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Research Article

Field screening of chickpea genotypes for pod borer resistance and yield traits

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ABSTRACT

The present study was conducted during 2023–24 at Arid Zone Research Institute, Bhakkar and at 36/TDA farmer field to evaluate the resistance response of various chickpea genotypes against the pod borer (*Helicoverpa armigera*) under field conditions. Twelve chickpea genotypes were screened, among which TGK-1804, TGK-1803, and TG-1908 exhibited high resistance with average pod borer populations of 1.38, 1.42, and 1.51 per plant, respectively which were significantly lower than the check varieties TG-Striker and Noor-2009. In contrast, TGK-1504, TG-1626, and TG-1762 recorded the highest susceptibility. TGK-1804 also recorded the highest number of fruit-bearing branches (10.47), plant height (51.87 cm), total pods per plant (68.6) and maximum yield (952.08 kg/ha). Conversely, TGK-1504 showed the lowest performance in these parameters. Weather parameters had a notable influence on pod borer infestation. The average and maximum temperatures exhibited a significant positive correlation with pod borer population (r = 0.844 and r = 0.718, respectively), while minimum temperature and relative humidity showed weak and non-significant positive correlations (r = 0.158 and r = 0.180). Average rainfall, however, showed a negative and non-significant correlation (r = -0.128). The study concludes that genotypes such as TGK-1804 and TGK-1803 offer promising resistance to pod borer and can be recommended for cultivation or further breeding programs aimed at enhancing pest resistance in chickpea.

Keywords: Screening; pod borer; chickpea; weather factors; yield parameters.

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INTRODUCTION

Pulses, also referred to as "poor man's meat," are a great source of vitamins, minerals, and proteins. Chickpea (*Cicer arietinum* L.) is a major pulse crop in Pakistan (FAO, 2000). In Pakistan, chickpea cultivated on approximately 830 thousand hectares during 2022–2023, producing 238 thousand tons with an average yield of 287 kg per hectare (Anonymous, 2023). Chickpea known as the "King of Pulses" because of their high nutritional content and demand (Bhatt and Patel, 2001). