



## Research Article

# Spatiotemporal Distribution of Sucking and Bollworm Insect Pests on Transgenic and Conventional Cotton Cultivars at Sahati Region of Central Sindh

Wali Muhammad Mangrio<sup>1\*</sup>, Hakim Ali Sahito<sup>1</sup>, Abdul Hafeez Mastoi<sup>2</sup>, Sanaullah Sattar<sup>3</sup>, Fahmeeda Imdad Sahito<sup>4</sup> and Shahid Ali Jakhrani<sup>1</sup>

<sup>1</sup>Department of Zoology, SALU, Khairpur, Pakistan; <sup>2</sup>Department of Entomology, LUAWMS, Balochistan, Pakistan;

<sup>3</sup>Department of Wildlife and Ecology, UVAS, Lahore, Pakistan; <sup>4</sup>Department of Teacher Education, SALU, Khairpur, Pakistan.

**Abstract** | *Gossypium hirsutum* L. is referred as the “king of fiber”, “white gold” cash crop with prominent economic value. This study aims to seek out and examine the potential resistance against infestation of sucking and bollworm insect pests on promising transgenic and non-transgenic cotton genotypes in farmer’s field condition, Naushahro Feroze. The seeds of three popularly grown genetically hybrid cotton varieties namely; KMG-1, KMG-2, KMG-3, and non-Bt NIAB-78 were sown on 8<sup>th</sup> May 2023. After 6<sup>th</sup> week of cotton sowing, the data of pest infestation were gathered through randomized complete block design on a weekly interval basis on recommended cotton cultivars. The maximum infestation of the thrips population per leaf was recorded on KMG-3, 1.66, followed by KMG-2, 1.35, KMG-1, 1.12, and 1.01 on NIAB-78. The population of spotted bollworms at 1.63, 0.96, 0.89, and 0.84 were counted. Jassid infestation was recorded at 1.24, 1.02, 0.96, 0.93, and whitefly population fluctuations at 1.18, 0.95, 0.83, and 0.79. Overall maximum pest infestation of thrips was recorded at 1.29 compared to spotted bollworms at 1.08, jassid 1.04, and whitefly 0.94, respectively. Present studies are planned to carry out and collect data for the information of the farming community and to fill the scientific information gap on these cotton genotypes in Sindh, Pakistan. Cotton growers immediately take some control measures before to avoid pest infestation. This study also have significant implications for pest management against destructive insect pest species of the cotton crop in future endeavors.

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**\*Correspondence** | Wali Muhammad Mangrio, Department of Zoology, SALU, Khairpur, Pakistan; **Email:** wali.mangrio@salu.edu.pk

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**Keywords** | KMG-1, KMG-2, KMG-3, NIAB-78, Spotted bollworm, Sucking pests



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## Introduction

Cotton, the prime natural fiber, most commercial and main crop of Pakistan (Shah *et al.*, 2017; Sahito *et al.*, 2017), is cultivated more than

100 countries in the semiarid, tropical, and subtropical agro-climatic conditions of the world (Tarazi *et al.*, 2020). Pakistan, India, United States, Brazil, and China are the five top most cotton producer hubs in the world (Parmar *et al.*, 2023). This preeminent fiber crop extends the world’s biggest textile indus-

try with a \$600 annual economic impact throughout the world (Ashraf *et al.*, 2018). Cotton is regarded as a cash crop of Pakistan with significant economic value and the country ranked 4<sup>th</sup> position worldwide (Marral *et al.*, 2023). The cotton crop is cultivated widely throughout Pakistan but Sindh and Punjab provinces are growing belts, the seeds and fibers of the cotton are used by the textile industry and for edible oil purposes (Shuli *et al.*, 2018). Cotton crop is not only used as raw material in the textile industry but also a source of livelihood to local farmer's and country earns foreign exchange (Saleem *et al.*, 2019). The production of cotton in the last decades has been gradually decreasing due to variation in climatic conditions, reduced seed quality, genetic diversity, viral disease, crop and weed competition, insect pest infestation, output and input instability (Razzaq *et al.*, 2021). Cotton breeding and farming have a long history in Pakistan but the abruptly emergence of new widespread diseases instigated extensive yield losses (Saleem *et al.*, 2019). Bt and NIAB-78 cotton varieties could help in reducing the application of pesticides and are considered to be eco-friendly (Tokel *et al.*, 2022). There is a developing stage to create resistance power even after the introduction of several varieties of cotton cultivars (Karar *et al.*, 2020).

