INVESTIGATION ON THE NATURAL ENEMIES OF JUTE WHITE MITE, *Polyphagotarsonemus latus* (Banks) & JUTE RED MITE, *Tetranychus bioculatus* (Wood-Mason)

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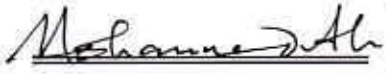

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CERTIFICATE

This is to certify that the thesis entitled, "Investigation on The Natural Enemies of Jute White Mite, *Polyphagotarsonemus latus (*Banks) & Jute Red Mite, *Tetranychus bioculatus* (Wood-Mason)" 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 Khandakar Mohammad Rashed Iftekher, registration no.23999/00411 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.

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DEDICATED TO

MY BELOVED PARENTS , SISTERS & THE

BEST WISHER

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INVESTIGATION ON THE NATURAL ENEMIES OF JUTE WHITE MITE, *Polyphagotarsonemus latus* (Banks) & JUTE RED MITE, *Tetranychus bioculatus* (Wood- Mason)

ABSTRACT

An experiment was conducted at Bangladesh Jute Research Institute, Dhaka from April to August, 2005 to investigate the natural enemies of jute white mite *Polyphagotarsonemus latus* (Bank) & Red mite *Tetranychus bioculatus* (Wood-Mason) to explore their utility as bio-control agents for the management of mite pests of jute in Bangladesh. Data were collected from the selected plots & incidence of natural enemies were detected by plant searching and leaf searching. Infested leaves were observed under stereomicroscope to identify the natural enemies and to observe their predation rate. Eight predators consisting of three bugs, two beetles, two thrips and one mite were primarily identified during the study periods. The predatory bug , *Orius* insidiosus was found most effective for controlling both white and red mite while predatory lady beetle *Stethorus* sp. was found effective against jute red mite. Brief morphological and bio-ecological studies of these predators were made in the present study.

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LIST OF ABBREVIATIONS

>	= Greater than
Abs.	= Abstract
Agric.	= Agricultural
BBS	= Bangladesh Bureau of Statistics
BJRI	= Bangladesh Jute Research Institute
CRS	=Central Research Station
J.	= Journal
mm	= Millimeter
No.	= Number
RH	= Relative Humidity
Temp.	= Temperature
TSM	=Two-spotted Spider Mite
Univ.	= University
Et OH	= Ethyl alcohol
i.e.	= That is
°C	= Degree Celsius

CHAPTER – 1

INTRODUCTION

INTRODUCTION

Jute is one of the most important cash crop of Bangladesh. It is obtained from phloem of two cultivated species of *Chorcorus* ,namely *Chorcorus capsularies* (white jute) and *Chorcorus olitorius* (deshi or tosha jute)

The crops stand up -to the end of August or early September in the field. A total of about 5.25 million hectares of land was under cultivation of jute crop in Bangladesh during 1998-99 and produced about 8.80 million metric tons , yielding 1.67 metric tons per hectares (krishi dairy Bangladesh ,2000). The nation earned taka 13385 million from jute goods and taka 4320 million from raw jute.

In Bangladesh jute suffers from losses both in quantity and quality due to attack of about forty species of different kind of insect and mite pests. White mite (*Polyphagotarsonemus latus* Banks) is one of the most important pests of both the cultivated species of jute (*Chorcorus capsularies & Chorcorus olitO. insidiosus*) and its incidence is so high in the field during summer seasons specially from April to July. White mite infested leaf becomes curled, dry up and pre-maturely drop down causing shortening of internodes and severe infestation causes top shoot death and resulted substantial yield loss.

Field infestation of the pest begins about 10 -14 days after sowing when the plants are about 10-15 cm long. Different measures eg. physical, mechanical, cultural and chemical control are practiced against white mite. So far acaricides considered as the most effective methods for control of white mite. However chemical acaricides have some limitation .It not only control pests but also kills their natural enemies . Besides these, its creates health hazards to human being and kill many beneficial insects. .Moreover repeated use of any pesticides may help to develop resistances to any target pests species, therefore alternate methods for the control of the pests need to be investigated

For many years non-chemical control method for control pests has been a recurrent theme (Vanden Bosch and Messenger, 1973) in recent years a broadened concept of

pest control has emerged, termed as Integrated pests management system . Integrated pest management system is a pest population management system that utilizes all suitable control techniques either to reduce pest population and maintain them to at levels below those causes the economic injury or to so manipulate the populations that they are prevented from causing such injury

Biological control of pests is one of the most important components of integrated pests management. Biological control is considered as a natural phenomenon of regulation of insect pests numbers by biotic mortality factors such as parasites ,predators ,disease and extremes of weather that keeps pests in a state of balance . Recent research gives emphasis and recognition of the importance of classical pest management practice.

Biological control, in these light it is quite apparent that naturally occurred biotic agents especially the parasitoid ,predators, pathogens and their utilization is utmost effect in pests control and this technique has received more attention as it is relatively safe ,permanent, self –renewing and less expensive. Entomologists has given attention to identify and use of bio-control agent specially insects parasites for suppression of jute pests.

From Morewood and Gilkeson (1991) observation Laboratory tests showed that an adult female *Neoseiulus barkeri* consumed a mean of 26 adult female broad mites in 24 h. Hunter (1997) stated that Potentially useful predatory mites for controlling *T. urticae* on ornamental plants are *Neoseiulus (= Amblyseius) californicus* (McGregor), *Neoseiulus (= Amblyseius) fallacis* (Garman), and *Phytoseiulus persimilis* Athias-Henriot.

Innumerable harmful insects have been controlled either fully or partially by exotic or native parasitoids (Debach and smith 1947). Kabir (1975) reported one predator i,e, *Stethorus sp. punctum.* as attacking the various stage of Red mites (*Tetranychus bioculatus*) in Bangladesh.

Although a number of predators of white mite and red mites are mentioned in various literatures, none have been studied details, the biology of various predators that attack

white mite in Bangladesh are fully unknown, Again no serious attempt has so far been made on the survey of the predators. keeping all these in mind the present work was initiated in order to gain a basic understanding of the possible influence of predators on white mite and red mites under field or laboratory conditions.

OBJECTIVES

The present study has therefore , been aimed to provide the following facts:

- To detect and identify natural enemies associated with jute white mite (*P. latus)* and red mites (*T. bioculatus*). and
- to study their bio-ecology, seasonal abundance and consumption rate.

CHAPTER--2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Weintraub et. al (2005) stated that *Neoseiulus cucumeris* is used for biological control of phytophagous mites such as the broad mite (*Polyphagotarsonemus latus*), and thrips such as *Frankliniella occidentalis* and *Thrips tabaci* on greenhouse cucumbers and sweet peppers. The distribution of *N. cucumeris* has been studied in cucumbers; however, information is lacking in sweet peppers. To determine the distribution of this predator on pepper plants, 500 *N. cucumeris* were released on each sweet pepper plant and allowed to establish. Samples of flowers, and leaves from the top, middle and bottom of plants were taken shortly after sunrise, noon and shortly before sunset, and placed in 80% EtOH. Data loggers recorded temperature and humidity from the same location as the leaf samples. In the laboratory, mites and western flower thrips were counted. Significantly more *N. cucumeris* were found on leaves in the middle and bottom of the plants at all hours as compared to top leaves. This is similar to the distribution of spider mites, *Tetranychus urticae*. When *O. insidiosus* spp. were not present, *N. cucumeris* were found in flowers with thrips; when *O. insidiosus* spp. were present, thrips, but not *N. cucumeris*, were found predominantly in the flowers. Implications of *N. cucumeris* distribution are discussed.

Osborne et al. (1998) stated that the ability of predatory mites to control *T. urticae* on various ornamental plants has been well documented.

Waite (1998) reported that *P. persimilis* gave effective control of the pest when it was released onto strawberry with low levels of TSM infestation in south-east Queensland, Australia.

Hunter (1997) stated that Potentially useful predatory mites for controlling *T. urticae* on ornamental plants are *Neoseiulus (= Amblyseius sp.) californicus* (McGregor), *Neoseiulus (= Amblyseius sp.) fallacis* (Garman), and *Phytoseiulus persimilis* Athias-Henriot . These predators are commercially available from a number of different commercial sources in many countries for the control of this pest and other mite pest species.

Hudson et. al. (1996) stated that any program designed to change pesticide use patterns in the ornamental foliage plant industry should focus on mite control as

one of its major target areas. To this end, predatory mites have excellent potential for biological control of pest mites. Biological control of twospotted spider mite has been practiced in greenhouses throughout Europe for many years.

Cross *et al.* (1996) other pesticide sprays could also be combined with the predator. The application of foliar sprays of chlorpyrifos, malathion, endosulfan, or cypermethrin, one week before or one week after the introduction of *P. persimilis*, did not eliminate the predator, and resulted in successful biological control. Chlorpyrifos and malathion were also successful, but a longer time was needed after spraying before the predator was introduced.

Pickel *et al.* (1996) recommended inoculative releases (i.e. initial releases of a small number of predators) of *P. persimilis* when TSM are first found in the crop. However, the grower in the current study released *P. persimilis* too late, by which time TSM had already reached a high density. The outbreak of TSM may have been caused by low humidity in May, when the weather was hot and dry. *P. persimilis* needs a RH > 60% to survive, particularly at the egg stage.

Petitt (1993) reported that control failures in pepper were observed in late October of 1989-1991, causing reversion to treatments of elemental sulfur for mite control. Reproductive diapause of the predator that was induced at the insectary in the northern United States or during shipment was suspected as the cause of the failure of the predatory mites.

Battaglia *et al.* (1992) studied the biological control of TSM by *P. persimilis* on strawberry in a greenhouse in the Metapontum area of Italy in 1988-1989. In 1999-2000, the effectiveness of the phytoseiid predator *P. persimilis* against TSM was investigated in five commercial greenhouses in Korea. The aim of this study was to understand the factors which contribute to the success or failure of biological control of TSM with *P. persimilis* on strawberry in Korea.

Spicciarelli *et al.* (1992) recommended that phytoseiid mites give good control of TSM, if one mite is released per plant when the infestation of TSM has reached two individuals per leaf, and about 30% of the leaves are infested.

Gerson 1992 reported that the biology and biological control of the broad mite *Polypphagotarsonemus latus* (Banks) is poorly known.

Bonomo *et al.* (1991) also reported that releases of *P. persimilis* gave effective control of TSM, and that it was essential that the predator be released when the density of the pest was low (1-2 per leaf).

Morewood and Gilkeson (1991) observed that *Neoseiulus barkeri* did not show any diapause and weekly releases controlled broad mites on pepper successfully throughout 1992 and 1993. Reproductive diapause has been studied in *Neoseiulus* (=*Amblyseius sp.*) *cucumeris* (Oudemans) Laboratory tests showed that an adult female *N. barkeri* consumed a mean of 26 adult female broad mites in 24 h. Consequences of this high predation rate were seen in cage experiments in which 20 adult female *N. barkeri* released per plant reduced the broad mite population from 230 per leaf to 16 mites per leaf in one week and to 0.3 mites per leaf in two weeks. Unfortunately, the colony at The Land, EPCOT Center was lost and this species is not available in the United States. Work is currently underway evaluating *N. californicus* and *N. cucumeris* to control this pest and the results look very promising.

Bonde (1989) stated that Since 1989, broad mite damage has been very effectively controlled by making inundative releases of *Neoseiulus barkeri* (Hughes) which has been released for biological control of thrips .About 1-2 ml of bran containing an average of 10-30 *N. barkeri* were placed weekly on each pepper plant (*Capsicum annuum* Linnaeus), though fewer predators may be sufficient as indicated by cage experiments.

Waterhouse and Norris (1987) stated that throughout the world, specific natural enemies are not known and there have been no attempts at biological control. However, many locally occurring general mite predators give satisfactory control in many areas. Broad mites on passion fruit in Hawaii are satisfactorily controlled by introduced general predators.

Osborne (1986) developed methods for reducing the potential for spreading these infestations on cuttings by dipping them in fluvalinate (a pyrethroid). This technique caused little or no phytotoxicity to cuttings of many plant types but it only

achieved an approximate 90% reduction in *T. urticae* density. If predatory mites could be released in "stock" plantings to seek out high density patches of *T. urticae* and then suppress them, and if all cuttings could then be dipped in an effective pesticide, it is conceivable that cleaner cuttings could be produced than are currently available. Review of a specific operational program may provide a perspective useful in guiding the development and implementation of future programs. The program selected as an example is the use of *P. persimilis* on shade-grown palms for management of twospotted spider mites.

Cross (1984) showed that introductions of predatory mites in March or early April at a rate of one mite per plant were consistently successful.

Hamlen and Lindquist (1981) demonstrated that the two species (*P. persimilis* and *Phytoseiulus macropilis* [Banks]) suppress mite populations equally; no differences were noted as a result of host plant or geographic region (Ohio versus Florida).

Port and Scopes (1981) showed that small numbers of *P. persimilis* could control TSM on strawberries in walk-in plastic tunnels in southern England. However, it was necessary to reduce overwintering populations of TSM by introducing predators in the autumn.

Hamlen (1980, 1978) observed that *Phytoseiulus macropilis* can significantly reduce *T. urticae* on greenhouse-grown dieffenbachia when introduced twice, 3 weeks apart, at the rate of 10 predators per infested plant with an initial *T. urticae* density of ca. 38 mites/leaf . Results of similar studies using parlor palms were not as promising. Thus certain ornamentals may not be good candidates for biological control programs because it is harder to obtain a suitable level of mite control or they do not have the ability to recover quickly from or mask mite feeding damage.

McMurtry *et al* (1978)stated that From Germany, *Phytoseiulus persimilis* Athias-Henriot was subsequently shipped to other parts of the world, including California.

Hamlen (1978) evaluated the control of *T. urticae* on *Dieffenbachia maculata* (Lodd.) G. Don and *Chamaedorea elegans* Martius (parlor palms) by *P. macropilis.* He established damage indices to evaluate aesthetic injury. The density of *T. urticae* (stage of mite not indicated) needed to obtain the specified level of damage was determined experimentally for each host plant.

Markkula and Tiittanen (1976) and Hamlen and Lindquist (1981) seperately stated that sufficient predators must be released to create a predator:prey ratio of 1:10 or 1:6-1:25 respectively. Once the mite population has reached a high density, the cost of releasing adequate numbers of predatory mites can be prohibitive. In greenhouses producing ornamentals, predators are used prophylactically. Releases of approximately 7500 predators are made once a month even if no mites are present in the crop, on the assumption that the crop is likely to become infested.

Dosse (1958) stated that in Korea, The two-spotted spider mite (TSM), *Tetranychus urticae* Koch, is an extremely difficult pest to manage on strawberries. The mite has become a major problem, primarily because of the excessive use of pesticides. These kill not only TSM, but also pollinating bees in strawberry greenhouses. Pesticide use results in the development of strains of TSM that are highly resistant to almost all classes of pesticides. In addition, chemical control of TSM is highly restricted in Korea, because of increasing concern over pesticide residues on fruits, especially on strawberries which are consumed fresh without removal of the skin. Fortunately, the predatory mite, *Phytoseiulus persimilis* Athias-Henriot, is now available for the control of TSM on strawberry in Korea. This predacious mite was accidentally introduced into Germany from Chili in 1958 .

CHAPTER-3

METHODS

AND

METHODOLOGY

MATERIALS AND METHODS

To investigate the incidence of predator on jute white mite in the field of plots were used each plot area was five decimal's. For data collection twig and leafs and plants were searched randomly.

locations :

The study was conducted at the head office premises & Central Research Station (CRS) ,of Bangladesh jute Research Institute (BJRI).

Collection of data:

Data were collected from the selected five plots in which no chemicals were sprayed. Sampling was done randomly without any biasness. Data were maintained by two way by leaf searching and other by plant searching.

a. Leaf Observation:

First from plot 5 infested plant were selected and mite infested leaf were colleted from each plant and then 25 total leaves were observed under stereomicroscope to investigate the predators.

b. Plant Observation :

From each plot 5 infested plant were selected for eye estimation to detect the large predators.

Estimation Of White mite Infestation :

To estimate the white mite population, infested leaves were collected from the plot and than observed under the stereo-microscope and counted.

Detection Of Specific Predators :

To detect the specific predator for specific host observation of infested leaves were made under the stereomicroscope and observed the insect which feeding white mite or red mites or not.

Identification Of The Predators :

The predators were identified with the help of expert scientists and university teachers.. Most of the predators could not be identified due to lack of specific key (literature) and shortage of time and fund.

Seasonal Incidence:

Seasonal incidence of host and predator were determined from the data collected at 5 days intervals during the infestation period April to September.

Body description:

The collected predator were observed under stereo-microscope and detected the various morphological features and then described.

Biology Of Predators:

To study the biology of various predators available food were supplied at the Petridis with cover part and then predators were released inside the Petridis and then data were taken one after another.

Ecology Of The Predators :

To determine the relation of predators with the temperature and humidity and rainfall 5 days interval data were collected from the field and measured the ecology of predators.

Rate Of Predation :

rate of predation by different predator were determined by observing the feeding tendency or feature of eating white mite or red mites counted the number of host predated by predator.

Synchronization Of The Predators with hosts :

Synchronization of predators life cycle with its host was most important things. Synchronization were determined from data collection about the incidence of host and predator at same time or not.

Preservation Of The Predators :

To preserve the collected predators 3 methods were adopted–

i) **Dry method** : paper tips mounting

ii) **Semi- Permanent method** –By using Canada balsam whole mount slide

iii) **In liquid**- at larval solution & alcoholic solution

CHAPTER-4

RESULT AND DISCUSSION

RESULTS AND DISCUSSION

Eight predator species were recorded on jute mites from CRS, Dhaka during the study period 2005. Among them three predators predate on jute white mite and three predate on red mites and two predators predate both white mite and red mites. They are listed below:

1. Minute Pirate bug *(O. insidiosus)*
2. Predatory Mites (Amblyseius sp. sp)
3. lady bird beetle (*Stethorus sp. sp.*)
4. Thrips (*Scolothrips* sp.)
5. Tarnished bug (*Adelphocoris* sp.)
6. Lady bird beetle
7. Six-spotted thrips (*Scolothrips* sp.)
8. Red bug

1. MINUTE PIRATE BUG
(Orious insidiosus)

MINUTE PIRATE BUG

(*Orious insidiosus*)

Among the predators identified at this study *Orious insidiosus* is the most numerous in the area studied. My point of view *O. insidiosus* is a good predator. In pursuit of the prey *O. insidiosus* move from to and fro and when it get any prey it pierce the body at the dorsal side of the prey (*P. latus*) or dorso- ventral side of the Red mites and suck the body sap except the exuviae and throw the exuviae. They eat 8-10 white mite one after one at a time and then take rest for several times It is also observed that their feeding tendency is varied from time to time. At the morning time their feeding tendency is low and with day passing the tendency increase and at the noon time their feeding tendency is so high and at the evening time the tendency also decrease.

Systematic Classification

Phylum :Arthropoda

Class – Insecta

Order: Hemiptera

Family - Anthocoridae

Genus -*Oious*

Species : *insidiosus*

Morphology Of *O. insidiosus*

Adults :

Adults are very small (about 3mm) some what oval shaped and black with white wing patches. Body eleven segmented .Fore wings are modified into hemielytra. Mouthparts piercing and suctorial type .Antennae five segmented.

Egg :

It was not observed where they lay egg . But from the previous study it was found that *O. insidiosus* lays their tiny eggs 2-3 days after mating within plant tissue where they are not usually seen .

Nymphs:

Egg hatches into nymphs ,the immature feeding stage .Nymphs are small ,wingless insects ,yellow orange to brown in color , teardrop shaped and fast moving nymphs.

Plate 1 Adult of Minute pirate bug ;*O. insidiosus*

Plate 2 Nymph of Minute pirate bug ;*O. insidiosus* predating on red mite

by sucking juice from their prey through a sharp ,needle like beak (rostrum) which is characteristics of all true bugs. At first the nymphal instar is whitish and transparent .with the increase of age and size gradually it becomes yellowish brown. The nymph become yellowish and two wings marks are found .on the second segment of the thorax and gradually the wings pads are found and the insects become yellowish black and at last they become adult by molting. Growth and development from nymphs to adults takes a minimum of 15 days , the three nymphal instar pass through 6-9 days Adult survive for 6- 9 days in the laboratory condition at the present of sufficient white mite.

Habitat

It was observed that adult and nymphs of *O. insidiosus* stay at the lower surface of the tender leaf of the topmost portion of the jute plants. It was also found at tender stipule.

Feeding rate :

O. insidiosus sp. was observed as a good predator. In an average a nymph predate 32+/-2.27 eggs, nymph or adult per hour. Where as an adult predate including all stage of white mite 30+/-2.27 per hour. but the rate of predating differ from time to time ,depending upon the utility, temperature, humidity, at just before noon or afternoon when the temperature is increased the rate of feeding increased.

Table 1 Predation rate of the predator *O. insidiosus* per hour in the laboratory condition of CRS, BJRI during 2005

Stage of Predator	**Predation rate /hour Mean+/-SE**
Nymph	32+/-2.27
Adult	30+/-2.27

At room temperature 28 ^{0}C & Relative humidity 80%

From the table-1 it is observed that the pradation rate of nymph of O. insidiosus was 32+2.27 per hour whereas 30+2.27 for nymph .It was observed that the predation rate of adult was less than nymph.

Attaking stage :

Both nymph and adult stage of *O. insidiosus* sp. Predate white and red mite of jute but prefer jute white mite.

Host stage :

This predator predate on all the stages (egg nymph and adult) of both the jute white and red mite.

Incidence :

O. insidiosus was found first to be appeared at the middle of the June and continued till the end of September. The highest incidence was recorded during the pick period of white mite infestation at the end of June.

Synchronization with the host life cycle :

There occurred a good synchrony in the life cycle of *O. insidiosus* with its host jute white mite. Even in adverse condition the predator occurred in the field. It compete with other predators at the same time but in this study it was not observed.

Activity :

In the field the adult predator were active before noon and at the morning and evening time under the life surface or in the twig.

Ecology

It was first seen at 22th April when the temperature is about 30 C and the relative humidity 60% in average recorded but these observing number is out of count . But in the month of May and June its severity is increased when the humidity and temperature and number of white mite are increased . It was salso observed that after the rainfall the number of ***O. insidiosus*** decreased.

Location

They hide inside the twig and axils of side branch at nymphal stage . They are also observed under side of the leaves infested by white mite between two vein of the leaves.

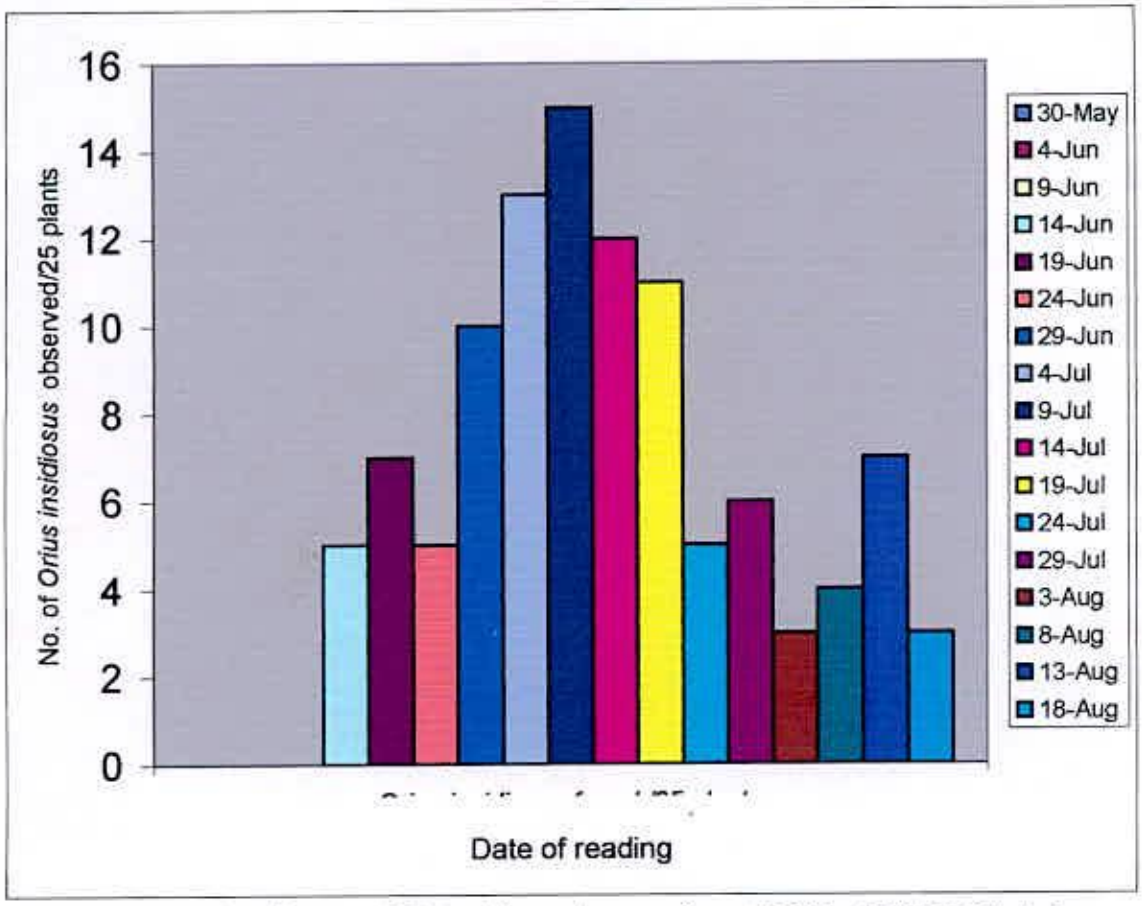


Figure 1 Seasonal Incidence of *O. insidiosus* in experiment field in CRS ,BJRI during 2005

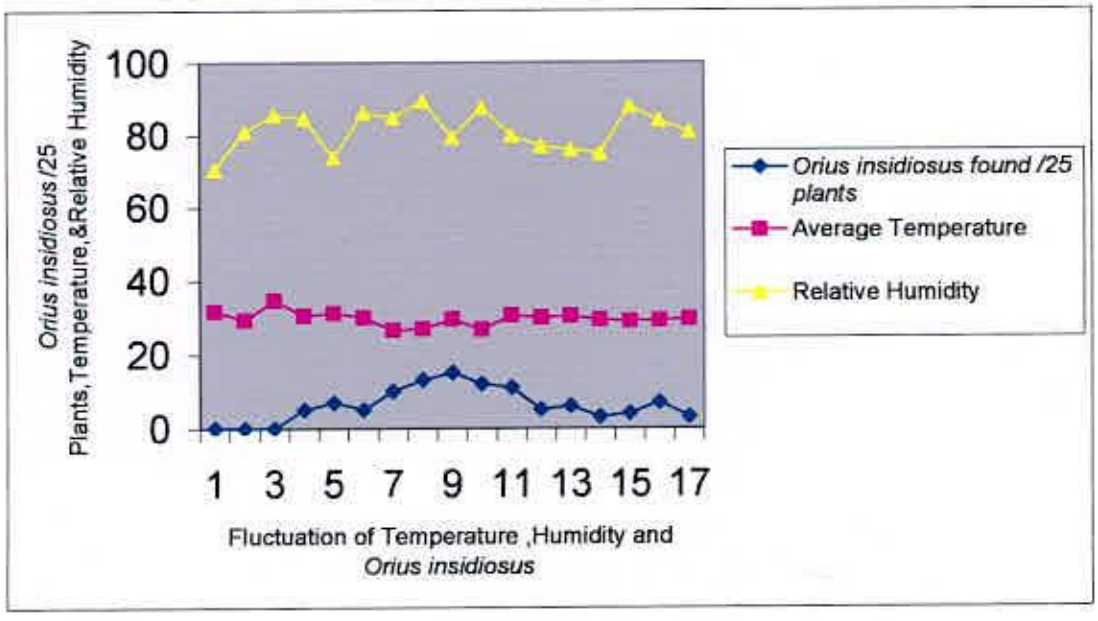


Figure 2 Effect of temperature ,relative humidity on *O. insidiosus* population experimental field in CRS ,BJRI during 2005.

Phoresy

Adults and nymphs have strong phoresy power ,they are of fast moving insects .Adults can fly several feet's at one flight .they hide into the twig for their safety or at the base of the leaf . It is also observed that their movement is restricted from the flag leaf to 10 -12th bottom leaf.

2. PREDATORY MITE

(Amblyseius sp.)

PREDATORY MITE

(*Amblyseius* sp.)

It is an important predator due to presence of it in the whole jute growing season A good number of species of predatory mites attack spider mites, the family Phytoseiidae being of the greatest importance. A good number of species of these species feed on spider.

Systematic classification

Phylum: Arthropoda

Class-Arachnida

Order: Acarina

Family : Phytoseiidae

Genus:. *Amblyseius sp.*

Description:

Amblyseius sp. is straw-colored to almost white, depending on age and recent food sources. It is flatter in shape than the relatively dome-shaped spider mites, and has fewer hairs protruding from the body than spider mites. Viewed from above, *Amblyseius sp.* is oval to somewhat pear-shaped., usually teardrop-shaped, long legged when compared to spider mites, and often orange-red, tan, or brown. They move quickly through and around *Amblyseius sp.* colonies in search of prey and, unlike spider mites, can move backwards as well as forwards. Eggs are usually oval-shaped and a little larger than the spherical eggs of spider mites. *Amblyseius sp.* nymphs resemble small adults. The time from egg to adult can range from a few days to weeks, depending on the temperature, humidity, and species.

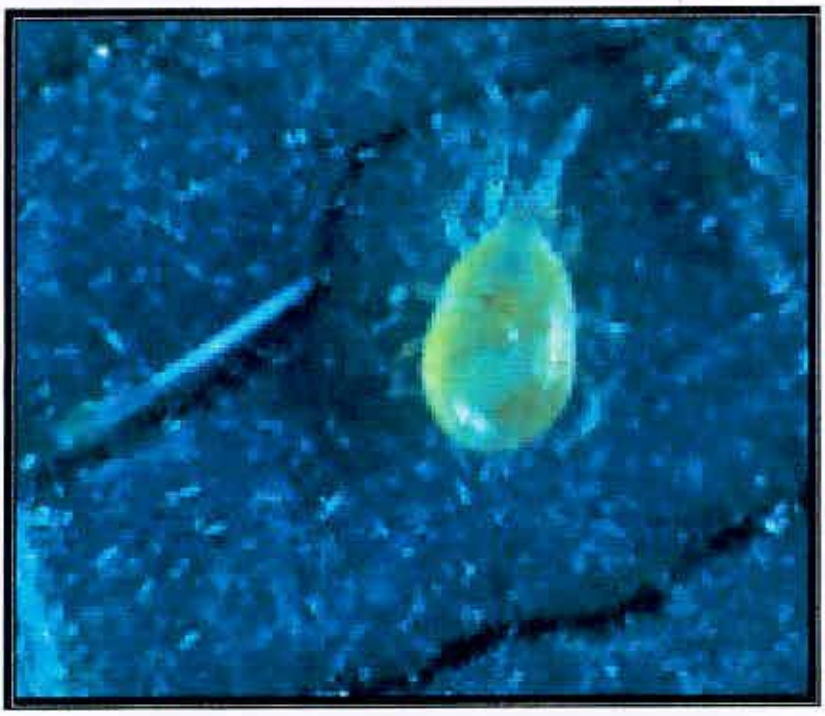


Plate 3 Adult of Predatory mite :*Amblyseius* sp.

Hosts:

Amblyseius sp. feeds on a variety of mite species, but exhibits little cannibalistic behavior. It is capable of feeding on all prey life stages.

Phoresy

Amblyseius sp. uses two alternative foraging patterns. When prey are plentiful, a random walking pattern is used, allowing them to utilize mites on a leaf most efficiently. When prey are scarce, the predators walk along leaf edges, increasing the chance of moving to a new leaf.

Feeding rate :

They predate on an average 6+/-.054 nymph or Egg or adult mite per hour. They predate only jute white mite.

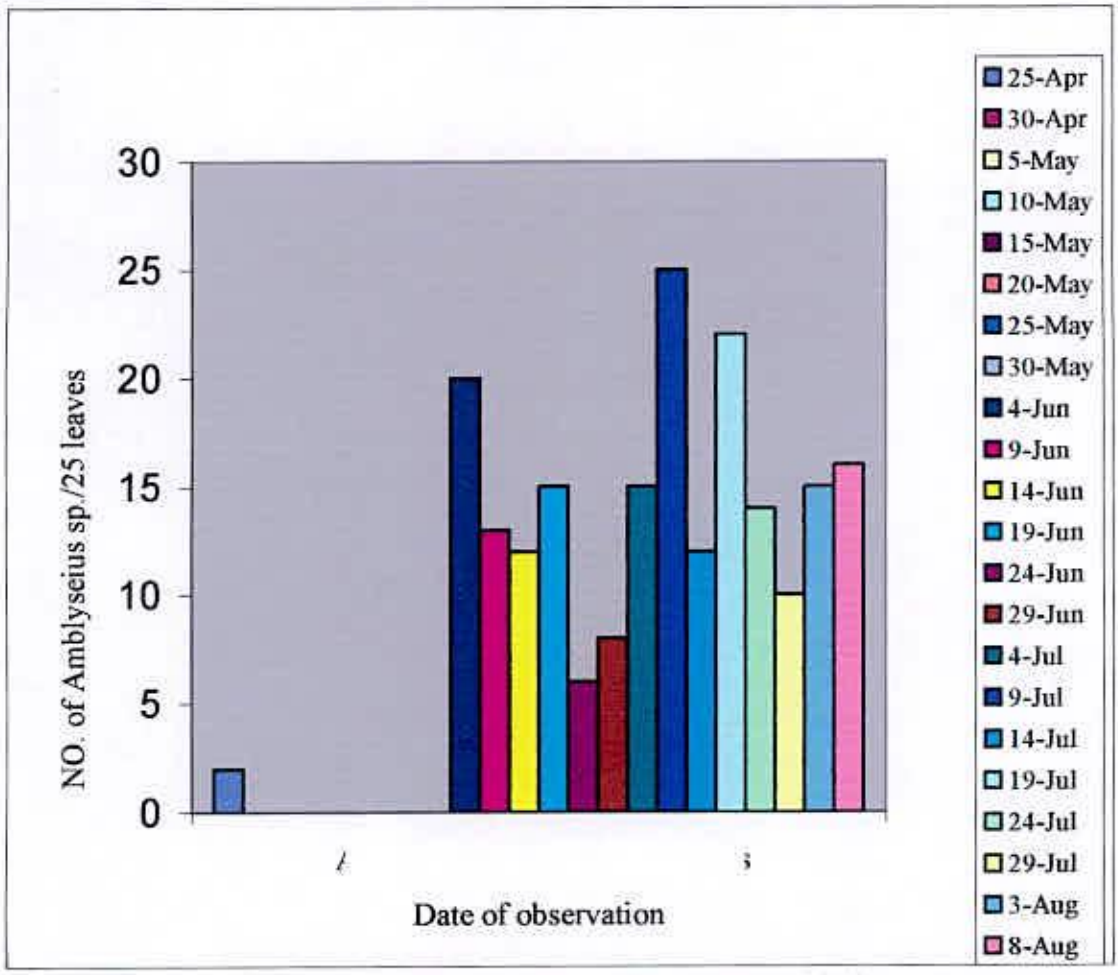


Figure 3 Seasonal incidence of *Amblyseius* sp in experimental field in CRS , BJRI during 2005

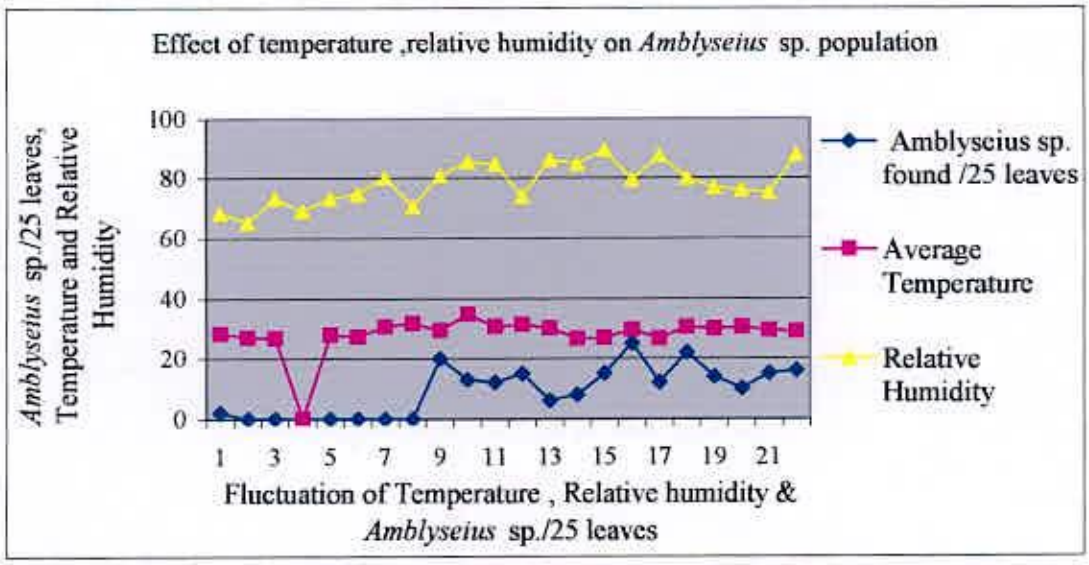


Figure 4 Effect of temperature ,relative humidity on *Amblyseius* sp. Population in experimental field in CRS , BJRI during 2005

Table 2 Predation rate of the predator *Amblyseius* sp. per hour in the laboratory condition of CRS, BJRI during 2005

Stage of Predator	**Predation rate /hour Mean+/-SE**
Adult	6+/-0.54

At room temperature 28 ^{0}C & Relative humidity 80%

Attacking stage :

Their attacking stage is only the adult.

Incidence :

It was first observed at the last of April but no found before 1st of June and from that time it was till August first. But with the rainfall the no. of predator decreased.

Synchronization with the host :

There occurred a good synchrony in the life cycle of *Amblyseius sp.* with the life cycle of jute white mite. Even in adverse condition it was found in the field. Though with the rainfall the no. of predatory mites decreased.

It compete with other predator but it was not observed in the present study.

Activity of predatory mite :

At the noon the active of adult is so much restricted to shady area. Morning and evening time adult activity were high.

Ecology :

They were found to be appeared at the high temperature and low humidity. With the rainfall their severity decreased. It also feed on plant sap of jute plants.

3. LADY BIRD BEETLE

Stethorus sp.

LADY BIRD BEETLE

Stethorus sp.

Stethorus. sp is usually the most important and frequent predator of red mites. This lady beetle is native to North America and was first identified in 1852 . Research conducted annually since 1967 in Pennsylvania has provided much of the basic biology and management information for using this predator as the cornerstone of integrated mite management programs for deciduous fruit crops.

It is a very much important predator for only red mite due to good synchronization in the life cycle with the life cycle of red mite.

Systematic Classification:

Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Family: Coccinellidae
Genus: *Stethorus*
Species: *Stethorus* sp.

Description:

Adults are oval, convex, uniformly shiny black, and covered with sparse, fine yellowish to white hairs. Adults reach a length of 1.5 mm .**Eggs** are very small in size, pale white, and oval. They become blackish just before the larva emerges. Eggs are laid singly on their sides leaf. **Larva** is gray to blackish and has many long-branched hairs and black patches. They have 13 segments, exclusive of the head. As the larva matures it becomes reddish .**Pupae** are uniformly black, small, flattened, and somewhat pointed on the posterior end. With magnification, lines representing abdominal segments can be seen. Wing pads are prominent and the entire body is covered with yellow hairs. For a short period after it is formed the pupa is reddish-orange. The emerging adult is also reddish-orange during the first few hours after emergence from the pupal case before turning black.

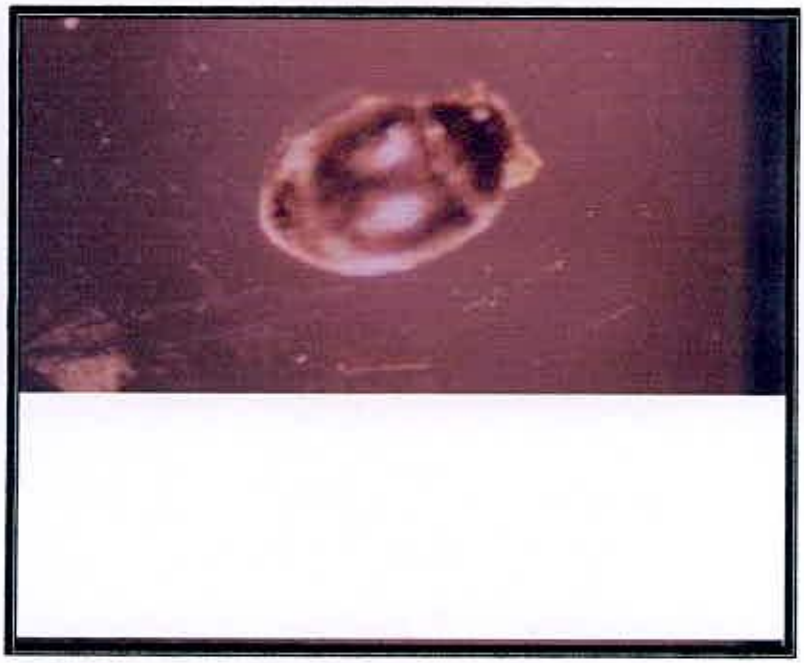


Plate 4 Adult of Stethorus sp. sp

Feeding rate :

Grub Predates on an average 36+/-.2.0 individuals per hours where as adult predate only 6+/-.84 in number per hour. Because at the adult stage their feeding tendency markedly decreased.

Attacking stage :

Both larva and adult predate on red mite. But larvae was voracious feeder.

Table 3 Predation rate of the predator *Stethorus* sp. per hour in the laboratory condition of CRS, BJRI during 2005

Stage of Predator	**Predation rate /hour Mean+/-SE**
Grub	36+/-2.0
Adult	4+/-0.84

At room temperature 28 ^{0}C & Relative humidity 83%

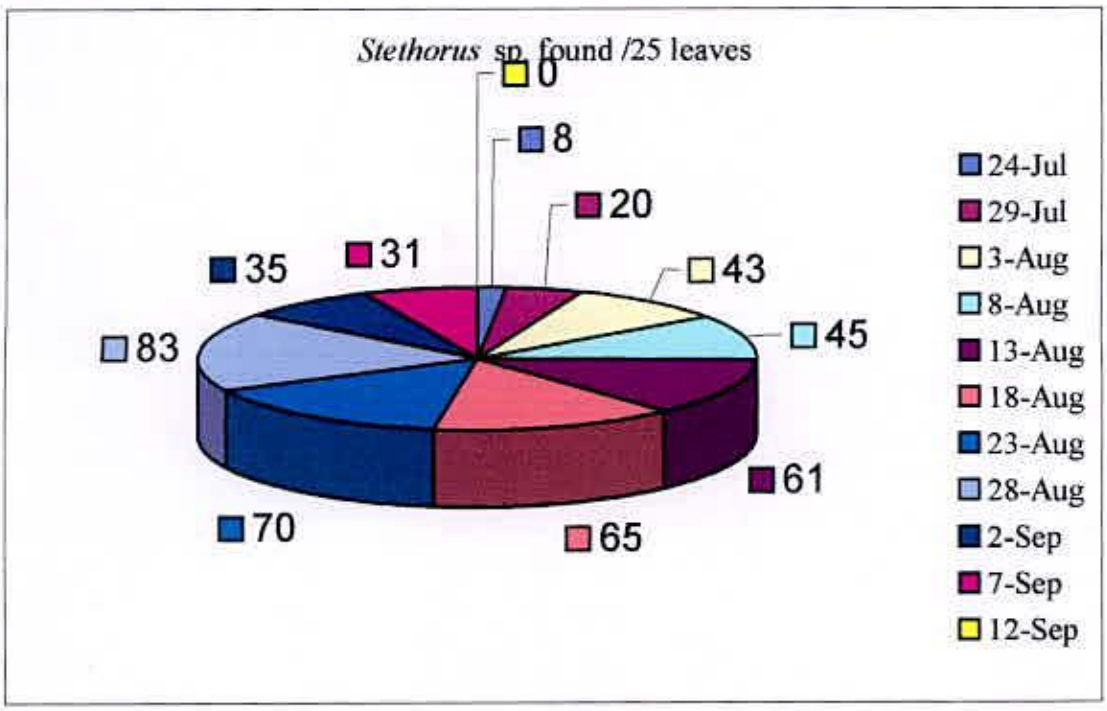
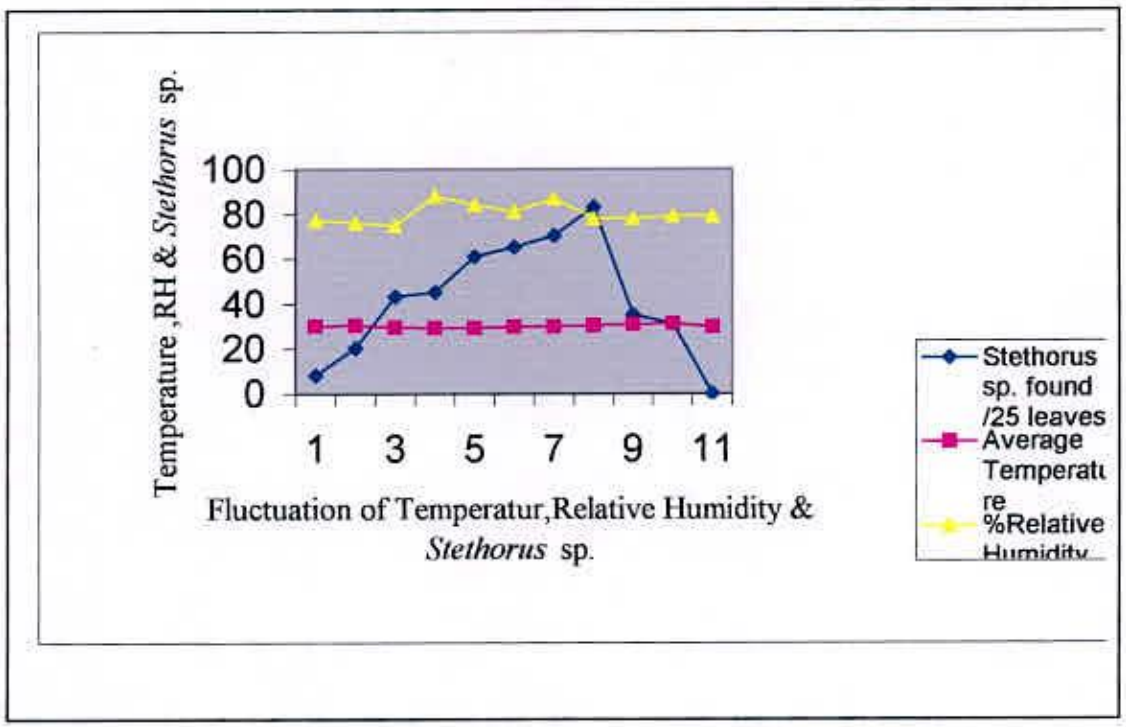


Figure 5 Incidence of *Stethorus* sp in experimental field in CRS ,BJRI during 2005



Fluctuation of Temperatur,Relative Humidity & *Stethorus* sp.

Figure 6 Effect of temperature ,relative humidity on *Stethorus* sp. population in experimental field in CRS ,BJRI during 2005

Host stage:

All the stage of host were predated on , preferably eggs of red-mite

Incidence :

Stethorus sp. was found to be appeared first time from the last of July and till September. It was recorded September first.

Synchronization :

With the introduction of red mites the appearance of *Stethorus* sp. were found. With the increase of severity of host or red mites the severity of *Stethorus* sp. were increased.

Ecology :

They were found when there was high temperature and high humidity in the area. Usual rainfall did not hamper their growth and development .With the decrease of temperature and humidity their severity were decreased.

Activity Of *Stethorus sp.*:

Stethorus sp. activity was high at the morning and evening time. At the laboratory condition it was found at the light they tried to escape. Alternate host of this predator and competition with other predator was not studied at the present study.

Habitat

They locate under surface of leaves where there is red mite and their eggs in abundant quantity . Their movement from tender leaves to older leaves of the jute plants.

4. Scolothrips sp.

THRIPS

Scolothrips sp.

This unanimous thrips may be considered as a good predator if it would remain all the period from the incidence of white mite. But it was observed that to be appeared at the one plot of jute plants not all field and only for few days.

Systematic classification

Phylum: Arthropoda

Class: Insecta

Order: Thysanoptera

Family: Thripidae

Genus: *Sclothrips*

Species: *Sclothrips* sp.

Description :

The thrips were yellow in color but at the nyphal stage they were transparent or whitish in color. They were ½ mm in length. They had short live span. They complete their whole life within a week.

Feeding rate :

Both nymph and adult predate on white mite irrespectively egg, nymph and adult preferably Egg. In an average nymph feed 19+/-1.82 individual per hour whereas adult feed on 22+/-1.52 individual per hour.

Activity of adult and nymph :

Nymph were not so much active but adult were very much active when the leaf was touched than they move by inverse jumping. They hide at the sunshine period . Morning and evening time they were active.

Synchronization :

There was no synchronization between the life cycle of white mite and the life cycle of that thrips. Because their introduction were only for few days and sudden.

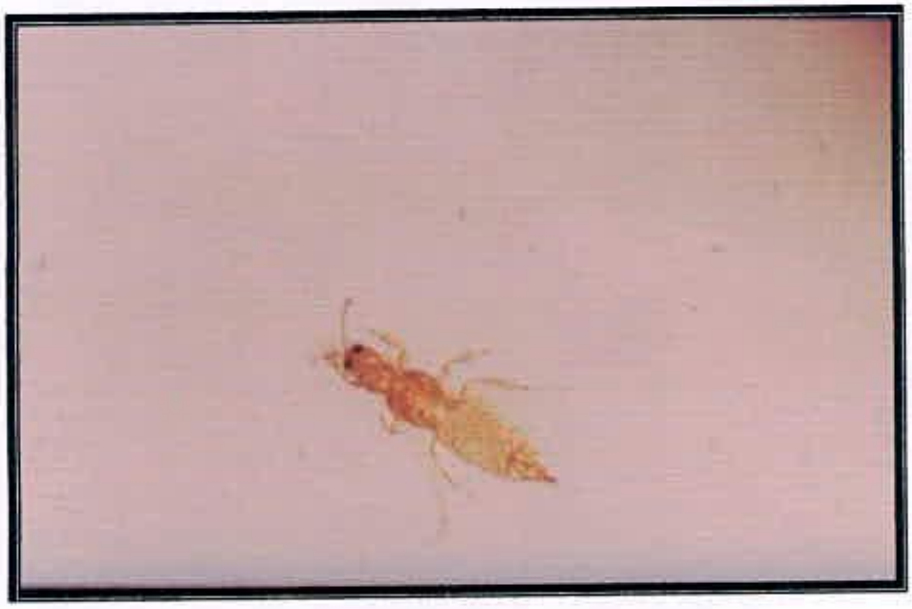


Plate 5 Adult of *Scolothrips* sp.

Plate 6 Nymph of *Scolothrips* sp. feeding on egg red mites

Table 4 Predation rate of the predator ,*Scolothrips* sp. per hour in the laboratory condition of CRS, BJRI during ,2005

Stage of Predator	**Predation rate /hour (Mean+/-SE)**
Nymph	19+/-1.82
Adult	22+/-1.51

At room temperature 26 ^{0}C & Relative Humidity 75%

Incidence :

They were first seen at the first week of June to last week of June, when temperature was high and humidity was in an average 80%. After a heavy rainfall they were not found any more.

Ecology :

From the graph it was observed that 27 ^{O}C of temperature with 73% RH was the best for *Scolothips* growth and development

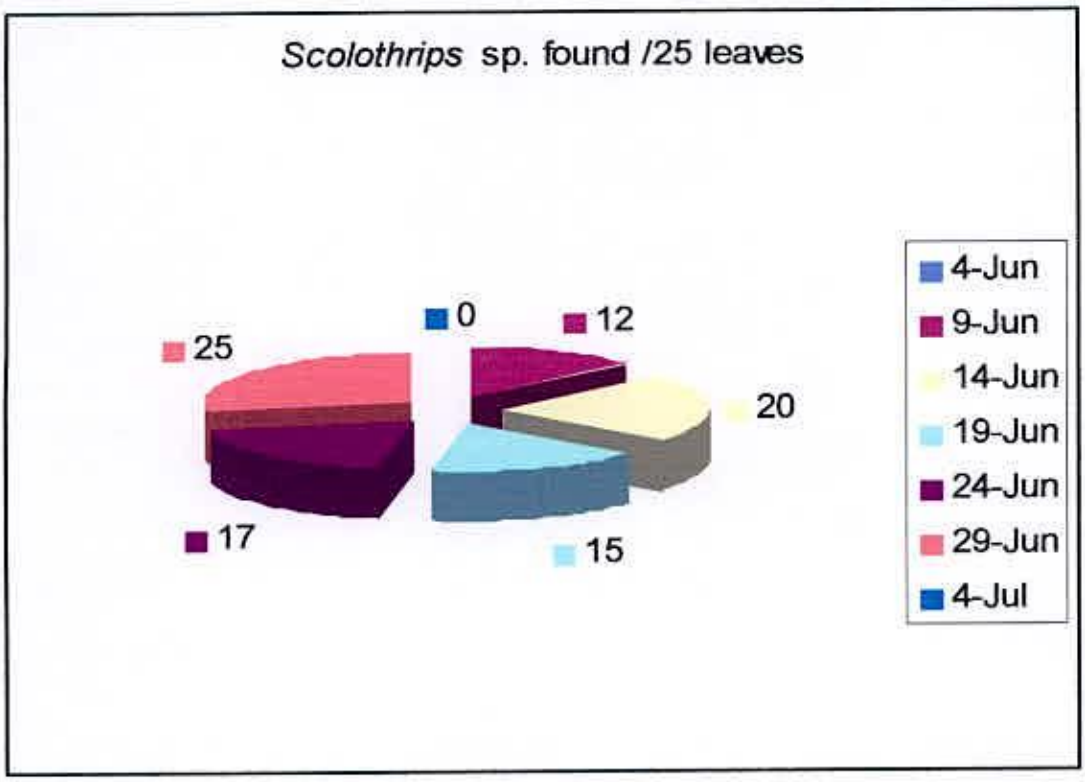


Figure 7 Seasonal Incidence of *Scolothrips* sp in experimental field in CRS ,BJRI during 2005

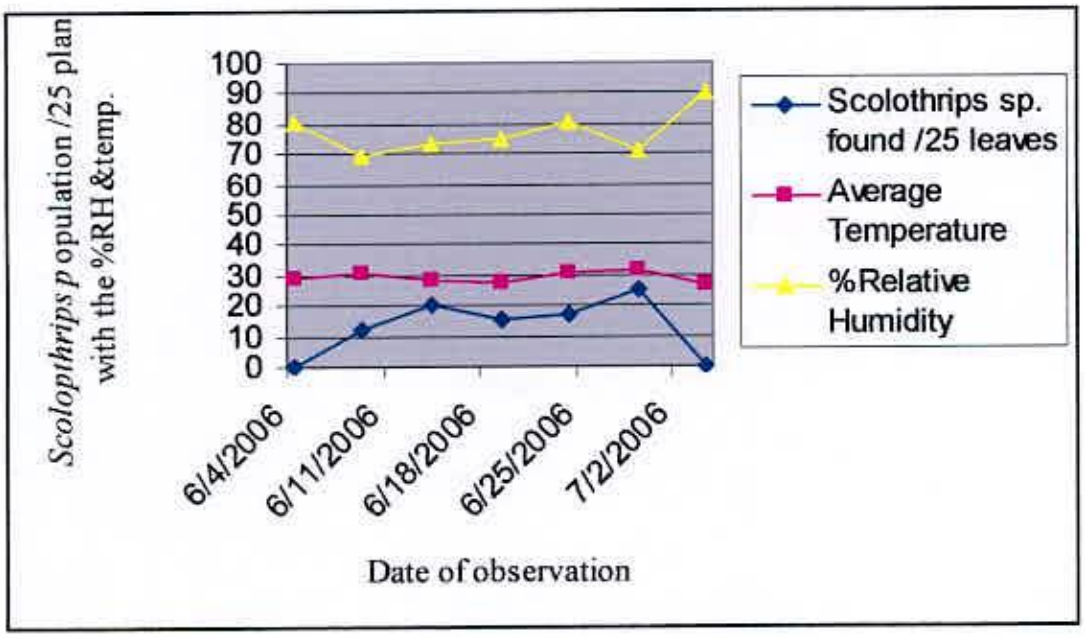


Figure 8 Effect of temperature ,relative humidity on *Scolothrips sp.* population in experimental field in CRS, BJRI during 2005

5.TARNISHED BUG

Adelphocoris sp

TARNISHED BUG

Adelphocoris sp

Systematic analysis

Phylum: Arthropoda

Class: Insecta

Order: Hemiptera

Family: Miridae

Genus: *Adelphocoris*

Description :

Under microscope it was found to like cockroach. Except the mouthparts it has a rostrum to pirce and suck the body liquid of mites or plant sap. It is 1mm length in size and greenish in color ; eyes are ocelli and red in color.

Feeding rate:

It's feeding power was not so high. The nymph or adult bug predate 5-6 white mite/ hour. Its alternate host may be red mite. They also feed on kenaf or jute plant sap.

Incidence:

This bug appeared at the first week of June till first week of July. But they were very few in number and after that they were found again at the first week of August till September last in abundant in kenaf field where they suck on plant juice.

Activity Of The Adult :

At the noon the adult were found to be less active but at the evening and at the morning time they were comparatively more active .After the rainfall they were observed hiding in the twisted leaf of kenaf jute.

Synchronization With The Host Life Cycle :

They did not synchronized in the life cycle with the life cycle of the white mite. They were found only for few days at the growing period of jutes .but they were also found

at first week of August to the first of September in the kenaf (*Hibiscus cannabinus*) field .At that time there were no white mite infestation.

Table 5 Predation rate of the predator *Adelphocoris* sp. per hour in the laboratory condition of CRS, BJRI during ,2005

Stage of Predator	**Predation rate /hour (Mean+/-SE)**
Nymph	6+/-0.90
Adult	5+/-0.74

At room temperature 29 ^{0}C & Relative humidity 77%

Plate 7 Ventral view of adult of *Adelphocoris* sp.

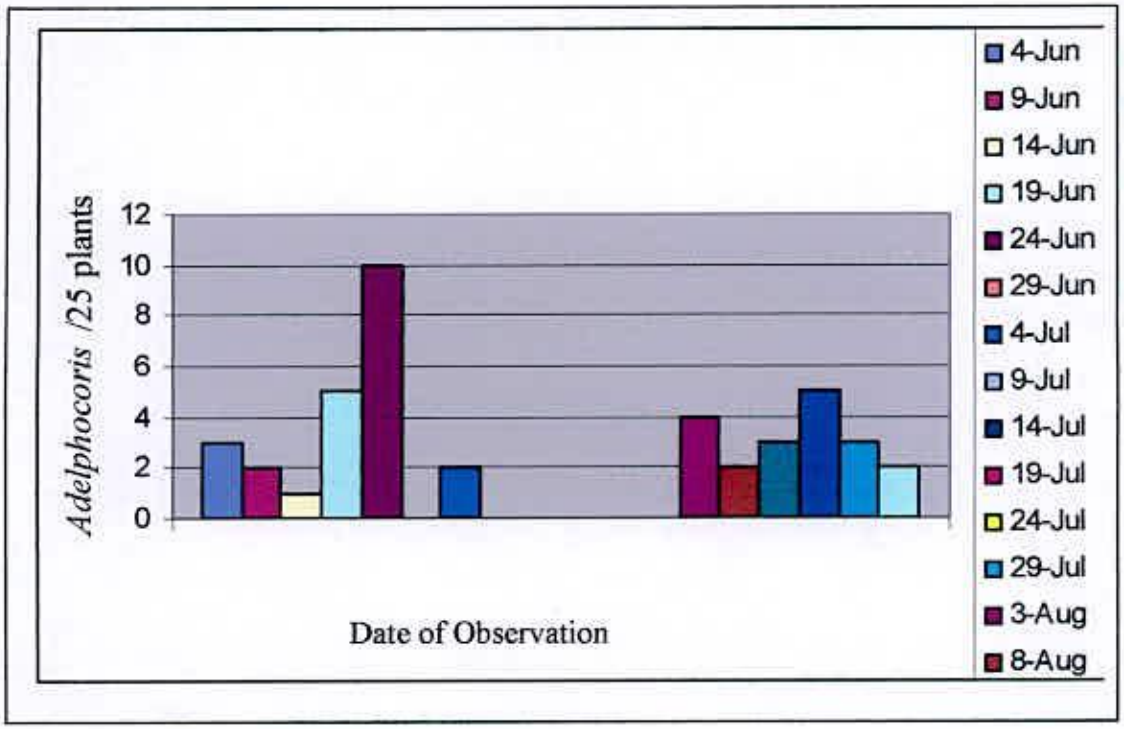


Figure 9 Seasonal Incidence of *Adelphocoris* sp. in experimental field. in CRS, BJRI during 2005

