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

Jahar Lal Saha and Bulganin Mitra

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 (Table-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 reduce 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. Several natural enemies have also been recorded from the cotton pest complex.

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).
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 littura (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 discoulour (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>
<thead>
<tr>
<th>Year</th>
<th>Area in lakh ha.</th>
<th>Production in lakh bales of 170 kg</th>
<th>Yield (kg/ha).</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950 – 1951</td>
<td>55.82</td>
<td>34.3</td>
<td>99</td>
</tr>
<tr>
<td>2000 – 2001</td>
<td>85.76</td>
<td>140.00</td>
<td>278</td>
</tr>
<tr>
<td>2010 – 2011</td>
<td>111.42</td>
<td>339.0</td>
<td>517</td>
</tr>
<tr>
<td>2015-2016</td>
<td>118.81</td>
<td>352</td>
<td>504</td>
</tr>
</tbody>
</table>

Table 2: Cotton damaging insect pests on non Bt. and Bt. cotton plants in Tripura.
Cotton aphid  \textit{Aphis gossypii} Glover, 1877
Cotton whitefly  \textit{Bemisia tabaci} (Gennadius, 1889)
Spotted boll worm  \textit{Earias vitella} (Fabricius, 1794)
Red cotton bug  \textit{Dysdercus koenigii} Fabricius, 1775
Black Weevil  \textit{Tanytarsus} sp.
Green semi-looper  \textit{Anomis flava} (Fabricius, 1775)
Coleoptera: Tenebrionidae  \textit{Alphitobius piceus} (Olivier, 1792)
Boll weevil  \textit{Anthonomus} sp.
Unidentified Surface grasshopper Orthoptera: Acridiidae

\begin{center}
\begin{tabular}{|c|c|}
\hline
\textbf{Predators} & \textbf{Parasites} \\
\hline
\textit{Coccinella transversalis} Fabricius, 1781 & \textit{Trioxys (Binodoxys) indicus} Subba Rao and Sharma, 1959. \\
\textit{Menochilus sexmaculatus} (Fabricius, 1781) & \\
\textit{Micraspis discolor} (Fabricius, 1798) & \\
\textit{Micromus timidus} Hagen, 1853 & \\
\textit{Ischioidon scutellaris} (Fabricius, 1805) & \\
\textit{Metasyrphus (Metasyrphus) confinater} (Wiedemann, 1930) & \\
\textit{Scymnus} sp. & \\
\hline
\end{tabular}
\end{center}

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

\textbf{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.

\textbf{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.

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

<table>
<thead>
<tr>
<th>Non Bt. Cotton</th>
<th>Bt. Cotton</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aphis gossypii</em> Glover, 1877</td>
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</tr>
<tr>
<td><em>Bemisia tabaci</em> (Gennadius, 1889)</td>
<td><em>Aphis gossypii</em> Glover, 1877</td>
</tr>
<tr>
<td><em>Dysdercus koenigii</em> Fabricius, 1775</td>
<td><em>Aphis gossypii</em> Glover, 1877</td>
</tr>
<tr>
<td><em>Earias vitella</em> (Fabricius, 1794)</td>
<td><em>Earias vitella</em> (Fabricius, 1794)</td>
</tr>
<tr>
<td><em>Amsacta</em> sp.</td>
<td><em>Amsacta</em> sp.</td>
</tr>
<tr>
<td><em>Sylepta derogata</em> (Fabricius, 1775)</td>
<td><em>Sylepta derogata</em> (Fabricius, 1775)</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Non Bt. Cotton</th>
<th>Bt. Cotton</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aphis gossypii</em> Glover, 1877</td>
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</tr>
<tr>
<td><em>Dysdercus koenigii</em> (Fabricius, 1775)</td>
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</tr>
<tr>
<td><em>Earias vitella</em> (Fabricius, 1794)</td>
<td><em>Earias vitella</em> (Fabricius, 1794)</td>
</tr>
<tr>
<td><em>Anthonomus</em> sp.</td>
<td><em>Anthonomus</em> sp.</td>
</tr>
<tr>
<td><em>Prodenia litura</em> (Fabricius, 1775)</td>
<td><em>Prodenia litura</em> (Fabricius, 1775)</td>
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Table 6: Insect pest species during boll maturation stage of cotton plant.

<table>
<thead>
<tr>
<th>Non Bt. Cotton</th>
<th>Bt. Cotton</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aphis gossypii</em> Glover, 1877</td>
<td><em>Aphis gossypii</em> Glover, 1877</td>
</tr>
<tr>
<td>Cotton whitefly: <em>Bemisia tabaci</em> (Gennadius, 1889)</td>
<td>Cotton whitefly: <em>Bemisia tabaci</em> (Gennadius, 1889)</td>
</tr>
<tr>
<td>Spotted boll worm: <em>Earias vitella</em> (Fabricius, 1794)</td>
<td>Spotted boll worm: <em>Earias vitella</em> (Fabricius, 1794)</td>
</tr>
<tr>
<td>Red cotton bug: <em>Dysdercus koenigii</em> (Fabricius, 1775)</td>
<td>Red cotton bug: <em>Dysdercus koenigii</em> (Fabricius, 1775)</td>
</tr>
<tr>
<td><em>Prodenia litura</em> (Fabricius, 1775)</td>
<td><em>Prodenia litura</em> (Fabricius, 1775)</td>
</tr>
<tr>
<td>Leaf roller: <em>Sylepta derogata</em> (Fabricius, 1775)</td>
<td>Leaf roller: <em>Sylepta derogata</em> (Fabricius, 1775)</td>
</tr>
</tbody>
</table>

4. Acknowledgement

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5. References

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