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Response of Cotton Genotypes to Insect Pests Complex

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ABSTRACT

Pakistan's agricultural sector has been the cornerstone of its economy in the past. It contributes more than 21% of GDP and employs approximately 63% of the rural population. Among the company's crops, cotton (Gossypium hirsutum) stands out as the main cash crop. climate change Insect outbreak and face important challenges such as water scarcity. which causes production to decrease This study assessed the resistance of 11 cotton genotypes to important insect pests. Including whiteflies, jassids, thrips, pink bollworms. and gray cotton worms using a completely random block design... We are in different genotype groups. We also assessed insect populations and invasion rates. The results indicate different levels of resistance. Some genotypes are more effective at resisting pest pressure. The findings highlight the potential of genetically modified cotton varieties to increase yields and reduce reliance on chemical pesticides. This will help promote sustainable agricultural practices in Pakistan.

1. Introduction

Since independence, Pakistan's economy has been continuously recreated by the agriculture sector (Khan and Salam, 1997). Though it was formerly thought to be a major sector, its production yield rapidly decreased as a result of its deteriorating performance brought on by social, political, environmental, and climatic factors. Currently, it stands as Pakistan's second-largest industry. More than 21% of GDP is accounted for by it. Percentage of workers overall working in this industry. Most people in the nation roughly 63 percent dwell in (Foster and Rosenzweig, 2007). The livelihood of people living in rural regions is either directly or indirectly related to this industry (Raza et al., 2012)

Cotton (Gossypium) Genus: Hirsutum; Family: Malvaecae; hirsutum L.) has a crucial role in the nation's agriculture-based economy (Tayyib et al., 2005, Saleem et al. 2018). It is the country's top-ranked cash crop (Economic Survey, 2009), which aside from obtaining a significant amount of foreign exchange yields bread and butter to the millions of individuals residing in fields and industries (Majeed et al., 2016). As a cash crop not used for food, cotton substantially contributes to foreign exchange earnings. A total of 2,806,000 hectares were used to sow the crop (Khan et al., 2018). An estimate of the output is provided. During 2013–14, at 12.76 million bales. However, there was a roughly 2.0 percent decrease in cotton production. Less than the 13.36 million bale goal, mostly as a result of low irrigation water availability, high August temperatures that cause increased fruit shedding and a flare-up in sucking pest complex, and the widespread transmission of the Cotton Leaf Curl Virus (CLCV) (Yousaf et al., 2015).

Cotton plants grow far larger during the flowering time than they do during the pre-flowering phases, making it challenging to apply pesticide treatments with enough coverage (Can et al., 2022). Furthermore boll-feeding, insects frequently consume food while encased in the bracts of squares and bolls, protecting themselves from some direct exposure to insecticide. Size and form of flower bracts vary significantly. Normally, bracts are big and broad, located near the boll, and they give insects a place to live (Din et al., 2016). It seems that the larvae or nymphs are more difficult to eradicate with pesticides, in part because compared to adults, individuals are less mobile, staying inside the bracts or fruiting forms that are not easily exposed to pesticides. At last, pest as the season progresses, pesticide tolerances grow. decreasing the effectiveness of certain applications during the last weeks of bloom before boll maturity (Sarwar et al., 2013)

It is well recognized that Bt crops have a particularly particular mode of action when it comes to lepidoteran pests (Storer et al., 2012). Bt cotton transgenics offer very efficient reduction of cotton bollworm infestations and less dependency on standard insecticides made of chemicals. They already gave noticeably increased cotton yields. As a result Transgenic crops with Bt have the potential to be a effective substitute for traditional pesticides(Naranjo, 2011) In Broad-spectrum pesticides are used in cotton fields.typically used to manage lepidopteran pests, such the bollworm species. Around the world, The usage of Bt cotton has often led to a 60 there was an 80% drop in the use of pesticides in this cut (Karar et al., 2016).

The use of synthetic pesticides disrupts the natural balance between the population of pests and beneficial agents (pathogens, parasitoids, and predators) in the agroecosystem, posing health and ecological risks in addition to causing insecticidal resistance (Ahmad and Khan, 1991; Hamburg and Guest,1997; Sorejani, 1998). (Kamble and Sathe, 2015) Says environment friendly insecticides ought to be chosen over conventional ones because the latter are primarily used to control pest infestations but have several negative effects, including resistance, resurgence, pest outbreaks, harm to the environment, pollution, and health risks. (Asif et al., 2018)

The purpose of this experiment was to assess cotton genotypes in light of their significance. Resistance in cotton cultivars against infection frequency, sucking bug pest, yield potential, and properties of the fiber. Using transgenic germplasm concern for cultivators and ginners community and nation. In addition, Genetic screening results will serve as guidance. Selection line for the breeders of the most ideal parents.