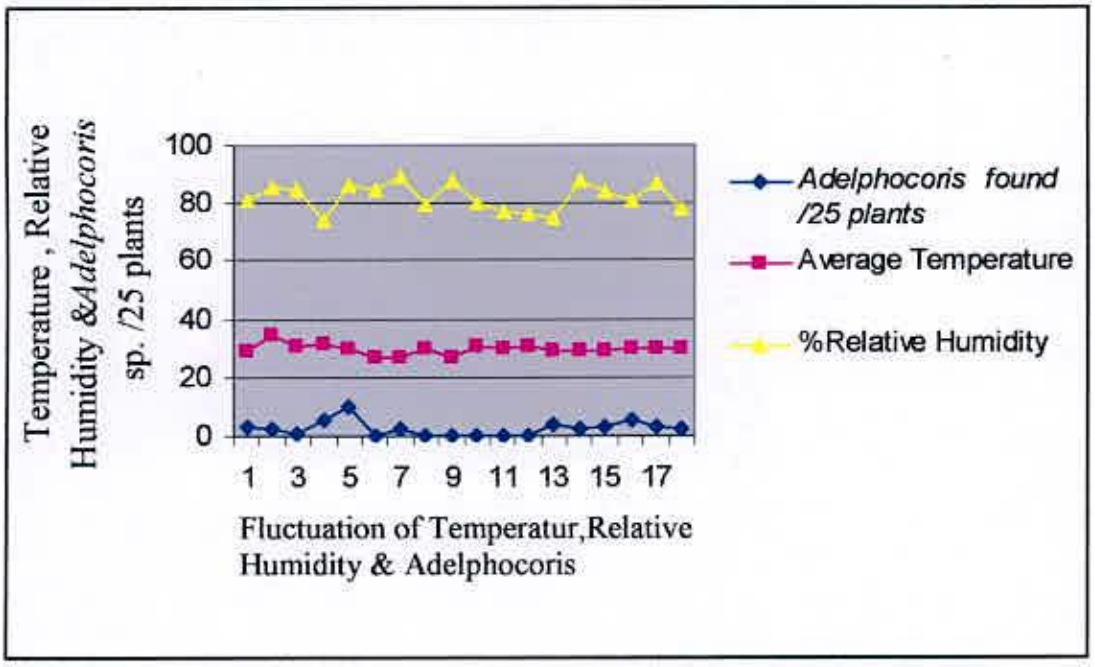
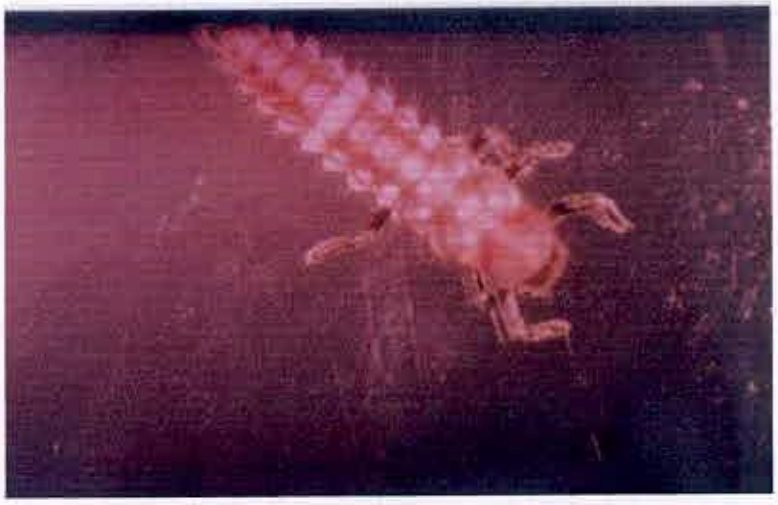


Figure 10 Effect of temperature ,relative humidity on *Adelphocoris* sp. population in experimental field in CRS ,BJRI during 2005

5.7 Ecology :

It was observed that with the increase of humidity the density of this predator increased & with the decrease of temperature population became nil. From the graph it is observed that comparatively high temperature of 29°C with high humidity of about >80% was the best for growth and development of *Adelphocoris* sp.

6. LADY BIRD BEETLE



LADY BIRD BEETLE

Systematic analysis

Phylum: Arthropoda

Class: Insecta

Order: Coleoptera

Family: Coccinellidae

Genus: Unidentified

Description

The larval stage of this predator feed on egg, nymph and adult stages of red mite . They are 13 segmented excluding cephalic segment at larval stage; dark red in color; whitish 3 long strip on the dorsal region. One strip at the midline and another two at the both side of the dorsal region.

Feeding rate

.In an average their grub consume above 20 egg , nymph , and adult stage of red mites per hour.

Activity of the larvae

They move from bottom to top of the jute plants freely.

Incidence

They appeared at the middle of the July and till to the middle of the August, 2005

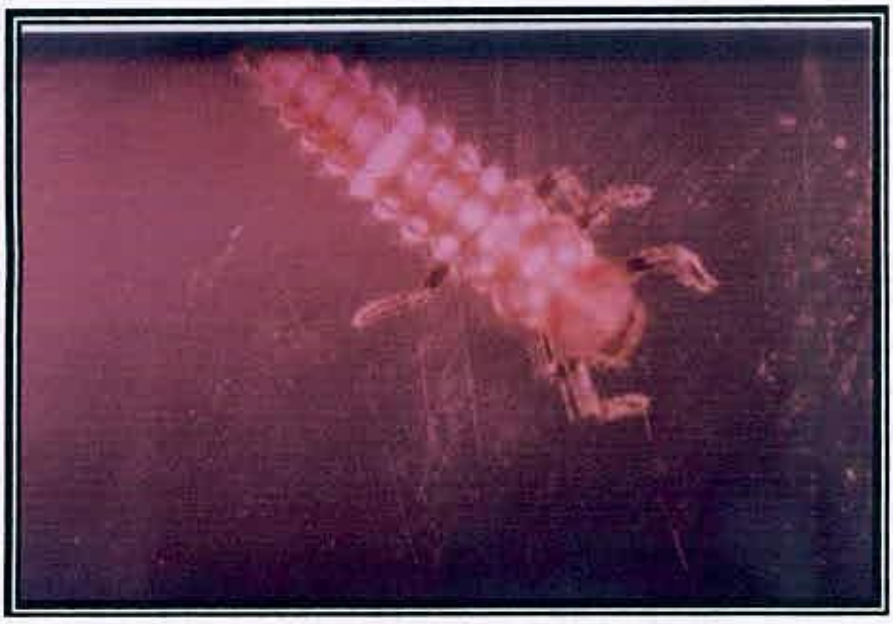


Plate 8 Grub of Lady Bird beetle

Plate 9 Adult of lady bird Beetle

7.SIX SPOTTED THRIPS

Scolothrips sp.

SIX SPOTTED THRIPS

***Scolothrips* sp.**

It was a good egg predator of the host red mites. It predate voraciously. It placed its mouthparts on the egg shell and break down and feed the liquid of the egg.

Systematic analysis

Phylum: Arthropoda

Class: Insecta

Order: Hemiptera

Family: Thripidae

Genus: *Scolothrips*

Body description

There is a red spot at last segment of the body. The body of the larvae is 13 segmented. They were polypod.

Habitat

They are found under surface of the leaves where there are jute mites in abundance. Their preference to eat egg of red mite they eat 20-30 eggs per 30 minutes. They are found to eat adult but very few in number.

Incidence of the larvae

They were found to be appeared at the middle of the august to last of august At the time of their introduction more than 3 individual were seen at each leaf.

Plate 10 Nymph of Six spotted thrips

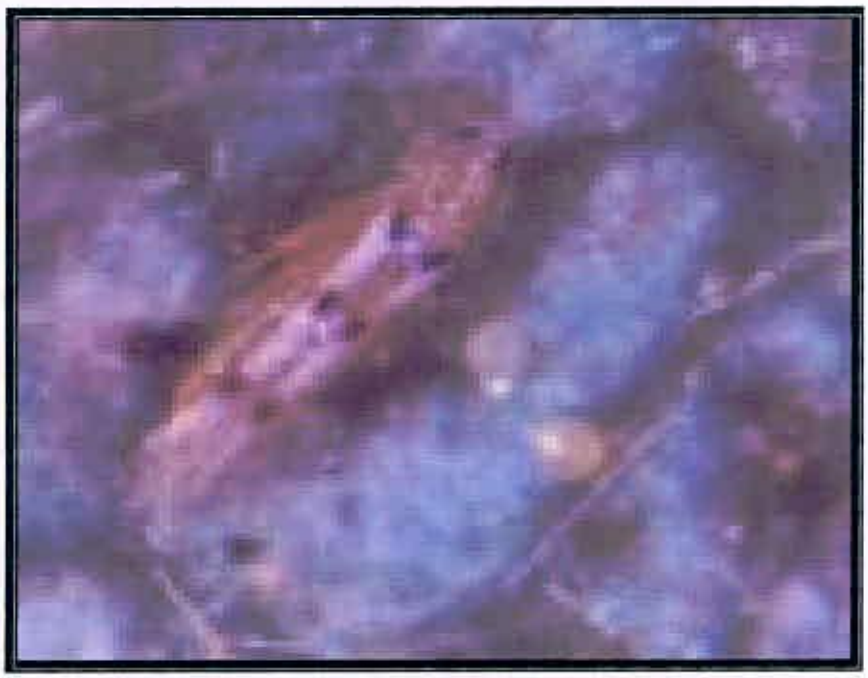


Plate 11 Adult of six spotted thrips

Table 6 Predation rate of the predator *Scolothrips* sp. per hour in the laboratory condition of CRS, BJRI during, 2005

Stage of Predator	**Predation rate /hour (Mean+/-SE)**
Nymph	35+/-1.42

At room temperature 29 ^{0}C & Relative humidity 77%

Feeding rate :

Both nymph predate on white mite irrespectively egg, nymph and adult preferably egg. In an average nymph feed 35+/-1.42 individual per hour.

Ecology :

From the graph (figure 12) it can be understood that 29^{O}C temp. with 75-78% RH was suitable for the growth of six spotted thrips. With the increase of relative humidity the number of thrips were increased.

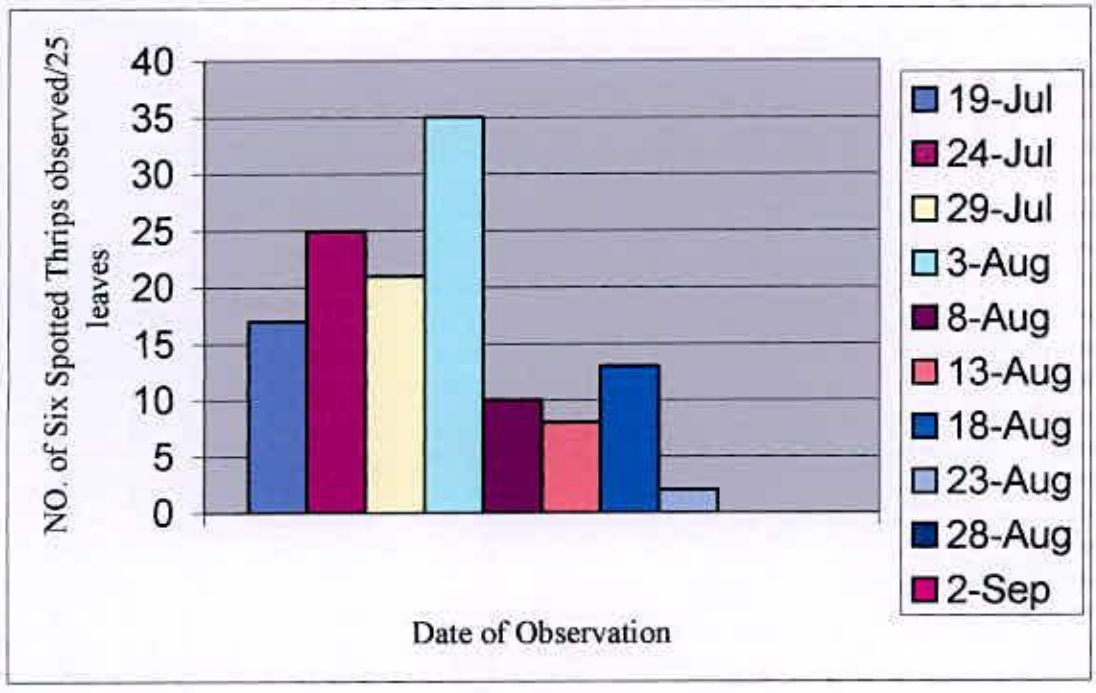


Figure 11 Seasonal Incidence of *Scolothrips* sp in experimental field in CRS, BJRI During 2005

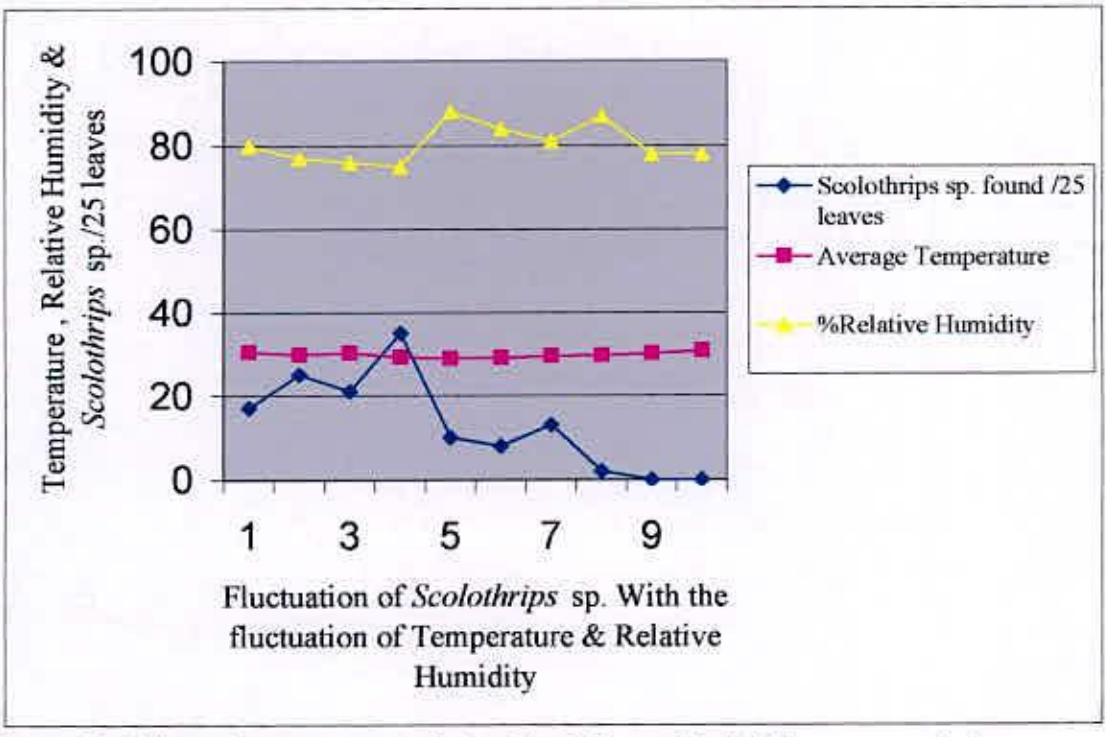


Figure 12 Effect of temperature ,relative humidity on *Scolothrips sp.* population in experimental field in CRS, BJRI during 2005

8. RED BUG

RED BUG

It would be best predator for both jute white mite and red mites if there were timely introduction of its synchronization with the host life cycle.

8.1 Systematic analysis

Phylum: Arthropoda

Class: Insecta

Order: Hemiptera

Family: Unidentified

Genus : Unidentified

8.2 Description:

Their nymph are dark red in color and a white ring was observed at the thoracic region of the body. This white ring was found to be faded at the adult stage. They reached to the adult through four nyphal instar.

8.3 Feeding rate:

It was observed that each bug eat 59+/-1.51 no. of white mite per hours. It was observed to eat red mite by nymph. but feeding by adult was not observed and determined due to so much activity at the light without taking food.

Table 7 Predation rate of the predator ,Red Bug per hour in laboratory condition of CRS, BJRI during 2005

Stage of Predator	Predation rate /hour (Mean+/-SE)
Adult	59+/-1.51

At room temperature 26 ^{0}C & Relative Humidity 75%

Attacking stage:

Both nymph and adult feed on egg, nymph and adult of jute white mite and red mite.

Plate 12 Dorsal view of Nymph of Red Bug

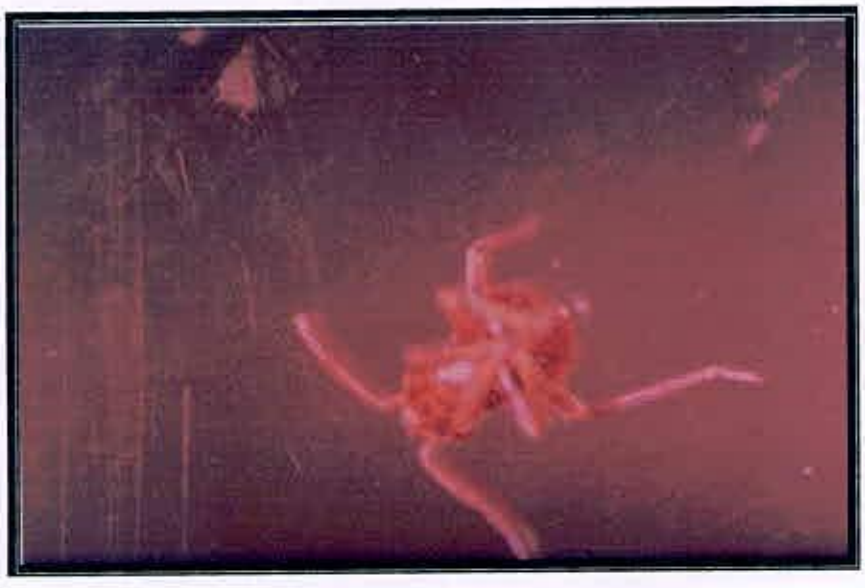


Plate 13 Ventral view of Nymph of Red Bug

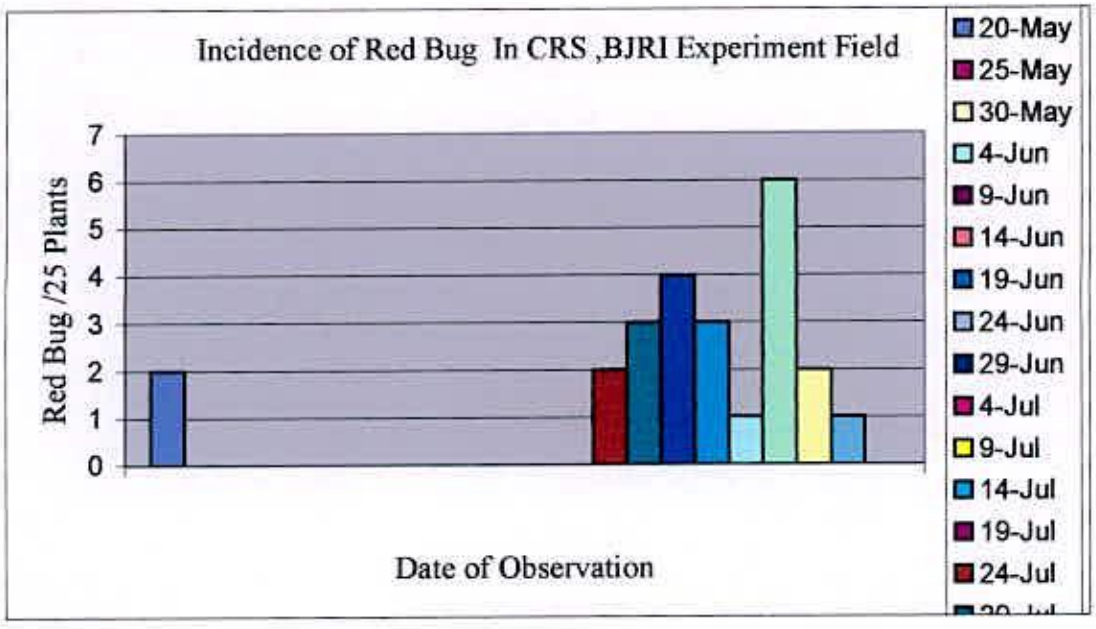


Figure 13 Seasonal Incidence of red bug in experimental field in CRS ,BJRI during 2005

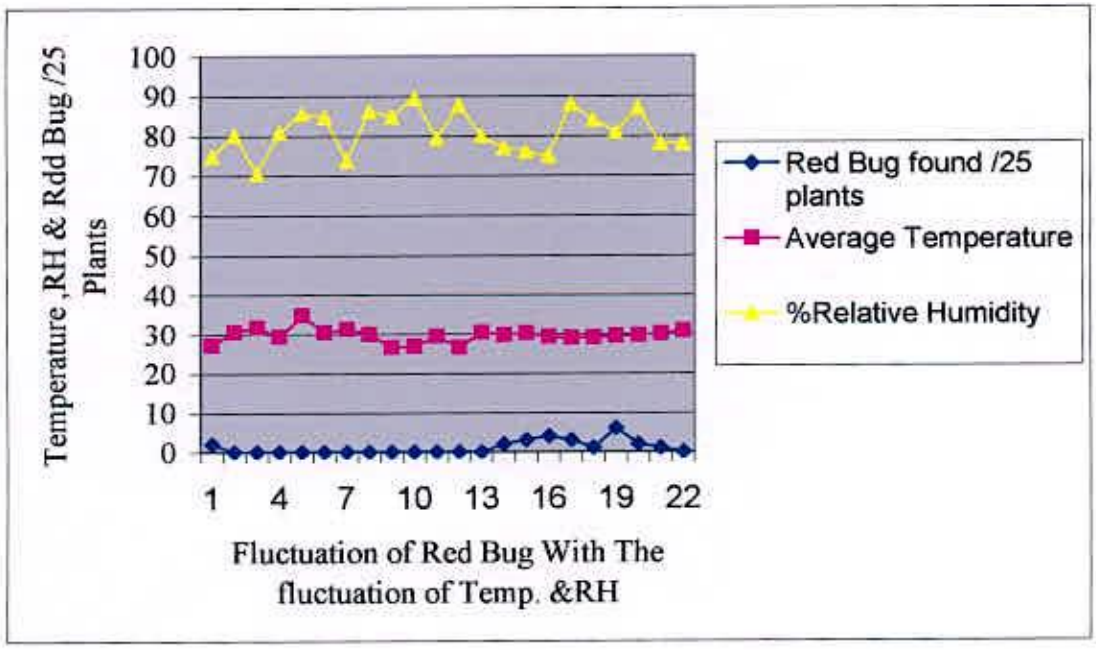


Figure 14 Effect of temperature ,relative humidity on red bug population in experimental field in CRS ,BJRI during 2005

Activity:

Their activity is going on all the day long. Their phoresy power is so high.

Incidence :

Their incidence was sudden at the jute growing season only rare case. But severe incidence was observed at the kenaf field so much. In kenaf field they were found to eat the cell sap of plants. Their incidence in the kenaf field from last of July till August last.

Ecology :

From the observation it was found that the high temperature and high humidity were suited to survive. It was not found most strictly that with the rainfall their density increased or not. High humidity about to 78-84% with high temperature of 29^{O}C were found more suitable for red bug. High temperature and low humidity was not preferred by red bug to survive.

DISCUSSION

From the study it was observed that *Neoseiulus (= Amblyseius)* sp. was an important predatory mite of jute mites. It was also reported by bonde 1989 as important predator of white mite. The consumption rate of predatory mite was recorded 6+/- 0.53 white mites per hour which differ with the finding of Gilkenson , 1991.

Hunter (1997) stated *Neoseiulus (= Amblyseius sp.) californicus* (McGregor), *Neoseiulus (= Amblyseius sp.) fallacis* (Garman), and *Phytoseiulus persimilis* as useful predators for controlling *T. urticae* on ornamental plants. Athias-Henriot Hamlen (1980, 1978) observed that *Phytoseiulus macropilis* can significantly reduce *T. urticae* on greenhouse-grown dieffenbachia when introduced twice, 3 weeks apart, at the rate of 10 predators per infested plant with an initial *T. urticae* density of ca. 38 mites/leaf.

Weintraub et. al (2005) stated that *Neoseiulus cucumeris* is used for biological control of phytophagous mites such as the broad mite (*Polyphagotarsonemus latus*), and thrips such as *Frankliniella occidentalis* and *Thrips tabaci* on greenhouse cucumbers and sweet peppers. Cross (1984) showed that introductions of predatory mites in March or early April at a rate of one mite per plant were consistently successful. Spicciarelli *et al.* (1992) recommended that phytoseiid mites give good control of TSM, if one mite is released per plant when the infestation of TSM has reached two individuals per leaf, and about 30% of the leaves are infested. Bonomo *et al.* (1991) also reported that releases of *P. persimilis* gave effective control of TSM, and that it was essential that the predator be released when the density of the pest was low (1-2 per leaf). Pickel *et al.* (1996) recommended the outbreak of TSM may have been caused by low humidity in May, when the weather was hot and dry. *P. persimilis* needs a RH > 60% to survive, particularly at the egg stage. but in presetnt study ,no find predatory mite has not been observed eating red mite. It has been observed predatory mite eating white mite only.

Sufficient information regarding natural enemiesof jute miteswere not avalable. Few author mentioned that only the thrips and lady beetle act as predator of white mites.

In the present study it has been detected only eight predators consisting of three bugs, two beetles, two thrips and one mite. The predatory bug , *O. insidiosus* sp. was found more effective for controlling both white and red mite while predatory lady beetle *Stethorus* sp. was found effective against jute red mites. It was observed that consumption rate of red bug was the highest than any other predators detected during the study .But under consideration of incidence and synchronization with the white mite *O. insidiosus* was the most efficient predator for mite control. Present study revealed that *O. insidiosus* was the best followed by *Scolothips* sp. *Amblyseius* sp., *Adelphocoris* sp, & Red bug.

CHAPTER--5

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

In the present study emphasis has been given to detect and utilize naturally occurring bio-control agents for the management of jute mites concerning the environmental issues and the farmer's economic condition . Data were collected from the selected plots in which no chemicals were sprayed. Detection of natural enemies were made by two ways; leaf searching and plant searching. Infested plant were selected and mite infested leaf were colleted from each plant and were observed under stereomicroscope to investigate the natural enemies.

Five predator species were recorded on jute white mite from CRS, Dhaka. during the study period . Of these, three were Hemipteran insects, one under Thysanoptera and one under Acarina. The predator *O. insidiosus & Amblysieus* sp.were found to attack all the stages ie.egg nymph & adult of jute white mite while the thrips attack only the eggs.

O. insidiosus was found to be the most abundant followed by *Amblyseius sp.* , red bug and thrips. *O. insidiosus* was found to appear from the middle of June till the end of September. Tarnished bug found at the middle June in 2005. But it was found again at the month of August to September. Predatory mites were first appeared at 25th April. It was also found again May and till the end of August. The thirps was first found at the month of June only for 20 days from 10th June to 30th June. After that it was not found.

There occurred a good synchrony in the life cycle of *O. insidiosus* with its host jute white mite. Even in adverse condition the predator occurred in the field although the number was low. A similar pattern was observed for Amblysieus sp.. But for Hemipteran bug and thrips no synchrony were found to occur with the life cycle of their host jute white mite. In the field, the adult predators were most active at the 10am to 12am as compared to early morning & evening.

Morphological features of different predators were also studied. At the nymphal instars of *O. insidiosus* was yellowish red or orange colored and they turned to black to become adult. In case of *Scolothrips* at first it was found to be transparent at nymphal instar and they become yellowish colored adult stage. It was also found that temperature and humidity markedly influenced the development of the predator.

Five predators species were recorded on red mite from CRS, BJRI during the study period of 2005. Of these, three species under Coloeoptera , one Hemipteran predator under the family Anthocoridae.

Brief biological and ecological description of *Stethorus sp.* and *O. insidiosus* have been done. Some relevant information on other species have also been provided. Host stage preference temperature & humidity tolerance limits of the *Stethorus sp.* sp. and *O. insidiosus* have been determined. The biological control potentialities of these species have been worked out.

Among the predators recorded from the field, *Stethorus sp.* was found to be the most numerous in all the areas followed by *O. insidiosus*, ,*Scolothrips* sp. and another

coleopteran grub. The incidence of *Stethorus sp.* was found to appear at the middle of the July and till the end of August 2005.

Good synchrony was observed in the life cycle of *Stethorus sp.* with the host of red mite. Even in adverse condition the predator occurred in the field. Though the number was low *Stethorus sp., O. insidiosus* compete in the same area and time. Multiple parasitism becomes inevitable but such situation was not observed in the study.

In the field adult predators were active during 8am to 11am. In the morning time and also active at the evening time but in the noon their activity was low. The morphological structures of immature stages has been described for the *Stethorus sp.* and O. insidiosus.

It was concluded that the predator found in the present study played an important role in the suppressions of jute white mite and red mite. Information gathered here could be utilized in management practices in enhancing the stability and activity of the predator population in the field. This would also facilitate the activity of the predators and in the decline of jute white mite and red mite.

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CHAPTER -6

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REFERENCES

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APPENDIX

APPENDIX I.

WEATHER INFORMATION

Table 8 Monthly average of Temperature, Relative humidity, Total Rainfall and sunshine hour of the experiment site during the period from November 2004 to February 2005

Year	Month	Air temperature (^{0}c)			Relative humidity (%)	Rainfall (mm)	Sunshine (hr)
		Maximum	Minimum	Mean			
2005	May	32.20	21.80	27.00	66.69	66.70	155.0
	June	26.9	16.2	21.5	70.6	0.0	210.5
	July	24.5	13.9	19.2	68.5	4.0	194.1
	August	28.9	18.0	23.4	61.0	3.0	221.5

Source: Bangladesh Meteorological Department (Climate division), Agargaon, Dhaka- 1212.

APPENDIX II
WHITE MITE INFESTED JUTE PLANT

Plate 14 White mite infested jute field

Plate 15 White mite infested leaves and twig

Plate 16 White mite infested stick without leaves

APPENDIX III.

LIST OF PREDATORS OF JUTE MITES

Table 8 list of predators of jute mites detected from this study

Sl.	Figure	Name of Predator	Scientific name	Order	Host
1		Minute Pirate bug	*O. insidiosus*	Hemiptera	white mite &red mite
2		Predatory Mites	Amblyseius sp. sp.	Acarina	white mite
3		lady bird beetle	*Stethorus sp. sp.*	Coleoptera	red mite
4		Thrips	*Scolothrips* sp.	Thysanoptera	white mite
5		Tarnished bug	*Adelphocoris* sp.	Hemiptera	yellow mite
6		Lady bird beetle	----------	Coleoptera	red mite
Sl	Figure	Name of	Scientific name	Order	Host

Sl	Figure	Name of Predator	Scientific name	Order	Host
7		Thrips	*Scolothrips* sp.	Thysanoptera	red mite
8		Red bug	--------	Hemiptera	white mite & Red mite

APPENDIX IV.

COMPARATIVE CONSUMPTION RATE OF VARIOUS NATURAL ENEMIES OF JUTE MITES

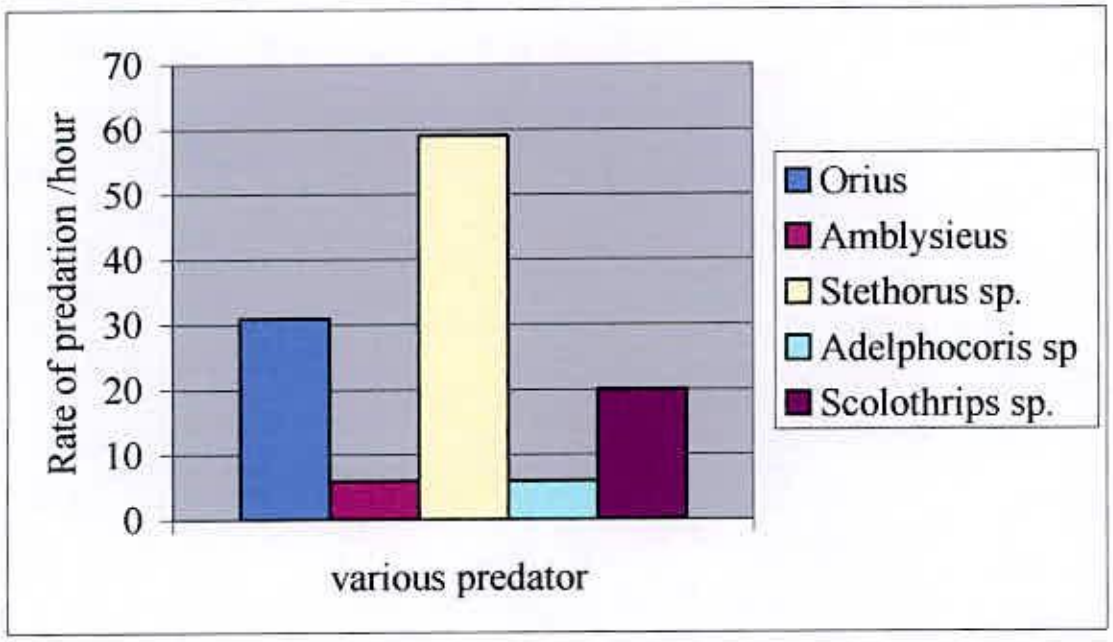

Figure 15 No. of white mite consumed by various predator

It was observed that consumption rate of red bug was the highest than any other predators detected during the study .But under consideration of incidence and synchronization with the white mite *O. insidiosus* was the most efficient predator for mite control . in the poin of study view *O. insidiosus* was the best followed by *Scolothips* sp. *Amblyseius* sp. ,*Adelphocoris* , Red bug .

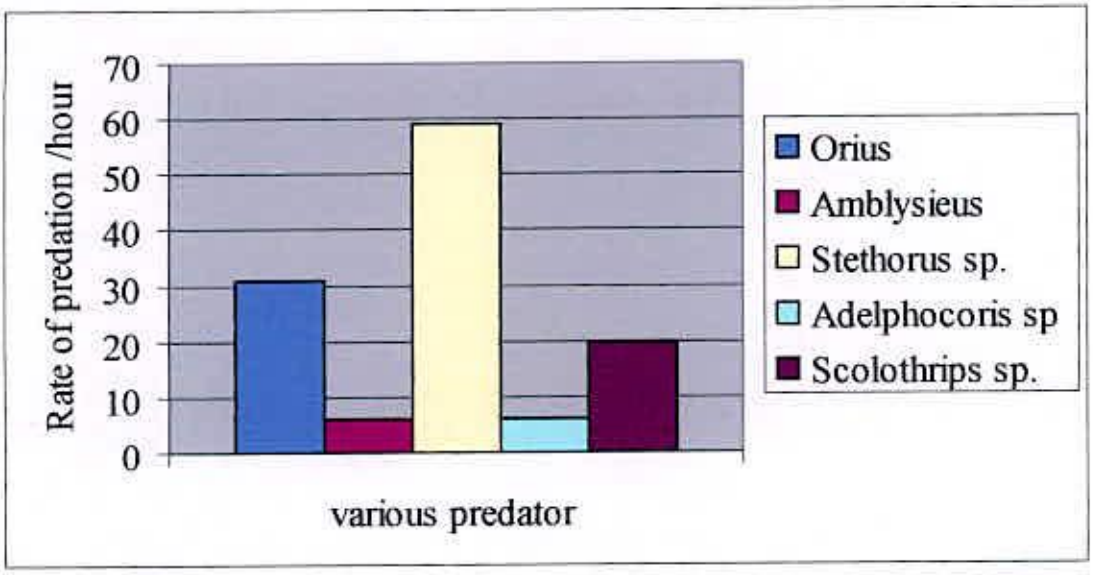

Figure 16 No. of host consumed by various predator

It was observed that consumption rate of *Stethorus* sp. was the highest than any other predators detected during the study . In the point of study view *Stethorus* sp. was the best followed by *Scolothrips* sp. *O. insidiosus* , lady beetle, Red bug