

POPULATION DYNAMICS OF THRIPS (*THRIPS TABACI*) AND LADYBIRD BEETLE (*COCCINELLA SEPTEMPUNCTATA*) ON TRADITIONAL AND TRANSGENIC CULTIVAR OF COTTON

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Abstract

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Cotton plays critical role in the economy of Pakistan. *Thrips tabaci* is reported as minor sucking pest of various field crops including cotton but in severe cases it causes heavy loss to cotton crop. In many cropping systems, the most common and plentiful predator of sucking insect pest like, aphid is ladybird beetle (*Coccinella septempunctata*). The current trail was conducted to determine the population dynamic of thrips (*Thrips tabaci*) and ladybird beetle (*Coccinella septempunctata*) on traditional and transgenic cultivars of cotton and predator-prey was used as measure to determine possible effect on population under investigation on the following cotton cultivars viz, FH-113, FH-114, FH-901, FH-1000 and CIM-496. These cotton cultivars were sown at the Entomological area of Postgraduate Agriculture Research Station (PARS), Faisalabad. Fisher's analysis of variance technique and least significant difference (LSD) test was applied at 5% probability level to test the significance of the treatments' means to analyze the collected data statistically. Results revealed that transgenic cultivars were more susceptible to thrips infestation as compared to conventional genotypes. Highest population of ladybird beetles was observed on transgenic cultivars as compared to conventional genotype due to more availability of thrips which act as a food source for ladybird beetles. The results indicated that maximum population of thrips (18.83 thrips/leaf) and ladybird beetles (11.49 LBB/leaf) were observed on FH-901 during 19-06-2011. While minimum population of thrips (0.82 thrips/leaf) and ladybird beetles (0.01 LBB/leaf) were observed on FH-1000 during 10-07-2011.

Key words: population dynamic, *Thrips tabaci*, *Coccinella septempunctata*, *Aphis gossypii*, cotton cultivars

Introduction

Cotton, *Gossypium hirsutum* L. (Family Malvaceae), is one of the most commercially important fiber crops in the world. It is a perennial semi-shrub grown as an annual crop in both tropical and warm temperate regions. In addition to textile manufacturing, it produces seeds with a potential multi product base such as hulls, oil, lint and food for animals (Ozyigit et al., 2007).

Cotton is the crop of commerce, history, industry and civilization, attracts renewed global interest being the silver

fiber of the world. Besides, earning a substantial foreign exchange of over 68 percent from the export of raw cotton and for 7.3 percent of the value added in agriculture and about 1.6 percent to GDP (Economic Survey, 2009). Cotton is known as “white gold” is an important fiber and cash crop of Pakistan. The average yield of cotton is about 570.99 kg/ha, which is low as compared to other cotton growing area of the world (Bakhsh et al., 2005).

Cotton is main fiber crop of Pakistan; it occupies the largest area after wheat, and earns highest export revenue. Cotton is the important non-food kharif crop and a leading

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source of foreign exchange earning. It accounts for 8.2% of the value added in agriculture and about 2% of GDP (GOP, 2004). During the last one and half decades the production of cotton has been doubled in Pakistan but it is still low as compared to major cotton growing countries of the world (GOP Agriculture Statistics, 2004). The Area under *Bt* improved astonishingly in 2005 when Pakistan Atomic energy commission provided 40,000 Kg seed of different *Bt* cotton strains which were grown over 3,238 hac during the 2005-06 season (Rao, 2006). Due to regular cultivation of land, hundreds of insect pests appear that reduce the quality and quantity of crops.