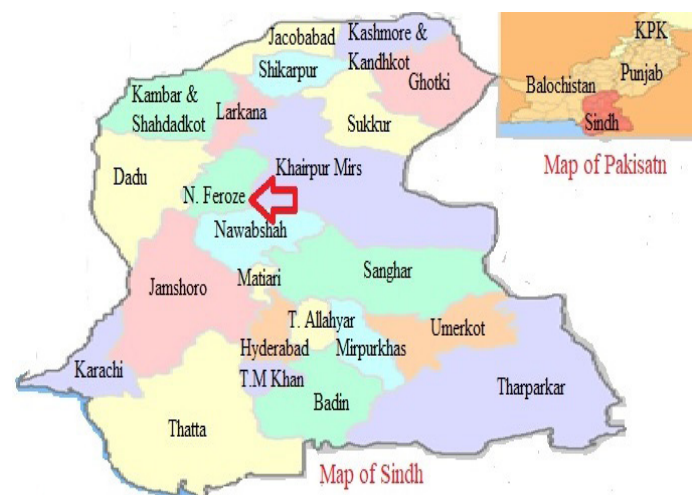
Certain biotic and a biotic stresses such as; insect pest infestations, fungal infections, viral diseases, salinity, drought, heat etc., caused prolonged morphological, physiological, and biochemical changes in cotton cultivars (Qamer *et al.*, 2021). The insect pest larvae have voracious feeder effects at different growing stages of the host plant communities and relay negative effects on productivity (Mangrio *et al.*, 2020). Several insect pest species including, jassid, thrips, whitefly, spotted bollworm, armyworm, American bollworm, and pink bollworm caused huge problems in Pakistan, massively affecting its quality and quantity (Faheem *et al.*, 2022). No doubt, the application of toxic insecticides are rapid control strategy against pest population and cultivars gives more than double income compared to natural enemy field reservoirs (Sahito *et al.*, 2015), but they are causative agents for environmental pollution and human health issues, hence should be used wisely (Mangrio and Sahito, 2023). However, the botanical insecticides exhibited potential alternatives (Mangrio *et al.*, 2023; Mal *et al.*, 2024). The thrips, spotted bollworm, jassid, and whitefly infest cotton genotypes throughout the vegetative and reproductive stages (Mal *et al.*, 2022). It is strongly needed to

boost up the activity of natural enemies to minimize insect pest infestation (Mangrio *et al.*, 2023). In this context, early insect pest management precautions are highly needed for cotton crop security.

## Materials and Methods

### Study area

This study was performed to examine the comparative susceptibility among (n=03) Bt and (n=01) non-Bt cotton genotypes against, thrips, jassid, whitefly, and bollworm populations at natural field conditions, from agriculture form of Rais Nabi Bux Khan Mangrio, Naushahro Feroze. The study area shown in (Figure 1), mostly contains fertile lands, geographically, this area is located at 26.8463°N, latitude and 68.1253°E longitude.



**Figure 1:** Aero in map of Sindh shows study area.

### Study design

The KMG-1 cotton genotype was created by a cross of NIAB-78 and MS-1, KMG-2 variety is the result of a cross of NIAB-78 and MS-2, KMG-3 genotype is the cross product of CIM-109 and MS-1, and NIAB-78 non-Bt genotype was developed from the Delta pine 16xAC-134 and F1 was irradiated with 30Kr gamma rays in 1981. This plant contains 20-26 sympodia and 18-25 monopodia. The (n=02) acres of land were prepared and the seed of three cross cotton genotypes and NIAB-78 were sown on May 8, 2023. The plant-to-plant spacing was kept at 68.5 X 60cm in a plot of 50 X 22 square meters. The fertilizers were applied at the rate of three bags of urea and 1 ½ bags of DAP per acre. The recommended doses of diammonium phosphate, DAP, and nitrogen, phosphorus, potassium, NPK were given at the time of sowing, irrigation, and flowering stage. The details

of genotypes tested in the present study were given in (Abro *et al.*, 2004b). All cotton experimental varieties were managed by using the recommended agronomic “package of practices of *Kharif crops*” and insecticides were strictly prohibited in experimental plots.

#### *Insect pest observation and data collection*

The observations on cotton sucking and bollworm insect pests were made after 45 days of sowing and continued till crop harvest. For data recording five plants were selected in RCBD with four replications. From each plant, data were recorded from the bottom, middle, and top portions of the plant leaves. Intensive carefully the population of *A. biguttula biguttula* (Ishida), *T. tabaci* (Lind), *B. tabaci* (Gennadius), and *Earias* spp were observed and recorded. The data of pest insects were collected at weekly interval basis. The infestation of the pest was calculated by using of following formula:

$$\text{Pest infestation (\%)} = \frac{\text{No. of infested fruiting plant bodies}}{\text{Total no of plant fruiting bodies}} \times 100$$

#### *Statistical analysis*

The analysis of variance (ANOVA) of the entire pest collected data (RCBD) was analyzed through student package (SXW) statistics software version 8.1. The mean results interpretations were separated by using (LSD) method at ( $P < 0.05$ ) probability level.

## Results and Discussions

#### *Prevalence of Thrips tabaci (Lind) on selected cotton cultivars*

The population of *T. tabaci* (Lind), on above discussed cotton cultivars varied significantly ( $P < 0.05$ ) on different calendar dates. Comparatively higher pest population was recorded during the last week of June and the first fortnight of July. The fluctuation of pest population remained throughout the season but gradually declined in the 2<sup>nd</sup> week of October. Comparatively, the highest mean seasonal pest population was recorded on KMG-3, followed by KMG-2, KMG-1, and NIAB-78 an average per leaf population 1.66, 1.35, 1.12, and 1.01, with an overall mean 1.29, respectively. Mostly pest suspected cotton genotypes were recorded KMG-3 followed by KMG-2, KMG-1 but the NIAB-78 cotton cultivar found with more resistant to pest infestation. When the ANOVA of *T. tabaci* (Lind) was statistically analyzed was found (DF= 3; F= 2.11; P= 0.10) non-significant difference in given cotton genotypes, but significant difference

was found (DF= 16; F= 2.61; P= 0.02) among pest data replications, as detail given in (Table 1).

#### *Prevalence of Amrasca biguttula biguttula (Ishida) on selected cotton cultivars*

In this study highest population of *A. biguttula biguttula* was recorded in KMG-3 compared with KMG-2, KMG-1, and NIAB-78 variety. However, the difference was non-significant ( $P < 0.05$ ) among different calendar dates on cotton genotypes. The maximum pest prevalence was recorded during the last week of June and July. However, the population of *A. biguttula biguttula* gradually decreased during the month of October. The average per leaf population was recorded at 1.24, 1.02, 0.96, and 0.93 with an overall mean 1.04, respectively. The NIAB-78 cotton variety found with more resistance against *A. biguttula biguttula* as compared to KMG-1, KMG-2, and KMG-3. When per leaf jassid population was statistically analyzed, the ANOVA was found (DF= 3; F= 2.03; P= 0.11) with non-significant difference but significant difference (DF= 16; F= 4.28; P= 0.02) in pest population on cotton genotypes in all replication, detailed description is given in (Table 2).

#### *Prevalence of Bemisia tabaci (Gennadius) on selected cotton cultivars*

The overall highest seasonal mean pest population was recorded on KMG-3 followed by KMG-2, KMG-1, and NIAB-78 genotypes. The prevalence of pest population was found throughout the year but population gradually increased during the last week of June and July months. During, October the population of *B. tabaci* gradually decreased on cotton cultivars. The maximum per leaf mean population of the *B. tabaci* was recorded at 1.18, 0.95, 0.83, and 0.79 with overall 0.94, respectively. ANOVA showed difference in population on different days found statistically non-significant at ( $P < 0.05$ ). The KMG-3 cotton genotype was found with less resistance power against *B. tabaci* followed by KMG-2, KMG-1, and NIAB-78. When data of whitefly per leaf was subjected to analyzed found non-significant difference (DF= 3; F= 3.46; P= 0.12) but significant (DF= 16; F= 15.7; P= 0.03) among pest data replication, further justification is shown in (Table 3).

#### *Prevalence of Earias spp., on selected cotton cultivars*

These bollworm species cause the shedding of fruiting bodies of cotton and reduce the potential yield of cotton crops. In the present research work

