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# Influence of Abiotic Factors on Population Dynamics of Sucking Insect Pests in Transgenic Cotton

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## ABSTRACT

**A field experiment was conducted to investigate the impact of abiotic factors on population dynamics of sucking insect pests in transgenic cotton *cv*. RCH-138 Bt *viz.,* aphid (*Aphis gossypii* Glover), jassid (*Amrasca biguttula biguttula* Ishida), whitefly (*Bemisia tabaci* Gennadius), thrips (*Thrips tabaci* Lindeman) and mealybug (*Phenaccocus solenopsis* Tinsley) under unprotected condition. The results of the field study revealed that the sucking pest population was found throughout the year from first fortnight of August to end of January. The peak population of aphid, jassid, whitefly, thrips and mealybug were 4.38, 4.39, 3.98, 1.53 and 4 grade infestation in 50$^{th}$, 37$^{th}$, 46$^{th}$, 40$^{th}$ and 41$^{st}$ – 42$^{nd}$ standard week, respectively. Correlation analysis with the weather parameters *viz*., temperature, relative humidity, wind velocity, sunshine hours and rainfall revealed that maximum temperature showed significant positive effect on all the sucking insect pests. The minimum temperature showed negative effect on aphid population and non significant effect on whitefly and thrips population. The relative humidity has non-significant effect, whereas precipitation has negative effect on all the sucking pests.**

**Key words** *Population dynamics, Abiotic factors, Correlation, sucking insect pests*

Cotton (*Gossypium* Spp.) being the king of natural fibre is grown in 111 countries all along the world. In India it is cultivated in 12.66 million ha with a production of 400 million bales of seed cotton. The average productivity of cotton in India is 537 kg per ha as compared to world average of 760 kg per ha. India occupies 37.20 per cent of global cotton area contributing 25.58 per cent of world production. Thus India ranks first in area and production on global basis. Despite the large area, the productivity in India is very low. In Gujarat, cotton is being grown in an area of 30.06 lakh ha with a productivity of 707 kg per ha (Anon., 2015). Cotton fiber is an important raw material to the textile industries and plays a key role in national economy in terms of employment generation and foreign exchange.

Among the insect pests, a complex of sucking pests *viz.,* jassid, *Amrasca biguttula biguttula* Ishida, aphid, *Aphis gossypii* (Glover), whitefly, *Bemisia tabaci* (Gennadius), mealybug, *Phenacoccus solenopsis* (Tinsley) and thrips *Thrips tabaci* (Lindeman) occupy major pest status of cotton crop. Information on seasonal activity of sucking pests on *Bt* cotton helps to take up effective management strategies. Keeping this in view present study was undertaken.

## MATERIALS AND METHODS

The field experiment was carried out during 2010-2011 at Regional Cotton Research Station, Maktampur Farm, Navsari Agricultural University, Bharuch, Gujarat. The transgenic cotton RCH-138 (BG-II) sown during the second fortnight of June. Crop was raised as per the package of practices recommended by University. The weekly observations on sucking pests *viz*., jassids, aphids, whitefly and thrips (nymph and adult) were recorded from three leaves / plant (top, middle and bottom) on five randomly selected plants throughout the crop period.

The data obtained correlated with abiotic factors *viz*., maximum temperature, minimum temperature, relative humidity (morning and evening), wind velocity, sunshine hrs. and rainfall were analyzed by standard statistical procedure.

## RESULTS AND DISCUSSION

### Aphid

The result showed in Table-2 indicated that the incidence of aphid started from October (40th standard meteorological week) and remained throughout the crop period (4th standard meteorological week) except July, August and September because of high rainfall. The peak incidence of aphid population was recorded 4.38 per three leaves in the 50th standard week.

The present findings are in partial agreement with the findings of Bakhetia and Sidhu, 1976 who revealed that the aphid population remaining active throughout the year. The present findings are in close association with the findings of Roy and Behura, 1979 *A. gossypii* was found throughout the year on aubergine plants with a peak during March-April. The present findings are not agreement with the findings of Dugger and Richter, 1998 who reported peak aphid incidence on cotton during July months it is strongly due to high rainfall during those months.

### Jassid

The population of jassid was noticed throughout the season except August. Maximum population of jassid was recorded 4.39 per three leaves during second week of September (37th standard meteorological week) followed by 3.93, 3.65, 3.61 and 3.33 per three leaves during 34th, 33rd, 41st and 35th standard meteorological week, respectively. The jassid population was fluctuated during crop period (Table 2). Anita and Nandihalli, 2008 and Arif *et al.,* 2006 reported that leafhopper population was found throughout the year.

### Whitefly

The observations regarding whitefly population (Table 2) recorded maximum in first fortnight of November (45 & 46th standard meteorological week) showed a peak with 3.71 and 3.98 whiteflies per three leaves. Population declined below ETL from December first fortnight onwards and similar trend was continued up to crop period. The lowest whitefly population was recorded during August month. Again from September onwards, the whitefly population gradually increased. The present findings are in line with the findings of Seif, 1980 and Gupta *et al.,* 1998 who reported that with increase in temperature and relative humidity, population of whitefly also increased. Jeyakumar *et al.,* 2008 reported higher incidence of whitefly in *Bt* cotton

October first fortnight onwards population was decreased and fluctuated without a definite pattern and it was almost negligible and continued throughout the crop period. The population steadily increased in second fortnight of November. The present findings are in close agreement with the findings of Anita and Nandihalli, 2008 who reported peak incidence of whitefly was noticed in November.

### Thrips

In case of thrips (Table 2) lower incidence was noticed throughout the cropping period. The first appearance of thrips was observed in third week of September and first week of November because of high rainfall. The maximum incidence of thrips population was recorded in 40th standard meteorological week (First week of October) with a peak incidence of 1.53 per three leaves. The present findings are in consonance to this phenomenon. According to Patel *et al*., 2013 maximum temperature had positive while rainfall had negative impact on thrips population. The effect of temperature was also significant and positive on thrips population (Arif *et al*., 2006).

### Mealybug

Higher mealybug population (Table 2) was observed from 38th to 46th standard meteorological week because of high rainfall. The minimum incidence of mealybug was noticed from 47th (second fortnight of November) to 1st standard meteorological week (First fortnight of January). Mealy bug population was significantly and positively correlated with maximum temperature and negatively correlated with other parameters. The present findings are similar with the results of Hanchinal *et al*., 2010 found positive association of mealy bugs with the maximum temperature. Dhawan *et al*., 2009 also reported positive correlation between mealybug and maximum temperature and negative impact of humidity and rainfall in Punjab which agrees with the present findings.

**Table 1. Correlation matrix of sucking insect pests of cotton with abiotic factors**

| Name of the insect pest | Maximum temperature | Minimum temperature | Relative humidity | Wind velocity (km / hr) | Sunshine hours | Rainfall |
|---|---|---|---|---|---|---|
| Aphid | *0.78 | -0.03 | 0.21 | -0.42 | -0.68 | -0.39 |
| Jassid | *0.72 | 0.28 | 0.22 | -0.76 | -0.18 | -0.25 |
| Whitefly | *0.71 | 0.27 | 0.31 | -0.28 | -0.61 | -0.23 |
| Thrips | *0.80 | 0.18 | 0.16 | -0.39 | -0.29 | -0.23 |
| Mealybug | *0.78 | 0.34 | 0.28 | -0.43 | -0.39 | -0.47 |

Significant at 5%

**Table 2. Population dynamics of sucking pests in RCH-138 *Bt* at Bharuch during 2010-11**

| SW | Period | Average population / 3 leaves | | | | Mealybug (Grade) |
|---|---|---|---|---|---|---|
| | | Aphids | Jassid | Whitefly | Thrips | |
| 31 | 30.07.10 to 05.08.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32 | 06.08.10 to 12.08.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 13.08.10 to 19.08.10 | 0.00 | 3.65 | 0.00 | 0.00 | 0.00 |
| 34 | 20.08.10 to 26.08.10 | 0.00 | 3.93 | 0.00 | 0.00 | 0.00 |
| 35 | 27.08.10 to 02.09.10 | 0.00 | 3.33 | 0.71 | 0.00 | 0.00 |
| 36 | 03.09.10 to 09.09.10 | 0.00 | 1.92 | 1.13 | 0.00 | 0.00 |
| 37 | 10.09.10 to 16.09.10 | 0.00 | 4.39 | 1.27 | 0.00 | 0.00 |
| 38 | 17.09.10 to 23.09.10 | 0.00 | 1.61 | 3.71 | 0.83 | 2.00 |
| 39 | 24.09.10 to 30.09.10 | 0.00 | 2.14 | 2.37 | 1.05 | 2.00 |
| 40 | 01.10.10 to 07.10.10 | 0.87 | 1.31 | 2.17 | 1.53 | 3.00 |
| 41 | 08.10.10 to 14.10.10 | 0.00 | 3.61 | 0.91 | 0.67 | 4.00 |
| 42 | 15.10.10 to 21.10.10 | 0.76 | 0.91 | 0.65 | 0.00 | 4.00 |
| 43 | 22.10.10 to 28.10.10 | 1.23 | 0.63 | 1.15 | 0.00 | 3.00 |
| 44 | 2910.10 to 04.11.10 | 0.73 | 0.49 | 0.81 | 0.00 | 1.00 |
| 45 | 05.11.10 to 11.11.10 | 2.53 | 1.15 | 3.71 | 0.65 | 2.00 |
| 46 | 12.11.10 to 18.11.10 | 2.14 | 0.87 | 3.98 | 0.83 | 2.00 |
| 47 | 19.11.10 to 25.11.10 | 4.36 | 1.37 | 1.84 | 0.00 | 0.40 |
| 48 | 26.11.10 to 02.12.10 | 2.67 | 0.73 | 1.21 | 0.00 | 0.30 |
| 49 | 03.12.10 to 09.12.10 | 3.17 | 0.93 | 2.10 | 0.00 | 1.00 |
| 50 | 10.12.10 to 16.12.10 | 4.38 | 1.45 | 0.83 | 0.00 | 1.30 |
| 51 | 17.12.10 to 23.12.10 | 2.48 | 0.87 | 0.97 | 0.00 | 0.30 |
| 52 | 24.12.10 to 31.12.10 | 2.05 | 0.56 | 1.03 | 0.00 | 0.20 |
| 01 | 01.01.11 to 07.01.11 | 1.85 | 0.49 | 0.95 | 0.00 | 0.15 |
| 02 | 08.01.11 to 14.01.11 | 1.79 | 0.38 | 0.84 | 0.00 | 0.09 |
| 03 | 15.01.11 to 21.01.11 | 1.68 | 0.34 | 0.79 | 0.00 | 0.05 |
| 04 | 22.01.11 to 28.01.11 | 1.42 | 0.20 | 0.48 | 0.00 | 0.00 |