Pakistan cotton yields have been stagnant due to many reasons i.e., excessive rains at the time of sowing, high temperatures at the flowering stage, late wheat harvesting resulting in a decline of areaplanted to cotton, incidence of Cotton Leaf Curl Virus and improper production technology in the major cotton growing areas of Punjab and Sindh (Economic Survey, 2007). And also production of cotton is limited by various factors among which insect pests are very important. The key insect pests of cotton are Termite, *Microtermes obesi*; Cutworm, *Agrotis ipsilon*; Thrips, *Thrips tabaci*; Jassid, *Amrasca biguttula biguttula*; Whitefly, *Bemisia tabaci*; Aphid, *Aphis gossypii*; Leaf-roller, *Sylepta derogate*; Red cotton bug, *Dyesdercus koenigii*; Mite, *Tetranychus macfarlanei*; Grey weevil, *Myloccerus undecimpustuletus*; Spotted bollworm, *Earias insulana*; Pink bollworm, *Pectinophora gossypiella* and American bollworm, *Helicoverpa armigera* (Dhaka and Pareek, 2007). In cotton, the insect pests infestation caused deterioration in lint quality and 10-40% losses in crop production (Gahukar, 2006). *Thrips tabaci* damages young cotton seedlings, flowers and stems. The incidence is sever in the beginning of the season during the periods of low relative humidity (Colyer, 1991).

Chelonus blackburni Cameron, *Trichogramma achaeae* Nagraja, *T. brasiliensis* (Ashmead), *Chrysoperla carnea* Stephens, *Coccinella septempunctata* Linnaeus, *Menochilus sexmaculatus* Fabricius and Spiders have been observed as potential natural enemies of key pests of cotton and play an important role in the cotton ecosystem (Dhaka and Pareek, 2007). The biological control with coccinellids has contributed greatly and suppressed the pests below economic damage (Hoy and Nguyen, 2000). Development of the predator population depends on the availability of prey. A number of beneficial insects are found in fields, where their food habits are different. A high reproductive rate is important so that populations of natural enemy can rapidly increase when hosts are available (Solangi et al., 2005). In Pakistan many species of Coccinellid predators, (Coleoptera: Coccinellidae) are very efficient to control many insect-pests, particularly on

small and soft body insects. There are more than 4000 species of Coccinellids around the world (Michaud, 2001). The occurrence of insect pests greatly reduces both the yield and value of cotton production. The incidence and increase of all the insect pests are much dependent upon the prevailing ecological factors such as temperature, relative humidity and rain (Aheer et al., 1994). The present study was conducted to determine the control of Thrips (*T. tabaci*) by natural biocontrol agent and to check population of Thrips (*T. tabaci*) and ladybird beetle on transgenic and traditional cultivar of cotton. Keeping in view the importance of the crop and losses caused by different insect pests to it, the present research was aimed at studying population dynamics of thrips and their natural enemies on different cotton cultivars.

Materials and Methods

A field experiment was carried out to check the population dynamics of Cotton Thrips (*Thrips tabaci*) and beneficial fauna on traditional (non-*Bt*) and transgenic (*Bt*) cultivars of cotton. There are three cultivars of *Bt* (FH-113, FH-114 and FH-901) and two cultivars of non-*Bt* (FH-1000 and CIM-496) were sown. The experiment was conducted at the Entomological area of Postgraduate Agriculture Research Station (PARS), Faisalabad. The experiment was laid down in randomized complete block design (RCBD) with a factorial arrangement with three replications and plot size of 90 × 60 cm. Standard and recommended agronomic practices were carried out as and when required.

The five cultivars of cotton viz., three cultivars of *Bt* (FH-113, FH-114 and FH-901) and two cultivars of non-*Bt* (FH-1000 and CIM-496) were sown on 11th May, 2011. These cultivars were sown with the dibble method at Row × Row distance of 75 cm and the Plant × Plant distance of 20 cm. First data regarding on population dynamics of Thrips (*T. tabaci*) and natural fauna of cotton crop were recorded after one month of sowing cotton cultivars and then other data regarding on population dynamics of Thrips (*T. tabaci*) and natural fauna on these cotton cultivars was recorded on a weekly basis throughout the crop season by taking five plants randomly from each plot and from each plant five leaves (upper, middle, bottom) were observed. The average population of thrips was noted per leaf.

Each treatment was randomized by a lottery method in each replication. The adults of the predator seven spotted ladybird beetle, *C. septempunctata* L. was collected from these cotton cultivars which were sown in field of Entomological area of Postgraduate Agriculture Research Station (PARS), Faisalabad. After collection and preservation, identify these insects, the first step is to find out in which Order it is clas-

sified. For this purpose a dichotomous key was used. A dichotomous key is a tool that uses paired statements or questions to guide you to the solution. Good hand lens was used to run the key.

Statistical Analysis

Standard procedure was followed to record the data. The data collected was analyzed statistically by applying Fisher's analysis of variance technique and least significant difference test will be applied at 5% probability level to test the significance of the treatment means.

Results

The data regarding the thrips population on different cultivars of *Bt* and non-*Bt* cultivars on different dates of the cotton growing season are presented in the graphs.

Population recorded during 12-06-2011

Maximum population of thrips was observed on *Bt* varieties i.e., FH-901 (5.29 thrips/leaf) followed by FH-113 (4.55 thrips/leaf) and FH-114 (4.34 thrips/leaf), and minimum population was observed on non-*Bt* varieties i.e., FH-1000 (1.98 thrips/leaf) and CIM-496 (2.22 thrips/leaf) during 12-06-2011. While maximum and minimum population of beneficial fauna of ladybird beetles was seen on FH-901 (3.49 LBB/leaf) and FH-1000 (0.73 LBB/leaf), respectively during 12-06-2011 (Figure 1).

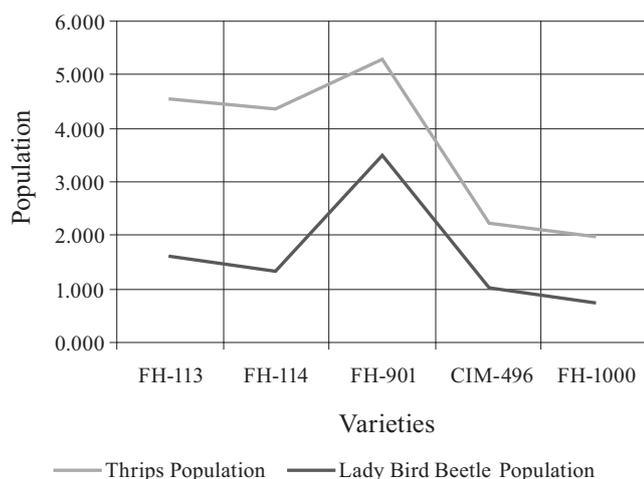


Fig. 1. Thrips and Lady Bird Beetle population on different Bt and Non-Bt cultivars of cotton recorded during 12-06-2011 at Entomological area of Post-graduate Agriculture Research Station (PARS), Faisalabad (Punjab), Pakistan

Population recorded during 19-06-2011

Maximum population of thrips was observed on *Bt* varieties i.e., FH-901 (18.83 thrips/leaf) followed by FH-113 (17.98 thrips/leaf) and FH-114 (17.30 thrips/leaf), and minimum population was observed on non-*Bt* varieties i.e., FH-1000 (5.40 thrips/leaf) and CIM-496 (6.92 thrips/leaf) during 19-06-2011. While maximum and minimum population of beneficial fauna of ladybird beetles was seen on FH-901 (11.40 LBB/leaf) and FH-1000 (2.27 LBB/leaf), respectively during 19-06-2011 (Figure 2).

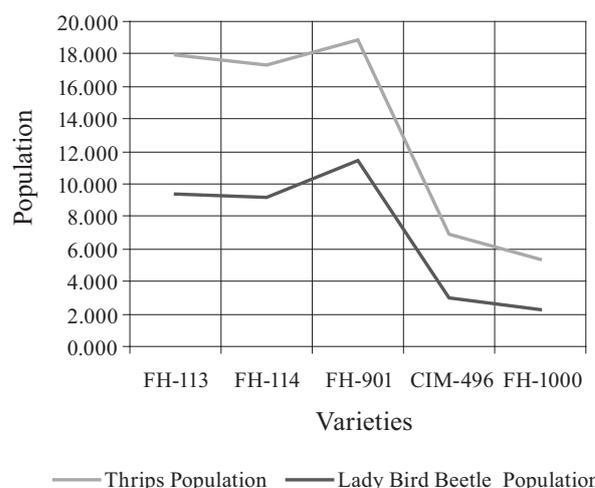


Fig. 2. Thrips and Lady Bird Beetle population on different Bt and Non-Bt cultivars of cotton recorded during 19-06-2011 at Entomological area of Post-graduate Agriculture Research Station (PARS), Faisalabad (Punjab), Pakistan

