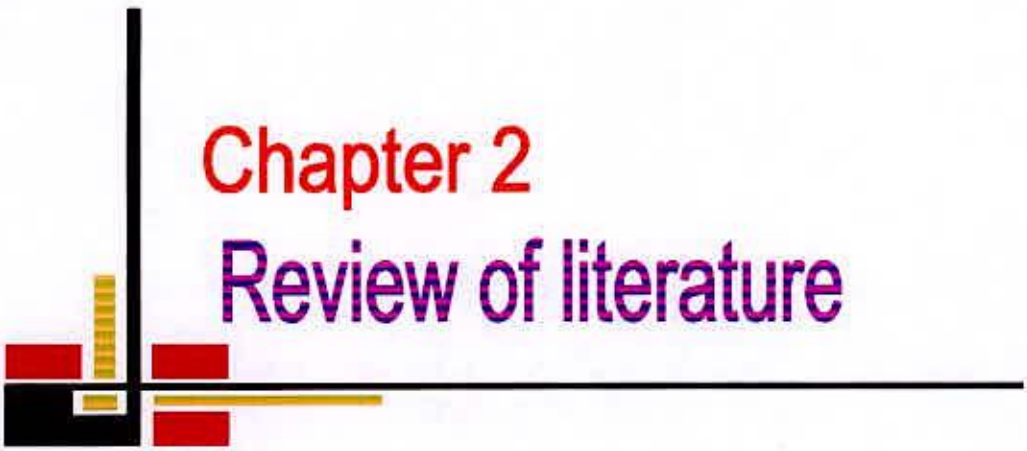
It is unlikely that any single method of pest control tactics can achieve a level of jassid control acceptable to the producers of Bangladesh; an integrated approach should be introduced. There are alternative approaches to controlling insect pests. They are cultural practices, including crop hygiene (fallow, crop rotation, ploughing, removing crop residues, planting time), use of resistant varieties, augmentation and conservations of natural enemies, use of bio-rationales etc.

Several brinjal entries / varieties have shown different level of resistant against jassid (Alam, 2005).

In Bangladesh several research activities have so far been taken on different aspects of jassid management. Although those works were mostly oriented with the insecticides screening, loss assessment etc. Very few studies have been done on the host range, varietal resistant, and bio-rationale based integrated management of the pest.

So, considering the importance of jassid for the production of brinjal and other vegetable crops, it is very important to develop the environment friendly management practices of jassid, So a series of research studies were undertaken with the following objectives:

1. To study on the host preference of jassid, *Amrasca devastans* on the selected vegetables crops and cotton.
2. To study on the varietal preference of jassid, *Amrasca devastans* (Distant) on brinjal.
3. To develop management packages for sustainable, economic and environmental friendly control measure of the pest.



Chapter 2
Review of literature

CHAPTER 2

REVIEW OF LITERATURE

Jassid, *Amarasca divastans* (Distant) is considered as one of the major pest of different vegetable crops, which causes significant damage to 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. Literatures regarding its host range, varietal resistant and management in one of the major vegetable crop brinjal are scanty. However, review of the available literatures relevant to the present study is presented below under the following sub-headings.

Taxonomy

This insect belongs to the Order: Homoptera and Family: Cicadellidae Synonym: *Amrasca biguttula,* Common Name: Cotton jassid or Okra jassid or brinjal jassid etc.

Origin and distribution

Jassid is a versatile and widely distributed insect. It has been recorded in India, china, Pakistan, Iran, Syria, Greece, Span, Argentina, Brazil and U.S.A. It is distributed widely throughout Eastern, Western, Southern and Central Africa.

This Pest is also common in Australia (Ghauri, 1963). *A. devastans* is a new crops pest on Christans Island and Cocos (Keeling) Islands (Bellis, 2004).

Host Range

Jassid is of widely distributed in India and is the most destructive pest of American cotton in the north-western region. Besides cotton, it also feeds on okra, potato, brinjal and some wild plants like hollyhock, Kangi buti (*Abutilon indicum*) etc. (Atwal, 1986). Incidence of *A. divastans* was observed on abergine and an average of 3.0 *A. devastans* per plant was recorded (Prasad and kumar 2002). Jacob *et al.* (2000) identified *A. devastans* on castor bean and was found to have attained pest status. A survey conducted in Madhya Pradesh, India during 1995-98 recorded that *A. divastans* also infesting potatoes in that area (Dharpure, 2003)

Seasonal abundance

The cotton jassid was formally considered to be an early season pest attacking plants in Bangladesh (Bohlen, 1984). 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 (Borah, 1995). Seasonal abundance of cotton jassid on okra was dependent on meteorological parameters. Jassid population was maximum during middle of April (30.00 nymphs per leaf) to last week of May (37.5 nymphs per leaf). 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. Investigation on the seasonal incidence of jassid (*Amrasca biguttula*) population on okra and their correlation with abiotic factors were carried out during kharif 1990 in the semi-arid region in India. The infestation of jassid started in the fourth week of July and reached peaks in the second and forth weeks of September, respectively (Kumawat *et al.*, 2000).

Studies on the seasonal incidence of jassid on cotton under rainfed conditions were conducted in Bharuch, Gujarat, India, during 1979-80 and 1981-82. Results showed that populations of *Amrasca biguttula* ranged from 0.59 to 2.78 per plant recorded in the second fortnight of November (Patel and Rote, 1995). The spatial distribution of *A. devastans* was studied in upland cotton in India. Environmental hetero-genially at low population in July, and innate behaviour at high population was responsible for aggregated dispersion in the species of Hemiptera (Singh *et al.*, 1990). Ali and Karim (1991) investigated the influence of cotton plant age on the seasonal abundance of *Amrasca devastans*. *A. devastans* remained below the economic threshold level of 1 insect/leaf for up to 35 days of plant age in kharif cotton and 65 days of plant age in Rabi cotton. Most of the cicadellids were found in 35 to 75 days- old cotton plants in kharif and 65 to 130 days old cotton plants in the Rabi season. Cotton grown in the Kharif season was more vulnerable to insect attack than cotton grown in the rabi season.

Biology and Life story

Egg: The adults mate two days after emergence and the eggs are laid two to seven days after copulation. Eggs are laid singly within leaf veins in the paranchymatous layer between the vascular bundles and the epidermis on the upper leaf surface. An average of 15 eggs (with a maximum of 29) is laid per female. Mature leaves (35-45 days old) are preferred for egg deposition. Curved, greenish-yellow eggs (0.7-0.9 x 0.15-0.2mm) are laid. Egg period lasts for 4-11 days (Nair, 1986).

Nymph: Nymphs are pale green, wedge-shaped, 0.5-2.0 mm long, have a characteristic crab-like, side ways movement when disturbed. They are confined to the under surface of leaves during the day time but can be found anywhere on the leaves at night. The nymphal period can vary from 7 to 21 days depending on food supplies and temperature. They pass through six stages of growth during nymphal period (Atwal, 1986). Another study revealed that they become full-grown in seven days in autumn and 25 days in winter.

Adult: The adults are small, elongate, wedge-shaped, about 2.5 mm long, body pale green with semi-transparent, shimmering wings; very active, having a side way walk like the nymphs, but quick to hop and fly when disturbed. The adults of the summer brood are greenish yellow in colour and those of the winter brood reddish. Unmated adults live for three months or more, when mated they live for longer than five weeks in summer and seven weeks in winter. Life cycle is completed in 15-46 days in the different seasons and up to eleven generation is

completed in a year (Nair, 1986). They are also attracted to light at night (Atwal, 1986).

Nature of Damage

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 in severe causes of infestation, which ultimately causes the retraction of plant growth, reduction of yield (Afzal & Ghani, 1953).

Nair (1986) reported that the nymphs and adults of *A. devastans* could attack host leaves at all stages of development. The adults and nymphs feeding on the sap and injected saliva into the tissues, which causes 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 gradually dries up and drops. The plant becomes stunted; quality of fruit is also affected. Ripper George (1965) reported that if the plants infested by jassid during their early ages, the plant growth may be arrested.

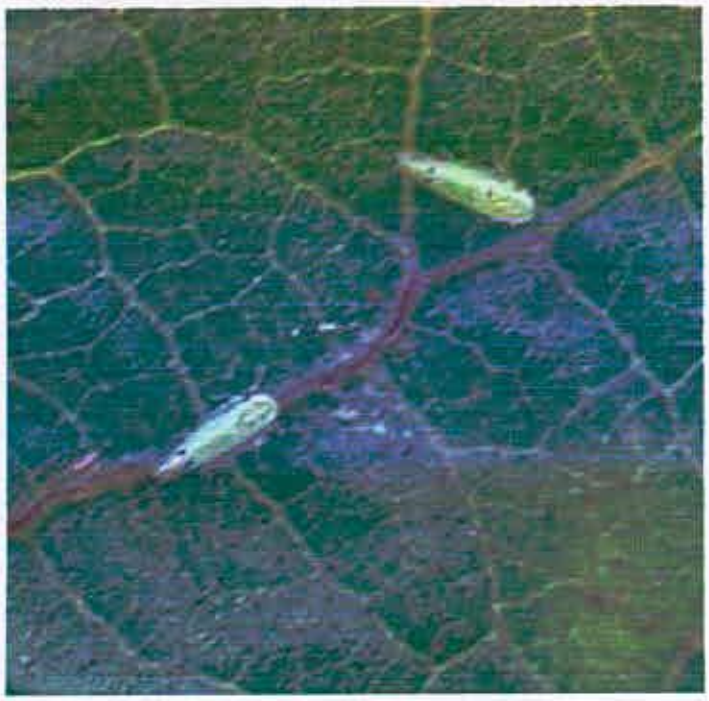


Plate 1. Adult jassid

Plate 2. Infestation of Jassid on brinjal leaf

El-Tom (1987) reported that cotton jassid, *A. devastans* is one of the key pests of cotton and in the major factor limiting cotton yield in Bangladesh. This pest caused more than 50 percent reduction of seed cotton yield in some cotton genotypes (Bhat *et al.,* 1984). The jassids while sucking the plant sap inject some toxic substance with saliva into the cotton plants (Nayer *et al.,* 1984). Time required to development characteristic jassid damage symptoms in cotton plants were found positively correlated with age of the plant. The younger plants were found susceptible to jassid attack than the older plants.

As the plants grew older, they become less susceptible to jassid infestation (Ali, 1990). Rote *et al.* (1985) reported a significant positive correlation between jassid damage symptoms and jassid population levels on the plant. Yield losses of cotton due to sucking pests (*Amrasca biguttula biguttula)* were evaluated during the rainy seasons of 1985 and 1986 in Karnataka, India. The average loss was 46.41% (Panchabhavi *et al*., 1990)

Spatial distribution to the host canopy

The population of *A. deveastans* significantly higher on the middle and lower canopy, respectively, this was thought to be due to anatomical/biological parameters (Das and Thukral, 1999). Again, Simwat and A.K Dhawan (1995) reported that the numbers of nymhs of jassids were significantly higher in the lower and upper canopy of cotton plants. Another field study reported that the

numbers of *A. devastans* were higher on middle aged leaves compared to young and old leaves (Arif, 1998).

The spatial distribution of *Amrasca biguttula* was studied on cotton during kharif using various distribution papameters. The pest was found to follow either aggregated or regular distribution on the crop (Kirti *et al.*, 1998). Sangha *et al.* (1997) reported that the jassid nymphs were mainly confined to the upper and middle canopies of the cotton plant during the day and followed a uniform distribution pattern. It was estimated that the population counts from 2 and 3 leaves from the upper canopy of 3 and 4 plants each formed on appropriate sampling plan for the whole season and peak period of jassid infestation, respectively.

Management

Non-chemical:

The Management of jassid, *A. devastans* (Distant) through various non-chemical methods namely, cultural, mechanical, biological and host plant resistant etc. is limited throughout the world. The research work on non-chemical control measure of this pest is also scanty.

The farmers of Bangladesh usually apply six to eight scheduled based insecticide sprays against this pest through out the season. But this kind of insect pest control strategy relaying solely on chemical protection has got many limitations and

undesirable side effects (Husain, 1984, 1993) and this in the long run leads to many insecticides related complications (Frisbie, 1984) such as direct toxicity to beneficial insects, fishes, man and other non-target organism (Munakata, 1997; Pimentel, 1981; Goodland *et al.*, 1985), human health hazards (Bhaduri *et al.*, 1989), resurgence of pests (Luckmann and Metcalf, 1975, Husain 1993) out break of secondary pests (Hagen and Franz, 1973) and environmental pollution (Kavadia *et al.*, 1984; Fishwick, 1988).

To overcome these problems botanical insecticides, soap water and water are now used in many developed and developing countries for combating this pest infestation with the aim of increasing crop yield.

Botanical pesticides are the most cost effective and environmentally safe inputs in integrated pest management (IPM) strategies. There are about 3000 plants and trees with insecticidal and repellant properties in the world, and India is home to about 70 per cent of this floral wealth (P. Narayanasamy, 2002) Narayansamy has chronicled the use of more than 450 botanical derivatives used in traditional agricultural systems & Neem is one of the well-documented trees, and almost all the parts of the tree have been found to have insecticidal value. The neem seed kernel extracts, neem oil, extracts from the leaves and barks have all been used since ancient times to keep scores of insect pests away. A number of commercial neem-based insecticides are now available and they have displaced several toxic chemical insecticides. The extracts are of particular value in controlling the

sucking and chewing pests. The young caterpillars devouring the tender leaves can be well managed by the botanical insecticides. The plant material should be thoroughly washed before preparing the extract, and the right quantity should be used.

With the continued robust growth of the global bio-pesticide market, azadirachtin is uniquely positioned to become a key insecticide to expand in this market segment. In the USA the actual or impending cancellation of some organophosphate and carbamate insecticides that have either lost patent protection or are not being re-registered in many markets because of the Food Quality Protection Act of 1996, has opened new opportunities for bio-pesticides and reduced risks of pesticides in general. The broad-spectrum activity of azadirachtin at low use rates (12·5 to 40 g AI ha^{-1}) coupled with the insect growth regulator activity (in all larval/nymphal instars including the pupal stage) and unique mode of action (ecdysone disruptor), make azadirachtin an ideal candidate for insecticide resistance, integrated pest control and organic pest control programmes.

The pest control potential demonstrated by various extracts and compounds isolated from the kernels and leaves of the neem plant [*Azadirachta indica, A. Jussieu* (Meliaceae)] seem to be of tremendous importance for agriculture in developing countries. Laboratory and field trial data have revealed that neem extracts are toxic to over 400 species of insect pests some of which have

developed resistance to conventional pesticides, e.g. sweet potato whitefly (*Bemisia tabaci* Genn. Homoptera: Aleyrodidae), the diamond back moth (*Plutella xylostella* L. Lepidoptera: Plutellidae) and cattle ticks (*Amblyomma cajennense* F. Acarina: Ixodidae and *Boophilus microplus* Canestrini. Acarina: Ixodidae). The compounds isolated from the neem plant manifest their effects on the test organisms in many ways, e.g. as antifeedants, growth regulators, repellents, toxicants and chemosterilants. This review strives to assess critically the pest control potential of neem extracts and compounds for their use in the tropics. This assessment is based on the information available on the wide range of pests against which neem extracts and compounds have proven to be toxic, toxicity to non-target organisms, e.g. parasitoids, pollinators, mammals and fish, formulations, stability and phytotoxicity (Lawrence *et al.*, 1996)

Azadirachtin has been exempted from residue tolerance requirements by the US Environmental Protection Agency for food crop applications. Azadirachtin exhibits good efficacy against key pests. Azadirachtin has minimal to no impact on non-target organisms, is compatible with other biological control agents and has a good fit into classical Integrated Pest Management programmes (John A. Immaraju, 1997).

Products derived from leaves and kernels of neem (*Azadirachta indica, A. Jussieu*) are becoming popular in plant protection programmes for cotton, mainly because synthetic pesticides have several undesirable effects. Neem products act both as

systemic and as contact poisons and their effects are antifeedant, toxicological, repellent, sterility inducing or insect growth inhibiting. Furthermore, neem products appear to be environmentally safe and IPM compatible and have the potential to be adopted on a broad scale, together with other measures, to provide a low cost management strategy (Hillocks, 1995, Gahukar, 2000). Indigenous plant materials are cheaper and hazard free in comparison to chemical insecticide (saxena *et al.*, 1992). These are also easily available in everywhere in our country. Obeng-ofori and sackey (2003) reported that actellic, aqueous neem seed extract reduced the *Amrasca biguttula* on Okra.