**Table 3. Data on weather parameters at Regional Cotton Research Station, NAU, at Bharuch during 2010-11**

| Std Week | Period | Weather Parameter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Temperature | | Relative Humidity | | Wind velocity km/hr | Sunshine Hrs | Rainfall | |
| | | Maximum | Minimum | Morn. | Even. | | | mm | days |
| 31 | 30.07.10 to 05.08.10 | 30.8 | 25.1 | 90.1 | 82.1 | 6.4 | 1.0 | 81.4 | 5 |
| 32 | 06.08.10 to 12.08.10 | 30.1 | 25.3 | 87.0 | 79.0 | 4.9 | 3.3 | 52.5 | 4 |
| 33 | 13.08.10 to 19.08.10 | 32.8 | 25.6 | 89.2 | 76.4 | 1.4 | 3.2 | 28.4 | 2 |
| 34 | 20.08.10 to 26.08.10 | 32.7 | 25.5 | 88.5 | 67.4 | 2.0 | 4.3 | 120.0 | 3 |
| 35 | 27.08.10 to 02.09.10 | 32.0 | 25.0 | 95.5 | 81.7 | 1.5 | 1.8 | 148.6 | 6 |
| 36 | 03.09.10 to 09.09.10 | 30.8 | 24.4 | 93.0 | 85.8 | 2.5 | 1.7 | 138.0 | 7 |
| 37 | 10.09.10 to 16.09.10 | 30.9 | 25.1 | 94.8 | 83.0 | 2.1 | 1.5 | 26.0 | 7 |
| 38 | 17.09.10 to 23.09.10 | 32.9 | 24.5 | 90.4 | 66.0 | 0.2 | 5.4 | 181.2 | 3 |
| 39 | 24.09.10 to 30.09.10 | 35.4 | 24.7 | 80.8 | 54.2 | 0.3 | 8.2 | 6.3 | 2 |
| 40 | 01.10.10 to 07.10.10 | 37.5 | 23.9 | 74.2 | 31.7 | 0.3 | 9.6 | 0 | 0 |
| 41 | 08.10.10 to 14.10.10 | 34.8 | 23.7 | 76.2 | 39.8 | 0.6 | 5.7 | 0 | 0 |
| 42 | 15.10.10 to 21.10.10 | 36.5 | 24.8 | 73.8 | 54.0 | 0.9 | 8.1 | 9.0 | 1 |
| 43 | 22.10.10 to 28.10.10 | 34.9 | 23.4 | 71.2 | 45.1 | 0.3 | 8.7 | 0 | 0 |
| 44 | 2910.10 to 04.11.10 | 35.0 | 20.2 | 61.4 | 36.0 | 2.3 | 8.9 | 0 | 0 |
| 45 | 05.11.10 to 11.11.10 | 33.9 | 22.9 | 81.1 | 52.8 | 5.6 | 7.0 | 7.0 | 1 |
| 46 | 12.11.10 to 18.11.10 | 34.6 | 23.4 | 80.2 | 55.4 | 4.9 | 7.1 | 11.4 | 1 |
| 47 | 19.11.10 to 25.11.10 | 31.1 | 21.0 | 85.5 | 64.8 | 5.9 | 5.8 | 40.5 | 3 |
| 48 | 26.11.10 to 02.12.10 | 30.8 | 19.9 | 85.0 | 59.0 | 4.8 | 8.0 | 0 | 0 |
| 49 | 03.12.10 to 09.12.10 | 30.0 | 16.8 | 65.5 | 48.2 | 5.9 | 8.3 | 0 | 0 |
| 50 | 10.12.10 to 16.12.10 | 28.7 | 10.5 | 65.0 | 27.4 | 2.8 | 9.3 | 0 | 0 |
| 51 | 17.12.10 to 23.12.10 | 30.1 | 10.1 | 62.0 | 27.8 | 3.3 | 9.9 | 0 | 0 |
| 52 | 24.12.10 to 31.12.10 | 29.3 | 13.1 | 76.1 | 34.2 | 2.7 | 7.7 | 0 | 0 |
| 01 | 01.01.11 to 07.01.11 | 27.4 | 11.6 | 58.5 | 27.8 | 6.5 | 9.5 | 0 | 0 |
| 02 | 08.01.11 to 14.01.11 | 29.8 | 10.6 | 61.8 | 24.7 | 4.4 | 10.0 | 0 | 0 |
| 03 | 15.01.11 to 21.01.11 | 30.4 | 10.9 | 72.0 | 30.0 | 3.8 | 9.9 | 0 | 0 |
| 04 | 22.01.11 to 28.01.11 | 31.8 | 13.6 | 77.0 | 30.0 | 5.3 | 9.9 | 0 | 0 |

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