Population recorded during 26-06-2011

Maximum population of thrips was observed on *Bt* varieties i.e., FH-901 (16.23 thrips/leaf) followed by FH-113 (15.18 thrips/leaf) and FH-114 (14.26 thrips/leaf), and minimum population was observed on non-*Bt* varieties i.e., FH-1000 (4.99 thrips/leaf) and CIM-496 (5.88 thrips/leaf) during 26-06-2011. While maximum and minimum population of beneficial fauna of ladybird beetles was seen on FH-901 (9.38 LBB/leaf) and FH-1000 (1.92 LBB/leaf), respectively during 26-06-2011 (Figure 3).

Population recorded during 03-07-2011

Maximum population of thrips was observed on *Bt* varieties i.e., FH-901 (11.48 thrips/leaf) followed by FH-113 (10.62 thrips/leaf) and FH-114 (10.39 thrips/leaf), and minimum population was observed on non-*Bt* varieties i.e., FH-1000 (3.29 thrips/leaf) and CIM-496 (4.30 thrips/leaf) dur-

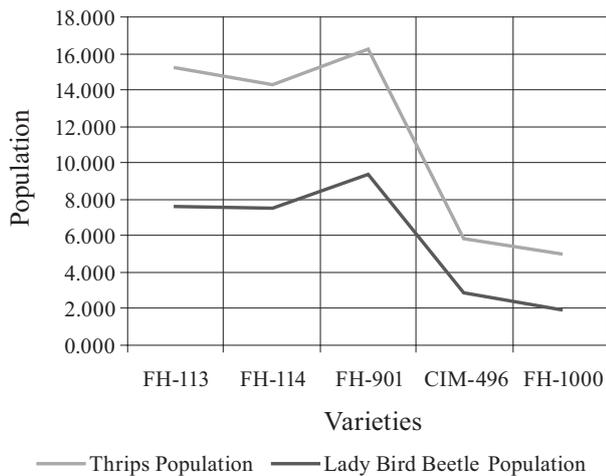


Fig. 3. Thrips and Lady Bird Beetle population on different Bt and Non-Bt cultivars of cotton recorded during 26-06-2011 at Entomological area of Post-graduate Agriculture Research Station (PARS), Faisalabad (Punjab), Pakistan

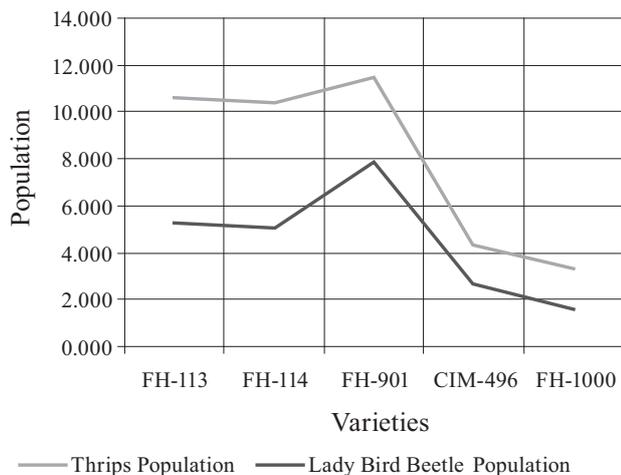


Fig. 4. Thrips and Lady Bird Beetle population on different Bt and Non-Bt cultivars of cotton recorded during 03-07-2011 at Entomological area of Post-graduate Agriculture Research Station (PARS), Faisalabad (Punjab), Pakistan

ing 03-07-2011. While maximum and minimum population of beneficial fauna of ladybird beetles was seen on FH-901 (7.88 LBB/leaf) and FH-1000 (1.57 LBB/leaf), respectively during 03-07-2011 (Figure 4).