**Table 1:** *Thrips tabaci* (Lind) mean population on different cotton cultivars.

| Date       | NIAB-78             | KMG-1               | KMG-2               | KMG-3               | Mean±SD                  |
|------------|---------------------|---------------------|---------------------|---------------------|--------------------------|
| 24/6/2023  | 1.78 <sup>abc</sup> | 1.82 <sup>abc</sup> | 1.81 <sup>abc</sup> | 4.32 <sup>def</sup> | 2.43±0.63 <sup>bcd</sup> |
| 1/7/2023   | 1.31 <sup>abc</sup> | 1.11 <sup>abc</sup> | 1.13 <sup>abc</sup> | 5.35 <sup>efg</sup> | 2.23±1.04 <sup>bcd</sup> |
| 8/7/2023   | 1.71 <sup>abc</sup> | 1.17 <sup>abc</sup> | 1.65 <sup>abc</sup> | 3.12 <sup>cde</sup> | 1.91±0.42 <sup>abc</sup> |
| 15/7/2023  | 1.04 <sup>abc</sup> | 1.33 <sup>abc</sup> | 3.08 <sup>cde</sup> | 2.09 <sup>bcd</sup> | 1.89±0.46 <sup>abc</sup> |
| 22/7/2023  | 1.27 <sup>abc</sup> | 1.42 <sup>abc</sup> | 1.26 <sup>abc</sup> | 1.37 <sup>abc</sup> | 1.33±0.04 <sup>abc</sup> |
| 29/7/2023  | 0.88 <sup>ab</sup>  | 1.95 <sup>abc</sup> | 1.38 <sup>abc</sup> | 1.28 <sup>abc</sup> | 1.37±0.22 <sup>abc</sup> |
| 5/8/2023   | 1.67 <sup>ab</sup>  | 1.78 <sup>abc</sup> | 2.56 <sup>bcd</sup> | 1.35 <sup>abc</sup> | 1.84±0.26 <sup>abc</sup> |
| 12/8/2023  | 0.86 <sup>ab</sup>  | 1.18 <sup>abc</sup> | 2.07 <sup>bcd</sup> | 1.38 <sup>abc</sup> | 1.37±0.26 <sup>abc</sup> |
| 19/8/2023  | 0.78 <sup>ab</sup>  | 1.21 <sup>abc</sup> | 1.11 <sup>abc</sup> | 1.91 <sup>abc</sup> | 1.25±0.24 <sup>abc</sup> |
| 26/8/2023  | 0.76 <sup>ab</sup>  | 0.81 <sup>ab</sup>  | 0.82 <sup>ab</sup>  | 0.78 <sup>ab</sup>  | 0.79±0.01 <sup>ab</sup>  |
| 2/9/2023   | 0.73 <sup>ab</sup>  | 0.69 <sup>ab</sup>  | 1.71 <sup>ab</sup>  | 0.76 <sup>ab</sup>  | 0.97±0.25 <sup>ab</sup>  |
| 9/9/2023   | 0.78 <sup>ab</sup>  | 0.73 <sup>ab</sup>  | 0.75 <sup>ab</sup>  | 0.77 <sup>ab</sup>  | 0.76±0.01 <sup>ab</sup>  |
| 16/9/2023  | 0.75 <sup>ab</sup>  | 0.75 <sup>ab</sup>  | 0.77 <sup>ab</sup>  | 0.76 <sup>ab</sup>  | 0.76±0.00 <sup>ab</sup>  |
| 23/9/2023  | 0.79 <sup>ab</sup>  | 0.79 <sup>ab</sup>  | 0.68 <sup>ab</sup>  | 0.75 <sup>ab</sup>  | 0.75±0.03 <sup>ab</sup>  |
| 30/9/2023  | 0.81 <sup>ab</sup>  | 0.94 <sup>ab</sup>  | 0.65 <sup>ab</sup>  | 0.79 <sup>ab</sup>  | 0.80±0.06 <sup>ab</sup>  |
| 7/10/2023  | 0.65 <sup>ab</sup>  | 0.72 <sup>ab</sup>  | 0.78 <sup>ab</sup>  | 0.77 <sup>ab</sup>  | 0.73±0.03 <sup>ab</sup>  |
| 14/10/2023 | 0.63 <sup>ab</sup>  | 0.69 <sup>ab</sup>  | 0.75 <sup>ab</sup>  | 0.78 <sup>ab</sup>  | 0.71±0.03 <sup>ab</sup>  |

The same letters in the horizontal columns are non-significant ( $P < 0.05$ ) from each other by LSD. Data  $\sqrt{x + 0.5}$  transformed.