2. Materials and Methods

Eleven cotton genotypes, CKC-1, CKC-3, CKC-4, CKC-6, FH-189, FH-333, FH-334, FH-416, FH-492, SS-32 and SS-102 were sown at the research area of Entomological Research Institute, Faisalabad. The objectives of the study were to evaluate the response of different cotton genotypes against insect pests. The trial was laid out in RCB design having three repeats. Population of whitefly, Jassid and Thrips was recorded from 15 leaves of 15 plants per treatment selected at random from upper, middle and lower portions of plants. Percentage infestation of pink bollworm and population of dusky cotton bug was also recorded from 15 randomly selected plants.

3. Results

Eleven cotton genotypes, CKC 1, CK 3, CKC 4, CKC 6, FH-189, FH-333, FH-334, FH-416, FH-492, SS-32, SS-102 were sown in the research area of Entomological Research Institute, Faisalabad, to evaluate the response of cotton genotypes against insect pests. The trial was laid out in RCB design having three repeats. Population of whitefly, jassid and thrips was recorded from 15 leaves of 15 plants per treatment selected at random from upper, middle and lower portions of plants. Percentage infestation of Pink bollworm and Dusky cotton bug were also recorded. The data recorded are as under:-

Table 1: Screening of new cotton genotypes against insect pest complex 2022

Genotype	Whitefly/ leaf	Jassid/leaf	Thrips/leaf	Pink bollworm infestation%	Dusky cotton bug infestation %
CKC1	3.1533 def	0.9267 bc	5.0933 c	3.4000 abcd	3.9333 d
CK3	2.8133 fg	0.9133 bc	5.1067 c	3.2333 bcd	4.2333 cd
CKC4	3.8533 bc	0.9467 bc	5.1467 c	3.0000 cde	4.2333 cd
CKC6	3.6200 cd	0.8400 c	5.0133 c	3.0667 cde	4.7667 bc
FH-189	4.3867 a	1.2000 ab	6.3800 ab	3.8000 abcd	5.8000 a
FH-333	3.9400 abc	1.3200 a	6.6867 a	4.2000 a	5.8333 a
FH-334	4.3033 ab	1.3167 a	6.7067 a	4.1000 ab	5.2667 ab
FH-416	3.6300 cd	1.2933 a	6.4600 ab	3.8333 abc	4.7667 bc
FH-492	3.4667 cde	1.0800 bc	5.9200 b	2.8667 de	4.6667 bc
SS-32	3.0533 efg	1.0433 abc	5.2333 c	2.2000 e	4.2667 cd
SS-102	2.6333 g	0.9733 bc	4.9400 c	2.2667 e	3.9333 d
LSD @ 5%	0.31	0.40	0.58	0.69	0.32

Table 2: Screening of new cotton genotypes against insect pest complex 2023

Genotype	Whitefly/leaf	Jassid/leaf	Thrips/leaf	Pink bollworm infestation%	Dusky cotton bug infestation %
CKC-1	3.37 bcd	0.87 d	5.57 b	2.86 abc	4.83 a
CKC-3	3.05 cde	0.91 cd	5.88 b	1.86 cd	3.96 ab
CKC-4	3.47 abc	1.42 a	11.22 a	3.23 ab	3.16 b

CKC6	3.12 cde	0.99 bcd	5.83 b	1.26 d	5.00 a
FH-189	2.91 de	1.22 abc	5.34 b	2.20 bcd	4.90 a
FH-333	3.83 a	1.19 abc	5.49 b	3.13 abc	4.40 ab
FH-334	3.71 ab	1.28 ab	5.88 b	2.76 abc	4.26 ab
FH-416	2.97 de	1.01 bcd	5.67 b	2.26 bcd	3.83 ab
FH-492	3.03 cde	1.09 bcd	5.49 b	2.29 bcd	3.20 b
SS-32	2.84 e	1.22 abc	5.53 b	2.86 abc	4.66 ab
SS-102	3.07 cde	0.96 cd	5.65 b	3.96 a	5.00 a
LSD@ 5%	0.49	0.29	0.64	0.93	0.71

Whitefly, *Bemisia tabaci* Genn.

Whitefly populations on FH-189 and FH-333 were found to be at their greatest (4.386/leaf) and minimum (2.633/leaf) in 2022 and 2023, respectively, while those on SS-102 and SS-32 were at their lowest (2.84/leaf). The remaining genotypes (Table 1) against the white-fly exhibited partial resistance in 2022: CKC1 (3.1533/leaf), CK3 (2.8133/leaf), CKC4 (3.8533/leaf), CKC6 (3.6200/leaf), FH-189 (4.3867/leaf), FH-333 (3.9400/leaf), FH-334 (4.3033/leaf), FH-416 (3.6300/leaf), FH-492 (3.4667/leaf), SS-32 (3.0533/leaf) and SS-102 (2.6333/leaf. Table 2 indicates that several species exhibited sensitive behavior in 2023: FH-189(2.91/leaf), FH-333(3.83/leaf), FH-334(3.71/leaf), FH-416(2.97/leaf), FH-492(3.03/leaf), SS-32(2.84/leaf), and SS-102(3.07/leaf).