Population recorded during 10-07-2011

Maximum population of thrips was observed on Bt varieties i.e., FH-901 (3.40 thrips/leaf) followed by FH-113

(2.62 thrips/leaf) and FH-114 (2.01 thrips/leaf), and minimum population was observed on non-Bt varieties i.e., FH-1000 (0.82 thrips/leaf) and CIM-496 (1.99 thrips/leaf) during 10-07-2011. While maximum and minimum population of beneficial fauna of ladybird beetles was seen on FH-901 (1.01 LBB/leaf) and FH-1000 (0.01 LBB/leaf), respectively during 10-07-2011 (Figure 5).

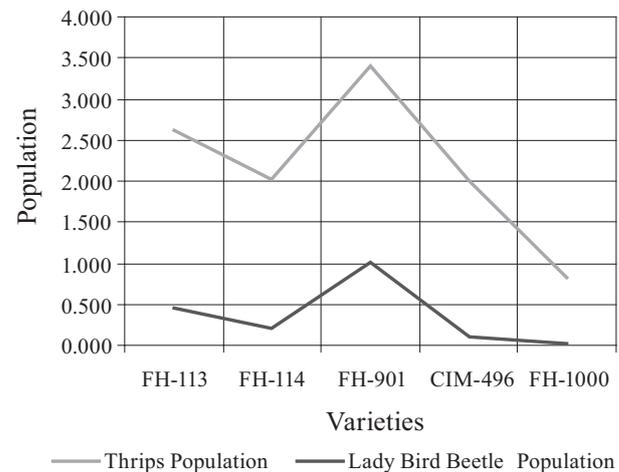


Fig. 5. Thrips and Lady Bird Beetle population on different Bt and Non-Bt cultivars of cotton recorded during 10-07-2011 at Entomological area of Post-graduate Agriculture Research Station (PARS), Faisalabad (Punjab), Pakistan

Population recorded during 17-07-2011

Maximum population of thrips was observed on Bt varieties i.e., FH-901 (7.39 thrips/leaf) followed by FH-113 (6.06 thrips/leaf) and FH-114 (5.10 thrips/leaf), and minimum population was observed on non-Bt varieties i.e., FH-1000 (2.30 thrips/leaf) and CIM-496 (3.93 thrips/leaf) during 17-07-2011. While maximum and minimum population of beneficial fauna of ladybird beetles was seen on FH-901 (5.91 LBB/leaf) and FH-1000 (1.02 LBB/leaf), respectively during 17-07-2011 (Figure 6).

Discussion

The results revealed that the maximum mean population of thrips was observed on Bt varieties i.e., FH-901 (10.44 thrips/leaf) followed by FH-113 and FH-114 (9.50 and 8.90 thrips/leaf, respectively), whereas minimum mean population of thrips was observed on non-Bt varieties i.e., FH-1000 and CIM-496 (3.13 and 4.21 thrips/leaf, respectively). The results also revealed that maximum mean population of lady-

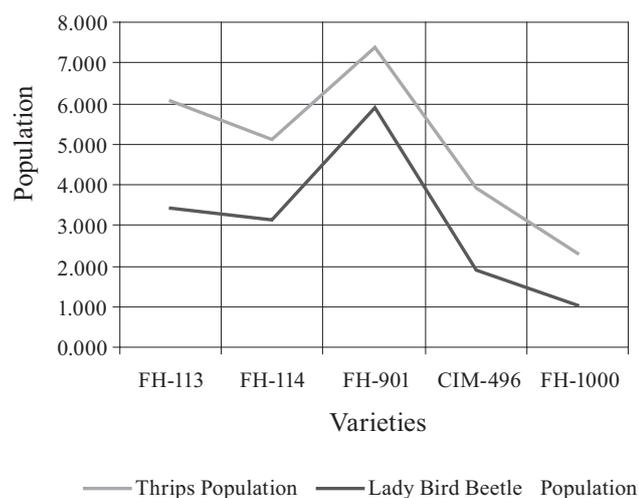


Fig. 6. Thrips and Lady Bird Beetle population on different Bt and Non-Bt cultivars of cotton recorded during 17-07-2011 at Entomological area of Post-graduate Agriculture Research Station (PARS), Faisalabad (Punjab), Pakistan

bird beetles was observed on *Bt* varieties i.e., FH-901 (6.51 LBB/leaf) followed by FH-113 and FH-114 (4.61 and 4.40 LBB/leaf, respectively), whereas minimum mean population of ladybird beetles was observed on non-*Bt* varieties i.e., FH-1000 and CIM-496 (1.25 and 1.93 LBB/leaf, respectively) (Figure 7).