**Table 2:** *Amrasca biguttula biguttula* (Ishida) mean population on different cotton cultivars.

| Date       | NIAB-78             | KMG-1               | KMG-2               | KMG-3               | Mean±SD                  |
|------------|---------------------|---------------------|---------------------|---------------------|--------------------------|
| 24/6/2023  | 1.09 <sup>abc</sup> | 1.22 <sup>abc</sup> | 1.13 <sup>abc</sup> | 2.15 <sup>bcd</sup> | 1.40±0.25 <sup>abc</sup> |
| 1/7/2023   | 1.12 <sup>abc</sup> | 1.37 <sup>abc</sup> | 1.17 <sup>abc</sup> | 1.68 <sup>abc</sup> | 1.34±0.13 <sup>abc</sup> |
| 8/7/2023   | 1.24 <sup>abc</sup> | 1.31 <sup>abc</sup> | 0.98 <sup>ab</sup>  | 1.12 <sup>abc</sup> | 1.16±0.07 <sup>abc</sup> |
| 15/7/2023  | 0.98 <sup>ab</sup>  | 1.12 <sup>abc</sup> | 1.77 <sup>abc</sup> | 2.68 <sup>bcd</sup> | 1.64±0.39 <sup>abc</sup> |
| 22/7/2023  | 1.23 <sup>abc</sup> | 1.08 <sup>abc</sup> | 1.13 <sup>abc</sup> | 1.21 <sup>abc</sup> | 1.16±0.03 <sup>abc</sup> |
| 29/7/2023  | 1.37 <sup>abc</sup> | 1.11 <sup>abc</sup> | 1.21 <sup>abc</sup> | 1.36 <sup>abc</sup> | 1.26±0.06 <sup>abc</sup> |
| 5/8/2023   | 0.87 <sup>ab</sup>  | 1.24 <sup>abc</sup> | 1.36 <sup>abc</sup> | 2.45 <sup>bcd</sup> | 1.48±0.34 <sup>abc</sup> |
| 12/8/2023  | 0.89 <sup>ab</sup>  | 1.13 <sup>abc</sup> | 1.13 <sup>abc</sup> | 1.23 <sup>abc</sup> | 1.10±0.07 <sup>abc</sup> |
| 19/8/2023  | 0.97 <sup>ab</sup>  | 0.88 <sup>ab</sup>  | 1.68 <sup>abc</sup> | 1.57 <sup>abc</sup> | 1.28±0.20 <sup>abc</sup> |
| 26/8/2023  | 0.84 <sup>ab</sup>  | 0.79 <sup>ab</sup>  | 0.76 <sup>ab</sup>  | 0.71 <sup>ab</sup>  | 0.78±0.03 <sup>ab</sup>  |
| 2/9/2023   | 0.78 <sup>ab</sup>  | 0.83 <sup>ab</sup>  | 0.71 <sup>ab</sup>  | 0.72 <sup>ab</sup>  | 0.76±0.03 <sup>ab</sup>  |
| 9/9/2023   | 0.76 <sup>ab</sup>  | 0.77 <sup>ab</sup>  | 0.72 <sup>ab</sup>  | 0.69 <sup>ab</sup>  | 0.74±0.02 <sup>ab</sup>  |
| 16/9/2023  | 0.77 <sup>ab</sup>  | 0.85 <sup>ab</sup>  | 0.69 <sup>ab</sup>  | 0.78 <sup>ab</sup>  | 0.77±0.03 <sup>ab</sup>  |
| 23/9/2023  | 0.76 <sup>ab</sup>  | 0.76 <sup>ab</sup>  | 0.76 <sup>ab</sup>  | 0.65 <sup>ab</sup>  | 0.73±0.03 <sup>ab</sup>  |
| 30/9/2023  | 0.73 <sup>ab</sup>  | 0.73 <sup>ab</sup>  | 0.79 <sup>ab</sup>  | 0.77 <sup>ab</sup>  | 0.76±0.02 <sup>ab</sup>  |
| 7/10/2023  | 0.77 <sup>ab</sup>  | 0.64 <sup>ab</sup>  | 0.78 <sup>ab</sup>  | 0.68 <sup>ab</sup>  | 0.72±0.03 <sup>ab</sup>  |
| 14/10/2023 | 0.69 <sup>ab</sup>  | 0.57 <sup>a</sup>   | 0.65 <sup>ab</sup>  | 0.69 <sup>ab</sup>  | 0.65±0.03 <sup>a</sup>   |

The same letters in horizontal columns are non-significant ( $P < 0.05$ ) from each other by LSD. Data  $\sqrt{x + 0.5}$  transformed.