The biological control agents *Bacillus thuringiensis* (Bt; Delfin 85 WG) at 0.04% and *Trichogramma chilonis* at 60000/ha and insecticides azadirachtin (Econeem) at 0.0006%, lufenuron (Match 5 EC) at 0.005%, avermectin (Vertimec [abamectin]) at 0.0004%, monocrotophos 36 SL (Monocil) at 0.05%, Spark 36 EC (deltamethrin 1+triazophos 35) at 0.05%, bulldock star 262.5 EC (beta-cyfluthrin 12.5+chlorpyrifos 250) at 0.05% and Nurelle-D-505, 55 EC (cypermethrin 5+chlorpyrifos 50) at 0.05% were tested in a field trial in Rahuri, Maharashtra, India, during the kharif season of 2000 against pest complex of brinjal. Azadirachtin were moderately effective against the sucking pests including *Bemisia tabaci*, *Aphis gossypii*, *Amrasca biguttula biguttula* (Mote and Shivu-Bhavikatti, 2003).

The joint action potential of methanolic extract of neem seed kernel (*Azadirachta Indica*) in commbination with methanolic extracts of two other botanical, viz., sweet flag (*Acorus Calamus*) and *Pongamia glabra* (*P. pinnata*) against *Ammrasca devastans* at 1:1:1, 2:1:1 and 3:1:1 (v/v) ratio. This combination at 0.42% concentration gave superior control of *A. devastans* (Rao and Rajendran, 2002).

An experiment was conducted with okra in India to determine the efficacy of neem based pesticide against the cotton jassid, *A. biguttulla*. The treatments comprised endosulfan at 0.07%, a chook at 3% neemarin at 0.7%, neem seed kernel extract (NSKE) at 1%, NSKE at 3% with a untreated control. Endosulfan a followed by a chook and NSKE (3%) were most effective in controlling the okra jassid. A chook treated plots gave the highest yield of 50.06 q/ha and significantly superior to other treatments. However on the basis of cost benefit ratio NSKE (3%) ranked first (Singh and kumar, 2003).

Schneider and madel (1992) reported that the treatments of neem seed kernel extract (NSKE) did not show a significant reduction in parasitization rate or fecundity of larval parasitoid, *Diadegma semiclausum*. The aqueous NSKE had no adverse effects on *D. semiclausum* following direct contact. Patel & Patel (1998) reported that application of Quinalphes and Triazophos resulted in a resurgence of *A. biguttula* on okra and a abergine (Brinjal), while endosulfan at 0.07% and Repelin (based on *Azadirachta indica*) 1% were highly effective. Nandagopal and

V.C. Soni (1992) determined in India that neem oil was least persistant insecticides and caused >50% mortality of jassid only up to 24 hours after application.

Different concentrations of soap solution were applied against jassid of cotton. Soap powder (25 gm per liter of water) predominantly reduced the pest population during the spray period and harvested the best yield than other treatments. Economic return is reasonably satisfied (Hossain, *et al.*, 2003).

Chemical:

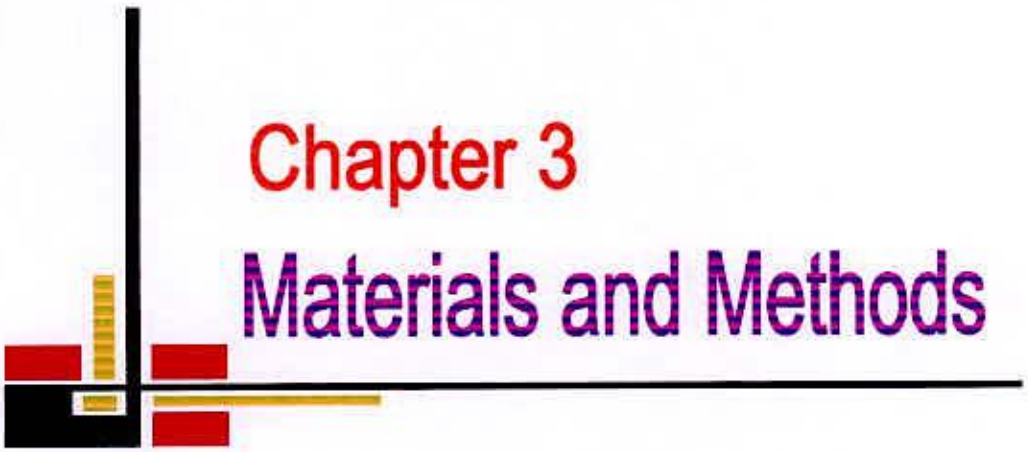
Ali and Karim (1993) reported monocrotophos, methamidophos and bifenthrin gave 91-97.53% mortality on the 2nd days post-treatment, and 73.27-79.17% mortality 30 days post- treatment of *Amrasca devastans* on cotton, Equivalent figures for dimethoate formulations were 56.50-72.37%, carbofuran had no effect on the 2nd day post treatment and gave only 8.72% mortality. All the insecticides tested were toxic to parasitoids and predators of *A. devastans* up to 30 days post-treatment.

A flexible 3-tier spraying threshold level (0.75 cicadellids/leaf during pre-flowering,1.0 cicadellid/leaf post flowering and 1.5 cicadellids/leaf during ball-maturity stages) was suggests for *A. devastans* on cotton in Bangladesh (Ali & Karim, 1994).

Yadav *et. al.* (1988) tested ten commercial formulations of commonly used insecticides against *A. devastans* on okra at Haryana, India. Endosulfan at 0.05%,

carbaryl at 0.15% and oxydemeton-methyl at 0.025% were observed as most effective compounds for controlling jassid. Maximum mortality of the pest was observed 1 day after treatment. In the seed crop, any of the three compounds can be used safely but in vegetable okra, use of oxydemeton-methyl should be discontinued after the initiation of square formation; after fruit formation, endosulfan, carbaryl or 0.05% malathion can be used.

Parkash and Verma (1985) determined the effectiveness of granular formulations of dimethoate, disulfoton, phorate, aldicards and carbofuran applied by various methods against the cicadellid, *A. devastans* and the aleyrodid, *Bemisia tabaci* on brinjal. The methods involved were application to the nursery bed at 2.5 kg a.i./ha seven days before transplanting, soil applications around the seedlings at 1.0kg/ha at the time of transplanting, and all possible combinations of the three. These were compared with foliar sprays containing 0.2% DDT, 0.03% dimethoate, 0.025% endrin (each applied at 20-day intervals). All the insecticidal treatments were equally effective in relation to untreated plots, and all the granular insecticides were equally effective against both pest. Among the various methods used to apply the latter, the least effective were application to the nursery bed, as a seedling root dip or with a combination of these 2; when applied by the other methods, the granular insecticides were as effective as the foliar sprays.



Chapter 3

Materials and Methods

CHAPTER 3

MATERIALS AND METHODS

The present study "Host preference and integrated management of Jassid, *Amrasca devastans* (Distant), Homoptera: Cicadellidae" was carried out at the experimental field of the Entomology Division, Bangladesh Agricultural Research Institute (BARI) Gazipur, Bangladesh during September 2004 to July 2005. The materials and methods adopted in the study are discussed in the following sub-heading:

3.1 Location

The study area is situated at 24.09° North latitude and 90.26° East Longitudes with an elevation of 8.4 meter from the sea level.

3.2 Climates

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.

3.3 Soil

The area belongs to the Madhupur tract (AEZ-28), clay loam in texture having low organic matter (1.12%) moderately slow permeability and deficient in nitrogen, potassium and sulphur in comparison with the standard nutrient status. The soil is acidic in nature having pH between 5.9 to 6.1.

3.4 Land preparation, fertilization and manuring

A tractor drawn disc plough followed by harrowing opened the land. For ensuring good tilth, power tiller was used. Tractor drawn labeler was use to level the land. According to prescribed rate different doses of manures and fertilizers for different plants were used. Half of the cow dung and entire amount of TSP were applied during final land preparation. The remaining cow dung and one third of MP were applied during pit preparation, one week before planting. The entire amount of urea and the rest two third of MP were applied as top dressing in three equal splits at 10, 25, 40 days after transplanting.

3.5 Host preference study

3.5.1 Host selection & seedling raising

Host preference as well as population distribution pattern of jassid was studied on different host plants. They were brinjal, tomato, country bean, okra, sweet gourd and cotton. The seeds of those vegetables were collected from the vegetables section of Horticulture Research Center; BARI, Gazipur and cotton seed collected from Cotton Development Board, Dinajpur. Five vegetables and cotton were

treated as the six different treatments. Seeds of brinjal and tomato were sown in 1x1 sq-m seedbed. On other hand seed of country bean, sweet gourd was sown in perforated polythene bags (6cm x 10cm). About one month old seedlings were transplanted in the main experimental plots. Cotton and okra seeds were direct sown in the main experimental plots.

Brinjal

Brinjal seeds were sown in second week of October. The seedlings were transplanted in the main plots after 35 days of seed sowing (24 November). The Size of the main experimental plot was 5 x 5sq- m. The spacing was 70 x 50 cm.

Tomato

Tomato seed were sown third week of October 2004. The seedlings were transplanted in the main plots after 30 days of seed sowing (24 November). The Size of the main experimental plot was 5 x 5sq- m. The spacing was 60 x 50 cm.

Country bean and sweet gourd

Seeds were sown in polythene bags second week of October 2004. Two seeds per bag were sown. The seedlings were transplanted in the main plots after 35 days of seed sowing on 24 November. The Size of the main experimental plot was 5 x 5 sq- m. The spacing was 70 x 50 cm. There were 3 plots of country bean and sweet gourd for each.

Okra

Seeds of okra were sown in the main field on last week of February 2005. The Size of the main experimental plot was 5 x 5sq- m. The spacing was 60 x 45 cm.

Cotton

Seeds of cotton were sown in the main field on last week of February 2005. The size of the main experimental plot was 5 x 5sq- m. The spacing was 60 x 45 cm.

3.5.2 Cultural operations

Weeding and mulching were done followed by top dressing and irrigation at and interval of 15 days. For country bean the plants were given support with the climber prepared by bamboo sticks. Propping of each tomato plant using bamboo sticks (1m height) was done for providing extra support to avoid lodging of the plants.

3.5.3 Experimental design and data collection

The experiment was laid out in a randomized complete block design with three replications. Number of jassids from upper five leaves of randomly selected five plants per treatment replication were counted and recorded at seven days interval. The number of both nymph and adult jassids were counted carefully from all the six host plants after one month of transplanting and continued till their senescence.

3.6 Management of Jassid

3.6.1 Varietal preference study on brinjal

Preference of jassid on five different lines/varieties was tested during November 2004 to May 2005 at Entomology Division experimental farm, BARI, Gazipur. The details of the study are as follows:

3.6.2 Seedling raising & cultural practices

Brinjal seeds of BL009, ISD006, BL114, Singnath and Jessore local were collected from Horticulture Division, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. A small seedbed measuring 5m x 1m was prepared and seeds were sown there following standard seedling raising practices. The plots were lightly irrigated regularly for ensuring proper growth 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 on 24 November 2004. 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. Weeding and mulching were given whenever necessary. The MP and urea were top dressed in 3 splits as described earlier.

3.6.3 Experimental design and data collection

The experiment was laid out in a randomized complete block design with three replications. Number of jassids from upper five leaves of randomly selected five plants per treatment replication were counted and recorded at seven days interval. The number of both nymph and adult jassids were counted carefully from all the six host plants after one month of transplanting and continued till their senescence. Yield (t/ha) of healthy fruits were also recorded from all the treatment replicates.

3.7 Management with bio-rationales /chemical

Integrated management of jassid with different bio-rational and chemical pesticides was carried out at the experimental field of the Entomology Division, Bangladesh Agricultural Research Institute (BARI) Gazipur, Bangladesh during November 2004 to June 2005.

3.7.1 Seedling raising & cultural practices

Brinjal seeds of Jessore local were collected from Horticulture Division, BARI, Joydebpur, Gazipur. Seedlings were raised in the seedbed following the method described above in the chapter 3.6.2. Thirty-six days-old (3/4 leaf stage) healthy seedlings were transplanted in the 3m x 5m experimental field on 24 November 2004. Weeding and mulching were given whenever necessary.

3.7.2 Experimental design and data collection

There were five treatments. They were as follows:

T1 = Neem seed kernel extract @ 500 gm crushed kernel dissolved in 10 liters of water for 24 hours. The filtered water with dissolved Azadirachtin was sprayed. Spraying was started 80 days after transplanting.

T2 = Neem oil @ 5 ml/liter of water mixed with 1 ml trix was sprayed. Spraying of neem oil was done with high volume knapsack sprayer from 80 days after transplanting.

T3 = Spraying of detergent powder @ 5 gm/liter of water was done with high volume knapsack sprayer from 80 days after transplanting.

T4 = Spraying of Imidacloropid (Admire 200 SL @ 0.5 ml/liter of water) was also done with high volume knapsack sprayer from 80 days after transplanting.

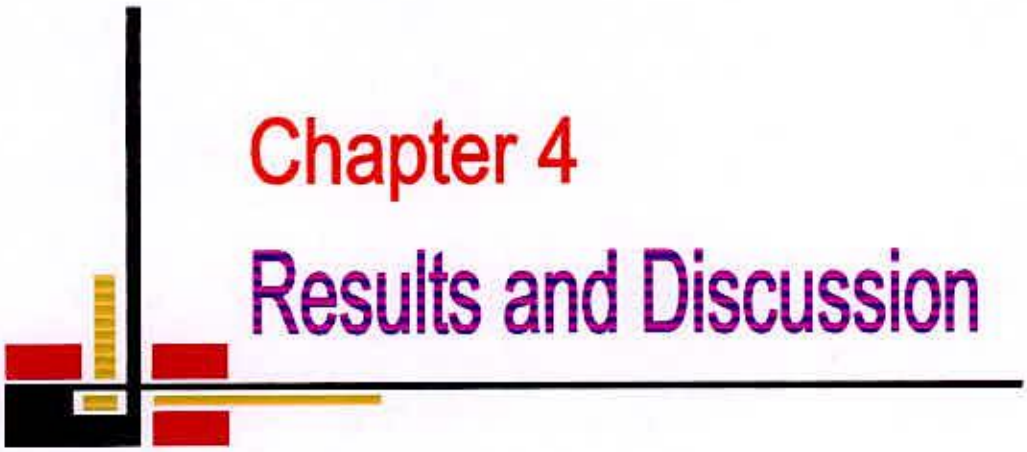
T5 = Untreated control. No pesticide or bio-rationales were applied in this treatment.

Total six sprays were done, first three were done at 7 days interval and 4th and 5th sprays were applied at 15 days interval. The 6th and last spray was done after 30 days of the 5th spray.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Numbers of jassids were counted and recorded from upper five leaves of randomly selected five plants of each treatment replicates. Data were recorded on the spray day (one hour before each treatment application). Yield (t/ha) of healthy fruits were also recorded from all the treatment replicates. Treatment wise benefit cost ratio was also calculated.

3.7.3 Statistical analysis

All the data were analyzed statistically followed by MSTAT programming and the mean value were judged by LSD (P>0.05). Standard error of each parameter was also calculated.



Chapter 4

Results and Discussion

CHAPTER 4

RESULTS AND DISCUSSION

Results of different studies on host preference and integrated management of Jassid, *Amrasca devastans* have been presented and discussed under the following sub-heading:

4.1 Host preference study

Host preferences of jassid on six hosts viz. tomato, sweet gourd, country bean, brinjal, okra and cotton were evaluated in this study. The result of this experiment was presented in the table 1 and Figure 1. It is revealed from the Table 1, that the mean numbers of jassid/leaf on different hosts were ranged from 0.14 to 13.49. The lowest jassid number per leaf was observed on sweet gourd (0.14) followed by tomato (0.44), country bean (0.46) and cotton (3.94). The highest number of jassid/leaf was observed in okra. (13.49).

The population fluctuation pattern of jassid varied on different hosts (Figure 1). On tomato, sweet gourd and country bean the variation of jassid number /leaf was not distinct. As the numbers of jassid/leaf on those three hosts were very low so their temporal fluctuation was also negligible in comparison with the other three hosts, brinjal, cotton and okra.

Table 1. Average number of jassid /leaf on different host plants at Entomology Division experimental field, BARI, Gazipur during Janaury-July 2005

Host Plants	**Mean number of jassid/leaf**
Tomato	0.44 ± 0.46
Sweet gourd	0.14 ± 0.08
Country bean	0.46 ± 0.28
Brinjal	4.26 ± 2.18
Okra	13.49 ± 7.94
Cotton	3.94 ± 0.88

±Standard Error

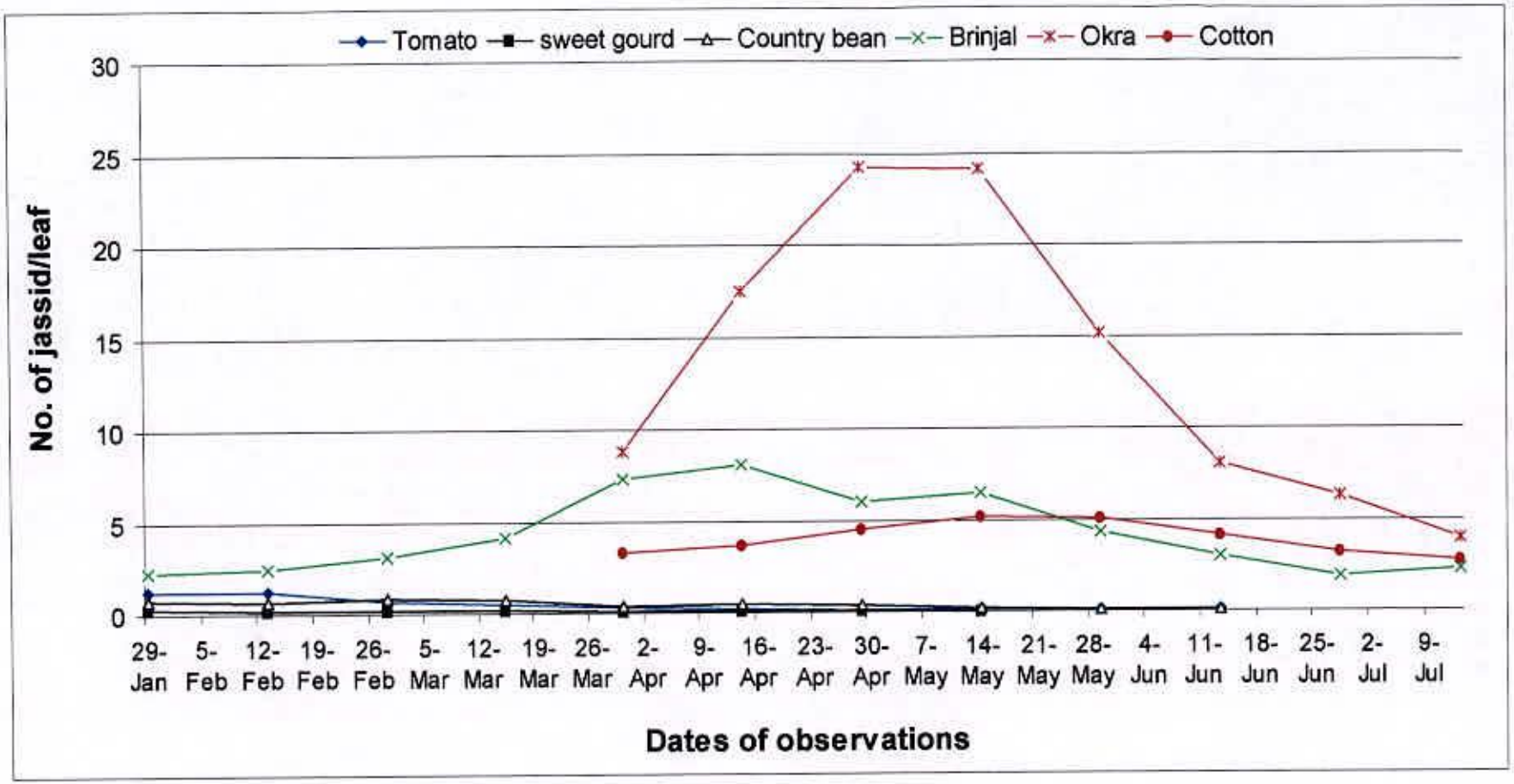


Figure 1. Number of jassid /leaf on different host plants at Entomology Division experimental field, BARI, Gazipur during Janaury-July 2005

In all the observations number of jassid/leaf was highest on okra than the other hosts (Figure 1). Jassid population was higher on brinjal than cotton till mid-May (179 days after brinjal transplanting and 75 days after cotton seed sowing). After that till 1st week of July the number of jassid on cotton showed higher trend in comparison with that of brinjal. Although during that period the natural senescence of the brinjal plants were happened while the cotton plants were in mid-age. Atwal (1986) also described okra, brinjal, cotton and potato as the favorable hosts for the development and reproduction of jassid along with some wild hosts like hollyhock, Kangi buti (*Abutilon indicum*) etc. On the other hand in India, incidence of *A. divastans* was observed on brinjal on an average of 3.0 per leaf (Prasad, 2002).

It is revealed from the figure 3 that the number of jassid was highest during April-May period, which was declined from mid June. Inee *et al.* (2000) reported that 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 jassid population. Ali and Karim (1991) observed that plants grown in the summer season was more vulnerable to jassid attack than cotton grown in the winter season. Among the host plants tested in the study, tomato, sweet gourd and country bean are generally grown during winter season in our country while brinjal can be grown in both the seasons and cotton and okra are summer season crop. As the jassid is a sucking pest so it must have some affinity to the plant saps and the quality of the sap may be one of the criteria of host

preference. In spite of that seasonal variation which affects the weather parameters may also be one of the reasons of host preference.

4.2 Management of Jassid

4.2.1 Varietal preference study in brinjal

Brinjal is one of the preferred hosts of jassid. It has been reported that jassid population on brinjal can increase several folds within short period in presence of favourable weather like high temperature coupled with dry weather (no rainfall) (Alam *et. al.*, 2005). Especially during February to April jassid population increase rapidly as the aforesaid favorable weather prevails during that period. So, a study was undertaken to screen five brinjal lines, viz. ISD006, BL114, BL009, Singnath and Jessore local against natural jassid population at Gazipur. The results of varietal preference study in brinjal has accomplished in the Table 2 and Figure 3

Significantly lowest infestation of jassid was recorded in the brinjal lines ISD006 and BL114 (mean number of jassid/leaf was 1.72 on ISD006 and 2.45 on BL114). Jassid population was significantly highest on Singnath (mean number of jassid/leaf was 6.19) and Jessore local (mean number of jassid/leaf was 4.52), while on the line BL009 it was at intermediate position (Table 2).

Weekly infestation status of jassid on different brinjal lines was plotted in the figure 3. It is revealed from the figure 3 that in all observations the jassid

populations were significantly highest in Singnath and Jessore local except the last observation. On the other hand reverse scenario was observed in case of ISD006 and BL114. Infestation of jassid in all the seven observations in those two lines was significantly lower than the other entries/lines. In all the lines jassid population declines at the later stages due to the influence of weather. High rainfalls occurred during that period.

The infestation status of jassid affects the total yield of brinjal. It is revealed from the Table 2 that highest yields were obtained from the lines ISD006 & BL114 and those were significantly higher than the other three tested lines. A total of 14.63 t/ha brinjal was harvested from ISD006 followed by BL114 (12.83 t/ha), BL009 (10.73 t/ha). Lowest yield was obtained in Singnath (7.77 t/ha) and Jessore local (8.57 t/ha). A negative correlation (r = - 0.96423) was observed between the severity of infestation of jassid and the yield of brinjal (Figure 2) which indicates that the yield of brinjal declined with the increase of jassid infestation.

Table 2. Average number of jassid/leaf on different lines/entries of brinjal and their corresponding yields (t/ha) recorded at Entomology Division experimental field, BARI, Gazipur during Feb.-Apr. 2005

Brinjal varieties/lines	**Number of Jassid/leaf (Mean of 07 observations)**	**Yield (t/ha) (Mean of 6 harvest)**
BL114	2.45±0.43 d	12.83±0.74 ab
ISD006	1.72±0.39 d	14.63±0.46 a
BL009	3.50±0.57 c	10.73±0.87 bc
Singnath	6.19±0.74 a	7.77±0.33 c
Jessore local	4.52±0.69 b	8.57±0.52 c
LSD (0.05)	0.9906	3.024

±Standard Error; Mean followed by the same letter are not significantly different (P>0.05, LSD test)

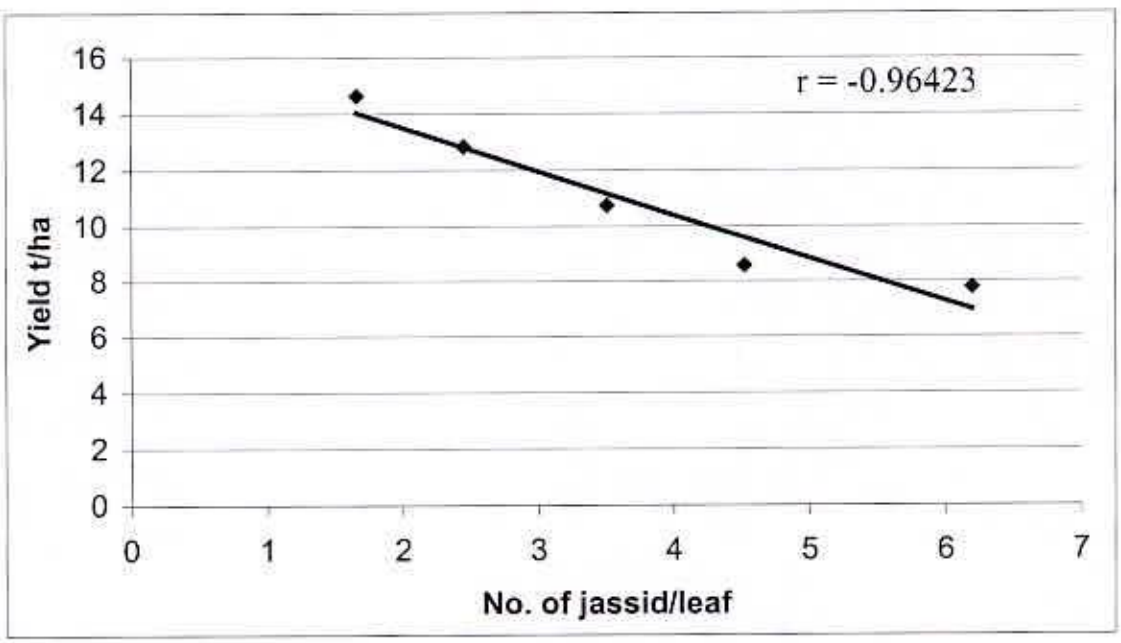


Figure 2. Correlation of the infestation status of jassid/leaf on different brinjal lines with their corresponding yields.

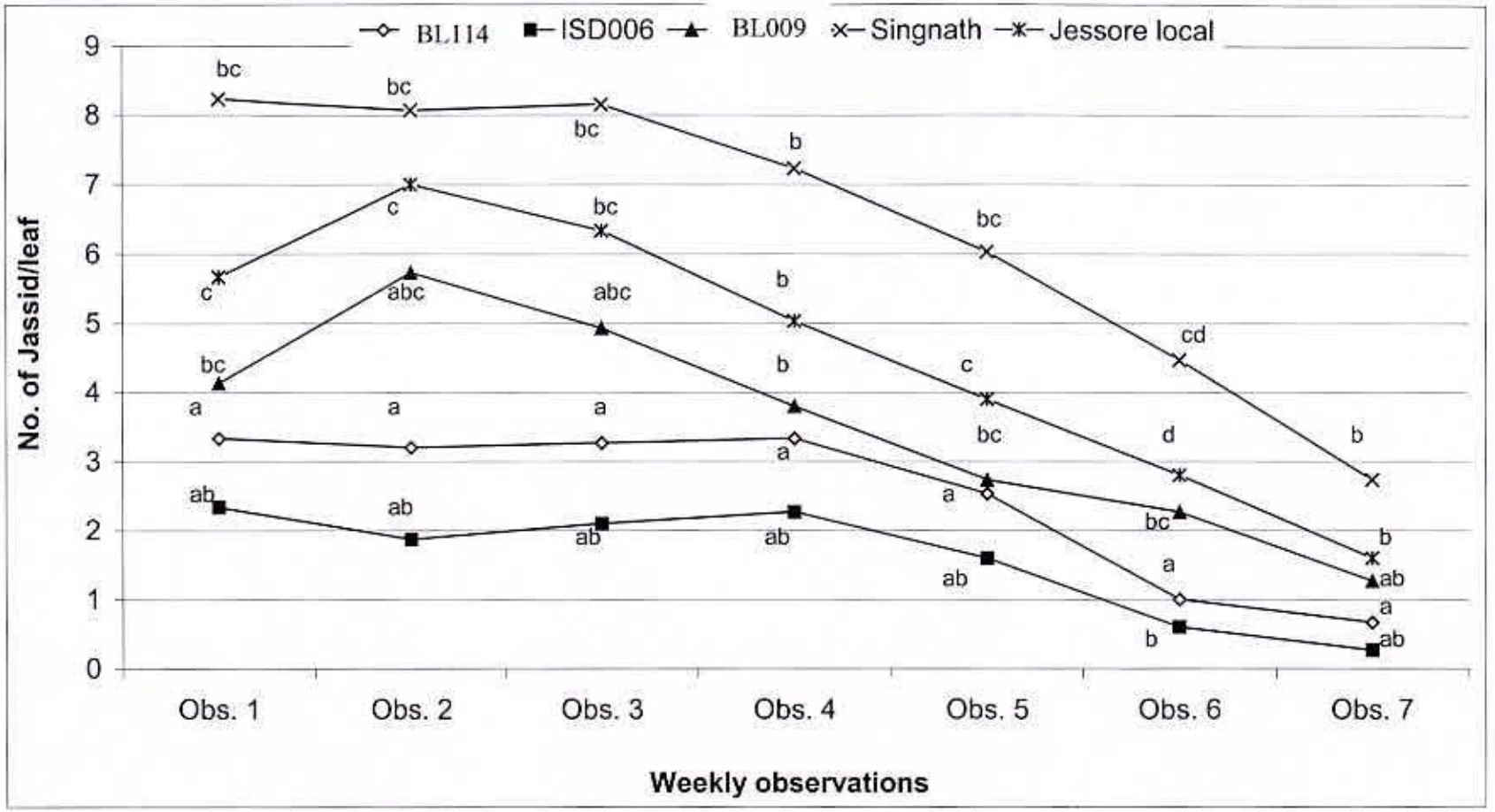


Figure 3. Number of jassid/leaf on different lines/entries of brinjal at Entomology Division experimental field, BARI, Gazipur during February-April 2005. Observations followed by the same letter are not significantly different (P>0.05, LSD test)

Plate 3. ISD006 experimental plot at Entomology Division experimental field, BARI, Gazipur

Plate 4. BL009 experimental plot at Entomology Division experimental field, BARI, Gazipur

4.2.2 Management with bio-rationales /chemicals

Efficacy of different neem based bio-rationales (neem seed karnel extract and neem oil), detergent and insecticide, Imidacloropid (Admire 200 SL) for the control of jassid on brinjal were shown in the Table 3. Six spraying were done with the bio-rationales and insecticide. In all the observations the numbers of jassid/leaf/plant were constantly lowest in the treatments; neem oil and neem seed karnel extract spraying. However the frequency of jassid infestation in comparison with that of the untreated control was varied at different dates of observations. During first spray numbers of jassid /leaf /plant in neem seed karnel extract (2.87) and neem oil (2.40) sprayed plots were significantly lower than the other treatments and that was followed by admire (6.07) and detergent treated plots (9.13). The highest infestation was recorded in the untreated control plots (number of jassid/leaf/plant was 13.47). Almost same trends of results were recorded after the second spray. However scenario was changed after the third spray, where the numbers of jassid/leaf/plant in all the treatments were ranged from 0.87 (neem oil) to 5.67 (untreated control). The remarkable feature was that no significant difference was observed among the treatments except that of untreated control. This trend continues till sixth spray. However, except the sixth spray the number of jassid /leaf /plant was lowest in the neem oil sprayed plots.