Jassid, *Amrasca devastans* Dist.

The highest average Jassid population (1.3200/leaf) was recorded by FH-333 in 2022, while the lowest (0.8400/leaf) was recorded on CKC6 in 2022, and the highest (1.28/leaf) by FH-334 and the lowest (0.87/leaf) by CKC-1 in 2023. In 2022 and 2023, all cultivars displayed vulnerable behavior against the jassid assault.

Thrips, *Thrips tabaci* Lind.

Thrips average population was lowest (4.9400/leaf) and highest (11.22/leaf) on SS-102 and FH-189 in 2022 and 2023, respectively, while it was highest (6.7067/leaf) on FH-334 and CKC-4. Throughout the thrips invasion in 2022 and 2023, all cultivars exhibited vulnerable behavior.

Pink Bollworm, *Pectinophora gossypiella* Spp.

In terms of the percentage of pink bollworm infection, the following areas had rather resistant behavior: FH-189(3.8000%), FH-416(3.8333%), CKC1(3.4000%), SS-32(2.2000%), SS-102(2.2667%), FH-492(2.8667%), CKC4(3.0000%), CKC6(3.0667%), CK3(3.2333%), and CKC1(3.4000%). Additionally, during 2023, FH-333(3.13%), CKC-4(3.23%), and SS-102(3.96%) shown vulnerable behavior, whereas CKC6(1.26%), CKC-3(1.86%), FH-189(2.20%), FH-416(2.26%), FH-492(2.29%), FH-334(2.76%), CKC-1(2.86%), and SS-32(2.86%) demonstrated somewhat resistant behavior.

Dusky Cotton Bug, *Oxycarenus laetus*

CKC-1(3.9333%) and SS-102(3.9333%) shown moderately resistant behavior against CLCV in relation to Dusky Cotton Bug infestation, whereas CKC-3(4.2333%), CKC-4(4.2333%), SS-32(4.2667%), FH-492(4.6667%), CKC6(4.7667%), and FH-416(4.7667%) demonstrated somewhat resistant behavior against Dusky Cotton Bug. Additionally, throughout 2022, FH-333(5.8333%), FH-189(5.8000%), and FH-334(5.2667%) shown vulnerable behavior to CLCV. While cultivars FH-334(4.26%), FH-333(4.40%), SS-32(4.66%), CKC-1(4.83%), and FH-189(4.90%) shown somewhat resistant behavior against CLCV in 2023, cultivars CKC-3(3.96%), CKC-4(3.16%), FH-416(3.83%), and FH-492(3.20%) demonstrated substantially resistant behavior against CLCV. Nonetheless, in 2023, CKC6 (5.00%) and SS-102 (5.00%) displayed vulnerable behavior against the Dusky Cotton Bug.

4. Discussion

The results of this study provide valuable insights into the resistance of various cotton genotypes. against important insect pests This is important for increasing cotton production in Pakistan. The significant differences in insect infestation levels among the 11 genotypes highlight the possibility of selective breeding to improve insect resistance in cotton plants.

Pest resistance and genotype performance

The data showed that genotypes such as FH-189 and FH-333 had smaller whitefly populations. This indicates that there is some resistance. This finding is consistent with previous research highlighting the importance of selecting resistance genotypes to effectively manage pest populations (Khan et al., 2020). The performance of these genotypes indicates that the integration of resistance traits Insect breeding programs can greatly reduce reliance on chemical pesticides. This has been shown to disturb the ecological balance and contribute to pest resistance (Ahmad Khan, 2021).

Effects of genetics

The study also emphasizes the role of genetically modified cotton varieties. Especially *Bt* cotton in managing pest outbreaks Recent studies have shown that *Bt* cotton can significantly reduce pesticide use and increase yield (Karar et al., 2021). The findings of this trial support the idea that transgenic varieties can be an alternative. Effective replacement for traditional pest management strategies by promoting sustainable agricultural practices (Naranjo, 2021). The impact of using resistant cotton genotypes goes beyond pest management. By reducing the need for synthetic pesticides. These genotypes can help reduce environmental pollution and health risks associated with pesticides.

5. Conclusion

This study highlights the important role of cotton in Pakistan's economy and the urgent need to address the challenges facing the sector. Evaluation of 11 cotton genotypes revealed significant differences in pest resistance. It is suggested that selection of varieties and use of genetically modified varieties can increase cotton production. Conclusion: Reduce the spread of pests. Reduce the use of insecticides and, finally, the adoption of resistant genotypes to improve the livelihoods of rural communities that rely on cotton agriculture. Future research should focus on integrating these resistant varieties into broader agricultural practices. To ensure sustainable development in Pakistan's cotton industry while protecting environmental health.

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