



E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(6): 331-334
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Received: 15-09-2016
Accepted: 16-10-2016

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Insects associated with Bt. and non-Bt. cotton plants in Tripura

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Abstract

Observation of different cotton pest species and their natural enemies have been made on *Bacillus thuringiensis* (Bt.) and non-*Bacillus thuringiensis* (non-Bt.) cotton plants in Tripura. Boll worm, *Earias vitella* Fabricius, Red cotton bug, *Dysdercus koenigii* (Fabricius) and cotton aphid, *Aphis gossypii* Glover were recorded from both Bt and non-Bt cotton plants, besides other pest species in non Bt. plants along with several natural enemies of cotton aphid. Altogether, 12 pest species and 9 natural enemies representing 7 predators and 2 parasites have been reported in this paper.

Keywords: Bt and non Bt cotton plants, cotton pests and natural enemies

1. Introduction

Cotton plant has been an important cash crop in India since a long time. Even today cotton is a vital crop of commerce and is popularly known as “white gold”. In India the area of cotton cultivation and production has increased over a period of time (Tabel-1). The cultivated cottons mainly belong to the genus *Gossypium* and there is a continuous process of domestication of this genus. Cotton agro ecosystem harbours more than 1300 insect species across the world in different agro-climatic conditions of cotton growing areas. But in a given area only 5-10 key pest species predominate and cause severe damage to the plants and ultimately lead to a substantial loss of yield. Cotton yield loss is mainly from the insect damage. An estimate indicates that the total yield loss due to insect cause would amount to about 15% of the world production [1-6].

Research on cotton cultivation had undergone a drastic change when Bt. cotton was introduced in the developed countries in the year 1996 and in India in 2002. The major problem of cotton cultivation is insect infestation of cotton plants which reduces the production substantially. Attention on cotton insects has been paid since its commercial production which continues till today and would continue in the coming years too.

162 species of phytophagous insects have been recorded from India, out of which 24 species have acquired the pest status, and only 9 species are the key pests in different cotton growing areas. [2, 4, 5, 7] Several natural enemies have also been recorded from the cotton pest complex. [5, 8, 9, 10, 11, 12]

In the state of Tripura no such information of cotton pest species is available, although there is record of cultivation of short staple (“Comilla Cotton”) cotton mainly in “Jhum” practice [13]. Therefore, an attempt was made to observe the incidence of insect pest complex of cotton plants (*Gossypium hirsutum*) in both Bt. and non Bt. plants and their natural enemies.

2. Material and Methods

2.1 Study area

Success of cotton cultivation depends on several factors mainly soil condition, rain, quality seeds, soil temperature, pH and other factors. Cotton prefers higher temperature throughout the year. Ideally cotton is grown on deep, well drained, fertile soils, to allow effective root development. If there is water logging, especially during the early stage, it results in stunted growth. The study was conducted at Sekherkot, District Sepahijola, Tripura (Long 91.16'.39'' E and Lat 23.44'.41'' N) in the month of July-December of the year 2011 & 2012. The map of Tripura with the study area is included in this communication (Fig. 1).

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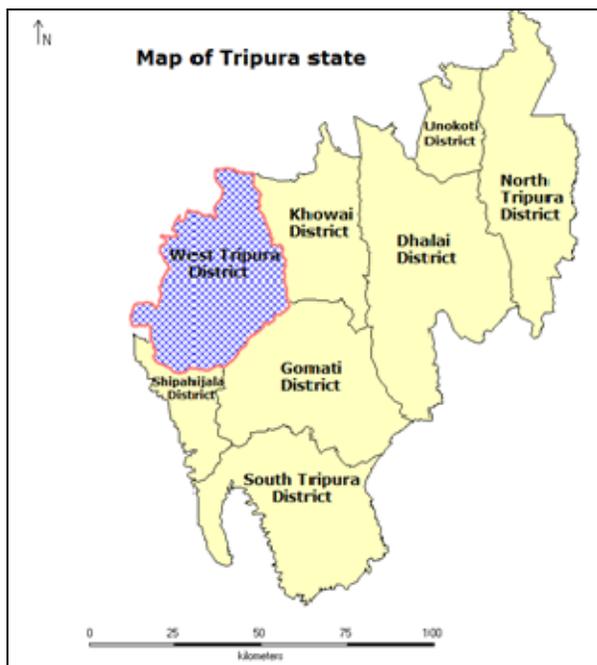


Fig 1: Map of Tripura showing the study area

2.2. Field preparation

To prepare soil, ploughing of the field was done initially and Nitrogen application was made @30kg / ha. but in dry land / poor soil application of Nitrogen was divided into three parts equally and applied at planting time, after 6 week (square formation time) and the 3rd dose at 12th week (hardening of boll). Besides Nitrogen-sulphur, phosphate and potash were also applied for proper nutrition. Irrigation of water at different stage of plant growth was made available. pH of the soil determined was 4.5 in laterite soil and 7.1 in clay soil. In the present study to find out the complex of insect pest species two kinds of cotton (*Gossypium hirsutum* Linnaeus) seeds were used namely the Bt. and non-Bt. cotton. The soil preparation and other suitable agronomic practice were adopted as per the requirements of the cotton plant. As per guidelines non-Bt. cotton seeds were also sown in the field of Bt. Cotton.

2.2. Collection and rearing of insects

Regular field scouting were done in the fields for collection of infested leaves, squares, flowers, bolls and tilted apical part of plants with immature stages of insects and these were brought to the laboratory for rearing and emergence of adult stage. Petri dishes and glass jars were used for rearing purpose.

3. Results and Discussion

Altogether 12 pest species have been found to damage the cotton plants in the studied area. Of them, five Lepidopteran species (*Earias vitella* (Fabricius, 1794); *Prodenia litura* (Fabricius, 1775); *Anomis flava* (Fabricius, 1775); *Sylepta derogata* (Fabricius,1775) and *Amsacta* sp.; two each of Hemipteran, (*Dysdercus koenigii* Fabricius, 1775 and *Bemisia tabaci* (Gennadius, 1889), and Coleopteran species (*Alphitobius piceus* (Olivier, 1972) and *Tanymecus* sp.) and

one each from the order Hemiptera (*Aphis gossypii* Glover, 1877), and Orthoptera (unidentified grasshopper) were found (Table- 2).

Occurrence of natural enemies included predatory species of four coleopterans (*Coccinella transversalis*, Fabricius, 1781, *Menochilus sexmaculatus*, (Fabricius, 1781), *Micraspis discolor* (Fabricius, 1798) and *Scymnus* sp.) two dipterans (*Ischiodon scutellaris* (Fabricius, 1805) and *Metasyrphus confrater* Wiedemann, 1930), one neuropteran (*Micromus timidus* Hagen, 1853) and one hymenopteran parasite (*Trioxys (Binodoxys) indicus* Subba Rao and Sharma, 1959 (Table- 3). Cotton plants after emergence are subject to insect attack and the infestation continues till hardening of the bolls. To understand the problem, observations on the growing phases of cotton plant are classified into three different stages namely: the early vegetative stage (up to 8 weeks), the reproductive stage (4 weeks after blooming) and Boll maturation stage (7-9 weeks). Duration of these stages may vary with the variety, area of cultivation, availability of the sun light and water. Each stage of cotton plant growth is crucial for the succeeding stages and ultimately for good harvesting of the crops. The incidence of individual pest species must therefore be considered in relation to the stages of plant development.

Table 1: Area and production of cotton/ha. in India, **Source:** Cotton Advisory Board(CAB).

Year	Area in lakh ha.	Production in lakh bales of 170 kg	Yield (kg/ha).
1950 – 1951	58.82	34.3	99
2000 – 2001	85.76	140.00	278
2010 – 2011	111.42	339.0	517
2015-2016	118.81	352	504

Table 2: Cotton damaging insect pests on non Bt. and Bt. cotton plants in Tripura.

Common Name	Non-Bt. Cotton	Bt. Cotton
Red hairy caterpillar	<i>Amsacta</i> sp.	
Leaf roller	<i>Sylepta derogata</i> (Fabricius,1775)	
Leaf worm	<i>Prodenia litura</i> (Fabricius, 1775)	

Cotton aphid	<i>Aphis gossypii</i> Glover, 1877	<i>Aphis gossypii</i> Glover, 1877
Cotton whitefly	<i>Bemisia tabaci</i> (Gennadius, 1889)	
Spotted boll worm	<i>Earias vitella</i> (Fabricius, 1794)	<i>Earias vitella</i> (Fabricius, 1794)
Red cotton bug	<i>Dysdercus koenigii</i> Fabricius, 1775	<i>Dysdercus koenigii</i> Fabricius, 1775
Black Weevil	<i>Tanymecus</i> sp.	
Green semilooper	<i>Anomis flava</i> (Fabricius, 1775)	
Coleoptera: Tenebrionidae	<i>Alphitobius piceus</i> (Olivier, 1972)	
Boll weevil	<i>Anthonomus</i> sp.	
Unidentified Surface grasshopper	Orthoptera: Acridiidae	

Table 3: Predators and parasites in Bt. and non-Bt. cotton plants in Tripura.

Non Bt. cotton	Bt. Cotton
Predators	
<i>Coccinella transversalis</i> Fabricius, 1781	
<i>Menochilus sexmaculatus</i> (Fabricius, 1781)	<i>Menochilus sexmaculatus</i> (Fabricius, 1781)
<i>Micraspis discolor</i> (Fabricius, 1798)	
<i>Micromus timidus</i> Hagen, 1853	<i>Micromus timidus</i> Hagen, 1853
<i>Ischiodon scutellaris</i> (Fabricius, 1805)	
<i>Metasyrphus (Metasyrphus) confrater</i> (Wiedemann, 1930)	
<i>Scymnus</i> sp.	<i>Scymnus</i> sp.
Parasites	
<i>Trioxyx (Binodoxys) indicus</i> Subba Rao and Sharma, 1959.	

a) Insects in the early vegetative stage

Occurrence of insects in cotton plant starts with the onset of germination and more significantly at the 3-5 leaf stage besides root cutter (Fig. 2). Several pest species have been recorded to damage in the early stage of plant growth (Fig. 3). These insects can affect the establishment of the crop so that initial control measure would yield good result. This early pest may delay the plant growth and boll formation. Insect pests found in this stage have been recorded in the Table- 4.

b) Reproductive stage of cotton plant.

This stage is crucial period of crop development. During this period of rapid growth there is an increasing number of buds,

squares, flowers and bolls which attract a number of insect pests and are able to damage the crop yield to a greater extent unless adequate control measure is undertaken (Fig.3). Insect pests found in this stage have been recorded in the Table- 5.

c) Boll maturation stage of cotton plant.

At this late stage of cotton plant growth several insect pests are seen to cause the multifarious damage to the cotton yield and quality of lint cotton and seed cotton (Fig. 4 and Fig. 5). Most of the pest species seen during the early and reproductive stages of plant growth are also observed in this late stage of plant growth (Table: 6).



Fig 2: 3-5 Leaf stage cotton plant.



Fig 3: Leaf damaged by leaf roller.



Fig 4: Cotton plant with mature bolls.



Fig 5: Cotton plant with bursting bolls

Table 4: Early season pest of cotton plant (*Gossypium* sp.)

Non Bt. Cotton	Bt. Cotton
<i>Aphis gossypii</i> Glover, 1877	<i>Aphis gossypii</i> Glover, 1877
<i>Bemisia tabaci</i> (Gennadius, 1889)	
<i>Dysdercus koenigii</i> Fabricius, 1775	
<i>Earias vitella</i> (Fabricius, 1794)	<i>Earias vitella</i> (Fabricius, 1794)
<i>Amsacta</i> sp.	
<i>Sylepta derogata</i> (Fabricius, 1775)	

Table 5: Insect pest species during Reproductive stage of cotton plant.

Non Bt. Cotton	Bt. Cotton
<i>Aphis gossypii</i> Glover, 1877	<i>Aphis gossypii</i> Glover, 1877
<i>Dysdercus koenigii</i> (Fabricius, 1775)	<i>Dysdercus koenigii</i> (Fabricius, 1775)
<i>Earias vitella</i> (Fabricius, 1794)	<i>Earias vitella</i> (Fabricius, 1794)
<i>Anthonomus</i> sp.	
<i>Prodenia litura</i> (Fabricius, 1775)	

Table 6: Insect pest species during boll maturation stage of cotton plant.

Non Bt. cotton	Bt. Cotton
<i>Aphis gossypii</i> Glover, 1877	<i>Aphis gossypii</i> Glover, 1877
Cotton whitefly: <i>Bemisia tabaci</i> (Gennadius, 1889)	
Spotted boll worm: <i>Earias vitella</i> (Fabricius, 1794)	Spotted boll worm: <i>Earias vitella</i> (Fabricius, 1794)
Red cotton bug: <i>Dysdercus koenigii</i> (Fabricius, 1775)	Red cotton bug: <i>Dysdercus koenigii</i> (Fabricius, 1775)
Black Weevil: <i>Tanymecus</i> sp.	
<i>Prodenia litura</i> (Fabricius, 1775)	
Leaf roller: <i>Sylepta derogata</i> (Fabricius, 1775)	

4. Acknowledgement

Authors are thankful to Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata for giving necessary permissions and extended help during the identification of several insect species. Thanks are also due to Shri K. C. Gopi, Additional Director and In-charge of Entomology Division (A & B), Zoological Survey of India for constant help and support. The first author is also grateful to the Principal, Women's College, Agartala for providing working facilities.

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