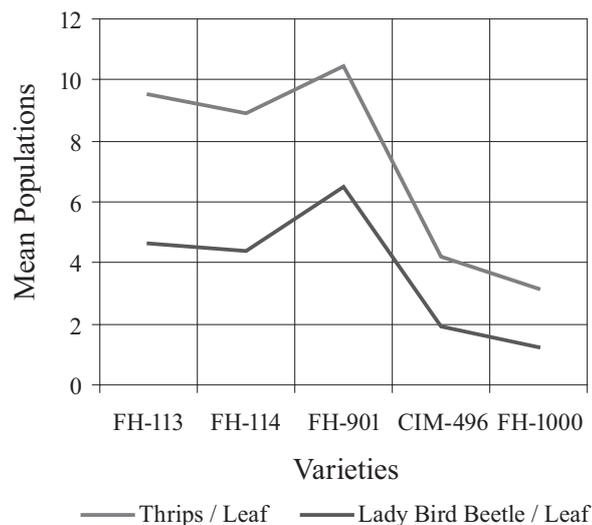


Fig. 7. Mean Comparison of Thrips and Lady Bird Beetles population on different cotton varieties during June-July 2011

According to results, maximum population of thrips was recorded on transgenic cultivars as compared to traditional cultivars so our findings have been supported by Naveen et al., (2007) and Men et al. (2005) who reported that higher population of thrips was recorded on *Bt* cotton as compared to conventional cotton. While according to the Whitehouse et al. (2005) population of thrips was low on *Bt* cotton as compared to conventional cotton cultivars whereas most of the studies showed that sucking pest were found equal abundance in *Bt* and non-*Bt* varieties Sisterson et al. (2004). However the results of present research show a high population of thrips on *Bt* cotton varieties which may be due to varietal response and favorable environmental condition and these results correlate with the results of Naveen et al. (2007) and Men et al. (2005). Increase or decrease in population may be due to temperature and relative humidity further influence the intrinsic rate of natural increase of the thrips (Murai, 2000) while according to Li et al. (1992), different weather factors like temperature, relative humidity were found to have positive associations with thrips population on cotton. Wahla et al., (1996) who found that rainfall and relative humidity and minimum air temperature were negatively correlated with the thrips population.

Weather variables including rainfall, temperature, relative humidity and wind have been reported as important factors that significantly affect thrips population according to Ananthakrishnan (1993), Kirk (1997) and Legutowska (1997). Relatively high temperature and lack of rainfall have been associated with increase in onion thrips population, while high relative humidity and rainfall reduce thrips population (Hamdy and Salem, 1994). Sharma and Pampapathy (2006) in a study found no significant difference between the population of white fly and thrips on *Bt* and non-*Bt* cotton.

According to results, maximum population of ladybird beetles was recorded on transgenic cultivars as compared to traditional cultivars so our finding have been supported by Armstrong et al. (2002) who found maximum population of predators on transgenic cultivars and they concluded that *Bt* cotton may act as a refuge for predaceous insects. Similarly, in the Chinese province of Hebei, growers reported a 25% increase in natural enemies of pests in *Bt* cotton fields and observed higher number of natural predators such as wasps, aphid consuming flies and ladybugs than in non-*Bt* field (Buranakanonda, 1999).

Conclusions

In the light of above mentioned results and numerical data, it is concluded that transgenic cultivars (*Bt*) were more susceptible to thrips infestation as compared to conven-

tional genotypes (non-*Bt*). Maximum population of ladybird beetles was observed on transgenic cultivars as compared to conventional genotype due to more availability of thrips which act as a food source for ladybird beetles). Maximum population of thrips (18.83 thrips/leaf) and ladybird beetles (11.49 LBB/leaf) were observed on FH-901 during 19-06-2011. While minimum population of thrips (0.82 thrips/leaf) and ladybird beetles (0.01 LBB/leaf) were observed on FH-1000 during 10-07-2011.

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