It is observed from the Table 4 that percent reduction of the number of jassid/leaf/plant over untreated control was lowest in the neem oil treated plots (82.18, 81.54, 84.66, 64.71, 71.15 & 75.12 after 1st, 2nd, 3rd, 4th, 5th and 6th spray,

respectively). That was followed by neem seed karnel spray (78.69, 79.46, 64.20, 55.00, 28.85 & 77.93 after 1st, 2nd, 3rd, 4th, 5th and 6th spray, respectively), admire spray (54.94, 54.38, 57.67, 41.18, 44.66 & 65.73 after 1st, 2nd, 3rd, 4th, 5th and 6th spray, respectively) and detergent spray (32.22, 27.23, 42.33, 23.53, 28.85 & 65.73 after 1st, 2nd, 3rd, 4th, 5th and 6th spray, respectively).

Highest yield was obtained in the neem seed karnel extract treated plots (11.33 t/ha) followed by neem oil sprayed plots (10.93) (Table 5). Although the BCR of neem oil spray treatment (2.50) was higher than neem seed karnel spray treatment (1.81) as the pest management cost of neem seed kernel (23,333.33) was higher than that of neem oil spray treatment (17,333.33). The yield of admire treated plots were 9.67 t/ha and that of detergent treated plots were 7.66 t/ha. But as the cost of admire is very high (15 ml Tk.120/00) so the BCR of this treatment became negative (-0.24), which means that spraying of insecticide, Imidacloropid (Admire 200 SL) is not at all profitable for the control of jassid in brinjal. Although the detergent sprayed plots yielded less but the BCR of that treatment is higher (1.3) than the insecticide treatment. Lowest yield was observed in the untreated control plots (5.87 t/ha).

Table 3. Effect of different management treatments on the number of jassid in brinjal at Entomology Division experimental field, BARI farm during March to May, 2005.

Treatments	Mean no. of jassid/leaf/plant					
	7 DAT			15 DAT		30 DAT
	1st spray 19-3-06	2nd spray 26-3-06	3rd spray 2-4-06	4th spray 16-4-06	5th spray 2-5-06	6th spray 31-5-06
Neem karnel extract	2.87 d	2.67 c	2.03 ab	1.53 ab	1.80 b	0.47 b
Neem oil	2.40 d	2.40 c	0.87 b	1.20 b	0.73 c	0.53 b
Detergent	9.13 b	9.46 ab	3.27 ab	2.60 ab	1.80 b	0.73 b
Admire 200 SL	6.07 c	5.93 bc	2.40 ab	2.00 ab	1.40 b	0.73 b
Control	13.47 a	13.00 a	5.67 a	3.40 a	2.53 a	2.13 a

Mean followed by the same letter are not significantly different (P>0.05, LSD test)

Table 4. Percent reduction of the number of jassid/leaf/plant over control due to the effect of different treatments in brinjal at Entomology Division experimental field, BARI farm during March to May, 2005.

Treatments	**Percent reduction of the no.of jassid/leaf/plant over control**					
	7 DAT			**15 DAT**		**30 DAT**
	1st spray	2nd spray	3rd spray	4th spray	5th spray	6th spray
Neem seed karnel extract	78.69	79.46	64.20	55.00	28.85	77.93
Neem oil	82.18	81.54	84.66	64.71	71.15	75.12
Detergent	32.22	27.23	42.33	23.53	28.85	65.73
Admire 200 SL	54.94	54.38	57.67	41.18	44.66	65.73
Control	0.00	0.00	0.00	0.00	0.00	0.00

Table 5. Economic analysis of different management tactic against jassid on brinjal at Entomology Division Experimental field, BARI farm during March to May, 2005.

Treatments	Pest management cost (Tk/ha)	Marketable yield (t/ha)	Gross return (Tk/ha)	Net return (Tk/ha)	Adjusted net return (Tk/ha)	BCR
Neem karnel	23,333.33	11.33	1,35,960.00	1,12,626.67	42,186.67	1.81
Neem oil	17,333.33	10.93	1,31,160.00	1,13,826.67	43,386.67	2.50
Detergent	9,333.33	7.66	91,920.00	82,586.67	12,146.67	1.30
Admire 200 SL	60,000.00	9.67	1,16,040.00	56,040.00	14,400.00	-0.24
Control	0.0	5.87	70,440.00	70,440.00	0.0	0.0

4.2.3 Details of the economic analysis:

Neem seed karnel treatment

Karnel requirement : 0.5 kg/spray, total spray 6, karnel needed = 3 kg.

Cost of karnel : 3 kg @ 25/- = Tk.75/-

Cost of labour : 6 spray @ 5/- = Tk.30/-

Total cost for 45 m^2 : (karnel + labour) = Tk.(75/- + 30/-) = Tk.105/-

Total cost/ha. : Tk.23,333.33

Neem oil treatment

Neem oil requirement : 50 ml/spray, total spray 6, total oil needed = 300 ml.

Cost of neem oil : 300 ml @ 0.12 = Tk.36/-

Cost of trix : Tk.12/-

Cost of labour : 6 spray @ 5/- = Tk.30/-

Total cost for 45 m^2 : (neem oil + trix + labour) = Tk.78/-

Total cost/ha : Tk.17,333.33

Detergent treatment

Detergent requirement : 50 g/spray, total spray 6, detergent needed = 300g.

Cost of detergent : 300 g @ 0.04 = Tk.12/-

Cost of labour : 6 spray @ 5/- = Tk.30/-

Total cost for 45 m^2 : (detergent + labour) = Tk.42/-

Total cost/ha. : Tk.9,333.33

Insecticide treatment

Insecticide requirement : 5 ml/spray, total spray 6, total need = 30 ml.

Cost of insecticide : 30 ml @ 8/- = Tk.240/-

Cost of labour : 6 spray @ 5/- = Tk.30/-

Total cost for 45 m^2 : (insecticide + labour) = Tk.270/-

Total cost/ha. : Tk.60,000.00

Market Price of brinjal : Tk.12,000.00/t.

Plate 5. Neem seed karnel treated plots at Entomology Division Experimental field, BARI, Gazipur

Plate 6. Insecticide treated plots at Entomology Division Experimental field, BARI, Gazipur

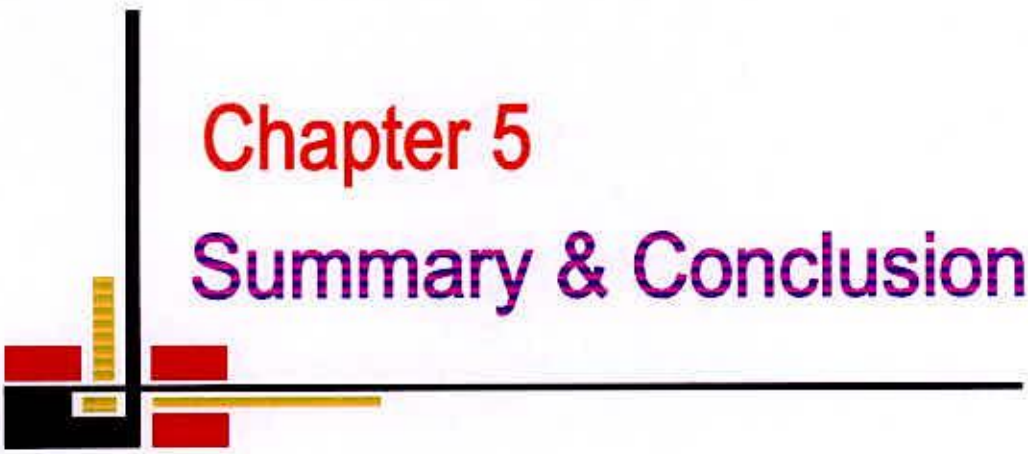
Plate 7. Neem oil treated plots at Entomology Division Experimental field, BARI, Gazipur

From this management studies it is observed that the neem based products are very much efficient for the control of sucking pests like jassid. Neem products (containing azadirachtin) act both as systemic and as contact poisons and their effects are antifeedant, toxicological, repellent, sterility inducing or insect growth inhibiting. Furthermore, neem products appear to be environmentally safe and IPM compatible and have the potential to be adopted on a broad scale, together with other measures, to provide a low cost management strategy (Hillocks, 1995, Gahukar, 2000). The broad-spectrum activity of azadirachtin at low use rates (12·5 to 40 g AI ha^{-1}) coupled with the insect growth regulator activity (in all larval/nymphal instars including the pupal stage) and unique mode of action (ecdysone disruptor), make azadirachtin an ideal candidate for insecticide resistance, integrated pest control and organic pest control programmes. Laboratory and field trial data have revealed that neem extracts are toxic to over 400 species of insect pests some of which have developed resistance to conventional pesticides, e.g. sweet potato whitefly (*Bemisia tabaci* Genn. Homoptera: Aleyrodidae), the diamond back moth (*Plutella xylostella* L. Lepidoptera: Plutellidae) and cattle ticks (*Amblyomma cajennense* F. Acarina: Ixodidae and *Boophilus microplus* Canestrini. Acarina: Ixodidae). Obeng-ofori and sackey (2003) reported that actellic, aqueous neem seed extract reduced the *Amrasca biguttula* on Okra.

Moreover azadirachtin has minimal to no impact on non-target organisms, is compatible with other biological control agents and has a good fit into classical

Integrated Pest Management programmes (John A. Immaraju, 1997). Schneider and madel (1992) reported that the treatments of neem seed kernel extract (NSKE) did not show a significant reduction in parasitization rate or fecundity of larval parasitoid, *Diadegma semiclausum*. The aqueous NSKE had no adverse effects on *D. semiclausum* following direct contact. Patel & Patel (1998) reported that application of Quinalphes and Triazophos resulted in a resurgence of *A. biguttula* on okra and abergine (Brinjal), while endosulfan at 0.07% and Repelin (based on *Azadirachta indica*) 1% were highly effective. Nandagopal and V.C. Soni (1992) determined in India that neem oil was least persistent insecticides and caused >50% mortality of jassid only up to 24 hours after application.

Considering those characteristics azadirachtin has been exempted from residue tolerance requirements by the US Environmental Protection Agency for food crop applications.



Chapter 5

Summary & Conclusion

CHAPTER 5

SUMMARY AND CONCLUSION

Several studies were undertaken to determine the host preference as well as to develop integrated management of jassid, *Amarasca devastans* at the experimental field of the Entomology Division, Bangladesh Agricultural Research Institute (BARI) Gazipur, Bangladesh during September 2004 to July 2005.

In the host preference study, natural preference of jassid on six hosts viz. tomato, sweet gourd, country bean, brinjal, okra and cotton were evaluated. The mean numbers of jassid/leaf on different hosts were ranged from 0.14 to 13.49. The lowest jassid number per leaf was observed on sweet gourd followed by tomato, country bean and cotton. The highest number of jassid/leaf was observed in okra. Population fluctuation of jassid on three hosts; tomato, sweet gourd and country bean were negligible in comparison with the other three hosts, brinjal, cotton and okra. In okra population of jassid was always high followed by brinjal and cotton.

Varietal preference of jassid was tested against five brinjal lines, viz. ISD006, BL114, BL009, Singnath and Jessore local. Among the entries significantly lowest infestation of jassid was recorded in the brinjal lines ISD006 and BL114. Jassid population was significantly highest on Singnath and Jessore local, while on the line BL009 it was at intermediate position.

Yield of brinjal was also affected by the infestation status of jassid. Highest yields were obtained from the lines ISD006 & BL114 and jassid infestation was significantly lower in those two lines than the other three tested lines. A total of 14.63 t/ha brinjal was harvested from ISD006 followed by BL114 (12.83 t/ha). Lowest yield was obtained in Singnath and Jessore local. A negative correlation (r = - 0.96423) was observed between the severity of infestation of jassid and the yield of brinjal. Which indicates that the yield of brinjal declined with the increase of jassid infestation.

Different management tactics, viz. spraying of two neem based bio-rationales (neem seed karnel extract and neem oil), spraying of detergent and spraying of chemical insecticide, Imidacloropid (Admire 200 SL) were evaluated for the control of jassid on brinjal. In all the observations the numbers of jassid/leaf /plant were constantly lowest in the treatments; neem oil and neem seed karnel extract spraying. However the frequency of jassid infestation in comparison with that of the untreated control was varied at different dates of observations. During first spray numbers of jassid/leaf/plant in neem oil and neem seed kernel extract sprayed plots were significantly lower than the other treatments which were followed by admire and detergent treated plots. The highest infestation was recorded in the untreated control plots. Almost same trends of results were recorded after the second spray. However scenario was changed after the third spray, where the numbers of jassid/leaf/plant in all the treatments were ranged from 0.87 (neem oil) to 5.67 (untreated control). This trend continues till sixth

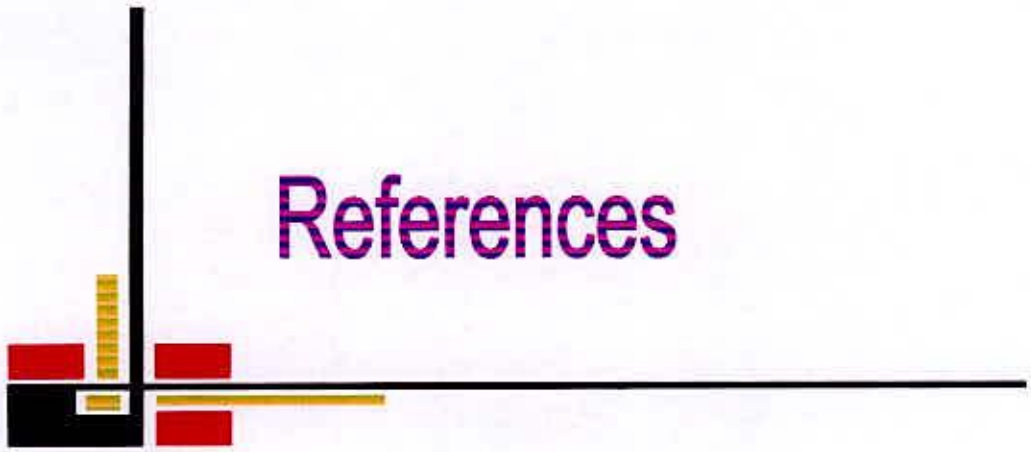
spray. However, except the sixth spray the number of jassid/leaf/plant was lowest in the neem oil sprayed plots.

Percent reduction of the number of jassid/leaf/plant over untreated control was also lowest in the neem oil treated plots followed by neem seed karnel spray, admire spray and detergent spray plots.

Although, highest yield was obtained in the neem seed karnel extract treated plots followed by neem oil sprayed plots but the BCR of neem oil spray treatment was higher than neem seed karnel spray treatment as the pest management cost of neem seed kernel was higher than that of neem oil spray treatment. The yield of admire treated plots were 9.67 t/ha and that of detergent treated plots were 7.66 t/ha. But as the cost of admire is very high so the BCR of this treatment became negative, which means that spraying of insecticide, Imidacloropid (Admire 200 SL) is not at all profitable for the control of jassid in brinjal. Although the detergent sprayed plots yielded less but the BCR of that treatment is higher (1.3) than the insecticide treatment. Lowest yield was observed in the untreated control plots.

From the above results, it may be concluded that okra is the most preferred host of jassid among the tested plants, followed by brinjal and cotton. Jassid infestation was less in two brinjal lines, ISD006 and BL114 producing highest yield among

the tested lines. So, those two lines can be considered as the resistant brinjal lines against jassid, *A. devastans*. Spraying of neem based bio-rationales, neem oil @ 5 ml /liter of water mixed with 1 ml detergent) or neem seed karnel extract (@ 500 gm crushed kernel dissolved in 10 liters of water for 24 hours) can effectively control the jassid population on brinjal.



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