**Table 3:** *Bemisia tabaci* (Gennadius) mean population on different cotton cultivars.

| Date       | NIAB-78             | KMG-1               | KMG-2               | KMG-3               | Mean±SD                  |
|------------|---------------------|---------------------|---------------------|---------------------|--------------------------|
| 24/6/2023  | 1.58 <sup>abc</sup> | 1.61 <sup>abc</sup> | 1.88 <sup>abc</sup> | 1.98 <sup>abc</sup> | 1.76±0.10 <sup>abc</sup> |
| 1/7/2023   | 1.53 <sup>abc</sup> | 1.62 <sup>abc</sup> | 1.76 <sup>abc</sup> | 1.87 <sup>abc</sup> | 1.70±0.08 <sup>abc</sup> |
| 8/7/2023   | 1.09 <sup>abc</sup> | 1.13 <sup>abc</sup> | 1.37 <sup>abc</sup> | 1.68 <sup>abc</sup> | 1.32±.014 <sup>abc</sup> |
| 15/7/2023  | 1.02 <sup>abc</sup> | 1.07 <sup>abc</sup> | 1.22 <sup>abc</sup> | 1.57 <sup>abc</sup> | 1.22±0.12 <sup>abc</sup> |
| 22/7/2023  | 0.94 <sup>ab</sup>  | 0.98 <sup>ab</sup>  | 1.14 <sup>abc</sup> | 1.53 <sup>abc</sup> | 1.15±0.13 <sup>abc</sup> |
| 29/7/2023  | 0.91 <sup>ab</sup>  | 0.93 <sup>ab</sup>  | 1.09 <sup>abc</sup> | 1.45 <sup>abc</sup> | 1.10±0.13 <sup>abc</sup> |
| 5/8/2023   | 0.78 <sup>ab</sup>  | 0.83 <sup>ab</sup>  | 1.05 <sup>abc</sup> | 1.56 <sup>abc</sup> | 1.06±0.18 <sup>abc</sup> |
| 12/8/2023  | 0.76 <sup>ab</sup>  | 0.78 <sup>ab</sup>  | 0.87 <sup>ab</sup>  | 0.93 <sup>ab</sup>  | 0.84±0.04 <sup>ab</sup>  |
| 19/8/2023  | 0.68 <sup>ab</sup>  | 0.69 <sup>ab</sup>  | 0.78 <sup>ab</sup>  | 0.87 <sup>ab</sup>  | 0.76±0.04 <sup>ab</sup>  |
| 26/8/2023  | 0.63 <sup>ab</sup>  | 0.67 <sup>ab</sup>  | 0.74 <sup>ab</sup>  | 0.84 <sup>ab</sup>  | 0.72±0.05 <sup>ab</sup>  |
| 2/9/2023   | 0.63 <sup>ab</sup>  | 0.65 <sup>ab</sup>  | 0.72 <sup>ab</sup>  | 0.98 <sup>ab</sup>  | 0.75±0.08 <sup>ab</sup>  |
| 9/9/2023   | 0.61 <sup>ab</sup>  | 0.66 <sup>ab</sup>  | 0.69 <sup>ab</sup>  | 0.87 <sup>ab</sup>  | 0.71±0.06 <sup>ab</sup>  |
| 16/9/2023  | 0.56 <sup>a</sup>   | 0.59 <sup>a</sup>   | 0.65 <sup>ab</sup>  | 0.83 <sup>ab</sup>  | 0.66±0.06 <sup>a</sup>   |
| 23/9/2023  | 0.53 <sup>a</sup>   | 0.57 <sup>a</sup>   | 0.62 <sup>ab</sup>  | 0.88 <sup>ab</sup>  | 0.65±0.08 <sup>a</sup>   |
| 30/9/2023  | 0.49 <sup>a</sup>   | 0.52 <sup>a</sup>   | 0.57 <sup>a</sup>   | 0.78 <sup>ab</sup>  | 0.59±0.07 <sup>a</sup>   |
| 7/10/2023  | 0.43 <sup>a</sup>   | 0.47 <sup>a</sup>   | 0.52 <sup>a</sup>   | 0.73 <sup>ab</sup>  | 0.54±0.07 <sup>a</sup>   |
| 14/10/2023 | 0.38 <sup>a</sup>   | 0.43 <sup>a</sup>   | 0.51 <sup>a</sup>   | 0.83 <sup>ab</sup>  | 0.54±0.10 <sup>a</sup>   |

The same letters in horizontal columns are non-significant ( $P < 0.05$ ) from each other by LSD. Data  $\sqrt{x + 0.5}$  transformed.

**Table 4:** *Earias spp.*, mean population on different cotton cultivars.

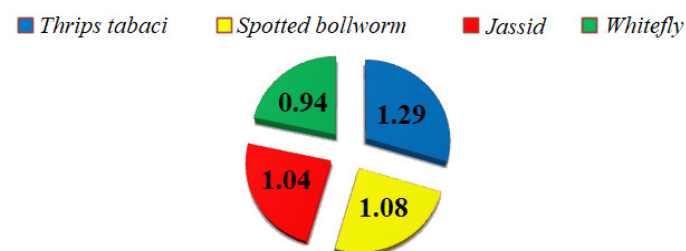
| Date       | NIAB-78             | KMG-1               | KMG-2               | KMG-3               | Mean±SD                  |
|------------|---------------------|---------------------|---------------------|---------------------|--------------------------|
| 24/6/2023  | 1.84 <sup>abc</sup> | 1.87 <sup>abc</sup> | 1.98 <sup>abc</sup> | 3.56 <sup>cde</sup> | 2.31±0.42 <sup>bcd</sup> |
| 1/7/2023   | 1.77 <sup>abc</sup> | 1.79 <sup>abc</sup> | 1.81 <sup>abc</sup> | 3.23 <sup>cde</sup> | 2.15±0.36 <sup>bcd</sup> |
| 8/7/2023   | 1.67 <sup>abc</sup> | 1.69 <sup>abc</sup> | 1.74 <sup>abc</sup> | 3.12 <sup>cde</sup> | 2.06±0.36 <sup>bcd</sup> |
| 15/7/2023  | 1.29 <sup>abc</sup> | 1.37 <sup>abc</sup> | 1.43 <sup>abc</sup> | 1.87 <sup>abc</sup> | 1.49±0.13 <sup>abc</sup> |
| 22/7/2023  | 1.19 <sup>abc</sup> | 1.28 <sup>abc</sup> | 1.31 <sup>abc</sup> | 1.76 <sup>abc</sup> | 1.39±0.13 <sup>abc</sup> |
| 29/7/2023  | 0.83 <sup>ab</sup>  | 0.87 <sup>ab</sup>  | 1.09 <sup>abc</sup> | 1.67 <sup>abc</sup> | 1.12±0.19 <sup>abc</sup> |
| 5/8/2023   | 0.69 <sup>ab</sup>  | 0.83 <sup>ab</sup>  | 0.88 <sup>ab</sup>  | 1.55 <sup>abc</sup> | 0.99±0.19 <sup>ab</sup>  |
| 12/8/2023  | 0.77 <sup>ab</sup>  | 0.79 <sup>ab</sup>  | 0.84 <sup>ab</sup>  | 1.47 <sup>abc</sup> | 0.97±0.17 <sup>ab</sup>  |
| 19/8/2023  | 0.69 <sup>ab</sup>  | 0.72 <sup>ab</sup>  | 0.78 <sup>ab</sup>  | 1.41 <sup>abc</sup> | 0.90±0.17 <sup>ab</sup>  |
| 26/8/2023  | 0.65 <sup>ab</sup>  | 0.68 <sup>ab</sup>  | 0.76 <sup>ab</sup>  | 1.37 <sup>abc</sup> | 0.87±0.17 <sup>ab</sup>  |
| 2/9/2023   | 0.62 <sup>ab</sup>  | 0.65 <sup>ab</sup>  | 0.73 <sup>ab</sup>  | 1.22 <sup>abc</sup> | 0.81±0.14 <sup>ab</sup>  |
| 9/9/2023   | 0.53 <sup>a</sup>   | 0.58 <sup>a</sup>   | 0.69 <sup>ab</sup>  | 1.08 <sup>abc</sup> | 0.72±0.12 <sup>ab</sup>  |
| 16/9/2023  | 0.49 <sup>a</sup>   | 0.51 <sup>a</sup>   | 0.57 <sup>a</sup>   | 1.02 <sup>abc</sup> | 0.65±0.13 <sup>a</sup>   |
| 23/9/2023  | 0.44 <sup>a</sup>   | 0.48 <sup>a</sup>   | 0.52 <sup>a</sup>   | 0.98 <sup>ab</sup>  | 0.61±0.13 <sup>a</sup>   |
| 30/9/2023  | 0.39 <sup>a</sup>   | 0.43 <sup>a</sup>   | 0.49 <sup>a</sup>   | 0.87 <sup>ab</sup>  | 0.55±0.11 <sup>a</sup>   |
| 7/10/2023  | 0.29 <sup>a</sup>   | 0.38 <sup>a</sup>   | 0.47 <sup>a</sup>   | 0.81 <sup>ab</sup>  | 0.49±0.11 <sup>a</sup>   |
| 14/10/2023 | 0.27 <sup>a</sup>   | 0.35 <sup>a</sup>   | 0.39 <sup>a</sup>   | 0.79 <sup>ab</sup>  | 0.45±0.12 <sup>a</sup>   |

The same letters in horizontal columns are non-significant ( $P < 0.05$ ) from each other by LSD. Data  $\sqrt{x + 0.5}$  transformed.

significantly high infestation of *Earias* spp., was recorded on KMG-3, followed by KMG-2, KMG-1, and Naib-78. The pest insect maximum mean population was recorded at 1.63, 0.96, 0.89, 0.84, with an overall 1.08 mean population, respectively. During the last week of June peak population of the pest species was calculated but gradually decreased in October on cotton genotypes. The population of *Earias* spp. recorded on different cotton genotypes significantly varied ( $P < 0.05$ ). The cotton genotype NIAB-78 was recorded with more resistance against spotted bollworm infestation followed by KMG-1, KMG-2, and KMG-3 cotton cultivars. The ANOVA of the spotted bollworm calculated non-significant difference (DF= 3;  $F = 6.06$ ;  $P = 0.09$ ), but among pest data replications found with significant difference (DF= 16;  $F = 8.20$ ;  $P = 0.03$ ), as shown in (Table 4).

#### Overall mean insect pest population on selected Bt and non-Bt cotton cultivars

Many species of insect pest species massively hit Bt and non-Bt cotton cultivars throughout the vegetative and reproductive stages and reduce yield in terms of quantity and quality. The overall higher pest infestation was calculated on KMG-3, compared to KMG-2, KMG-1, and NIAB-78. The overall maximum effect of *T. tabaci* was recorded at (1.29) followed by Spotted bollworm (1.08), Jassid (1.04), and Whitefly (0.94), respectively. The analysis of variance among the pairwise homogenous group in the comparison test found non-significant difference (DF= 3;  $F = 1.27$ ;  $P = 0.33$ ) on cotton cultivars and significant difference (DF= 3;  $F = 7.39$ ;  $P = 0.02$ ) in pest data replication as shown in (Figure 2).



**Figure 2:** Overall mean population of the insect pests on cotton cultivars.

The sucking insect pests of cotton like jassid, whitefly, thrips, and spotted bollworms are important pests during seedling and vegetative stages, making plants weak, ultimately causing wilting and shedding of leaves. This study was performed to assess the population fluctuation of selected insect pests. The maximum

mean population (1.66) of thrips tabaci was recorded on the KMG-3 cotton cultivar and the minimum (1.01) on NIAB-78. (Sahito *et al.*, 2020) cultivated (n=09) non-transgenic cotton cultivars, of which maximum pest resistant power was recorded in Marvi (CRIS-5<sup>A</sup>) and CRIS-467 against sucking complex but CRIS-342 (7.01) and Sindh-1 (7.04) found to be less insect pest resistance. The maximum mean population of spotted bollworm was recorded (1.63) and minimum (0.84) on KMG-3 and NIAB-78 cotton genotypes. *Earias* spp., prefers square formation to the host plants, and both transgenic and conventional are suspected by spotted bollworm (Abro *et al.*, 2004b). (Asif *et al.*, 2023), sown Sadori, NIA-88, NIA-30, and NIA-98 cotton genotypes during 15<sup>th</sup> April, May, June, the maximum infestation of jassid, spotted bollworm was recorded in April, thrips in May and all the cotton genotypes found with cotton spotted bollworm fluctuation but maximum insect pest fluctuation was observed at the upper canopy compared to lower parts of the plant leaves.

The maximum jassid population fluctuation was calculated in June and the minimum in October with the great conformity of (Siraj *et al.*, 2019) to find out the prevalence of jassid on different Bt. cotton cultivar in relation to different temperatures, air, rainfall and relative humidity, in September the maximum and November minimum mean population was observed per leaf. (Avinash *et al.*, 2022) evaluated jassid population on twenty-six cotton cultivars during Kharif season 2020-21, among them four genotypes were recorded with susceptible, three highly, and nineteen with moderate resistance power. The highest whitefly population was gathered during June and the lowest in October, which may be the environmental fluctuation. (Khan *et al.*, 2018), documented prevalence of cotton crop insect pests *viz.*, *Pectinophora gossypiella*, *Amrasca devastans*, and *Bemisia tabaci* depends on temperature, relative humidity, and rainfall. In the present study, three transgenic cotton genotypes were produced locally to compare their resistance against sucking and bollworm insect pests with one conventional Niab-78 variety. Scientific information is lacking on the comparative resistance of these genotypes against sucking and bollworm insect pests in our agro-ecological condition.

## Conclusion and Recommendations

The cotton is the trademark industry of Pakistan. The

results concluded that higher population of whitefly, *T. tabaci*, (Lind) jassid, *A. biguttula biguttula* (Ishida), spotted bollworm, *Earias* spp. and whitefly, *Bemisia tabaci* (Gennadius) were recorded in KMG-3 followed by KMG-2, KMG-1 and NIAB-78. The findings of this scientific study show that NIAB-78 cotton cultivars have more resistance power compared to other cotton genotypes, hence recommended. Moreover, develop to assist against pest control outbreaks through advanced IPM strategies.

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## Novelty Statement

*Gossypium hirsutum* L. is the “white gold” commercial cash crop of Pakistan. Sindh province is regarded as the cotton growing belt of the country. The cotton farming community of Sindh is less aware of identifying and to avoiding prior pest infestation. In this context, this scientific contribution will be supportive tool to early management and cotton crop security.

## Author's Contribution

**W.M. Mangrio:** Main author of this research manuscript, who gathered pest data, arranged, performed, and conceived experiments.

**H.A. Sahito:** Supervised the research work, and statistically analyzed pest data.

**A.H. Mastoi:** Helped in article review.

**S. Sattar:** Arranged tools for pest data collection.

**F.I. Sahito and S.A. Jakhrani:** Played support at any stage regarding this research work.

## Availability of data and materials

At the request of the corresponding author, the findings of this scientific contribution are available.

## Publication consent

All the responsibilities are accepted by the corresponding author for the release of this scientific contribution.

## Conflict of interest

There is no financial or personal relationship regarding any part of this scientific documentary.

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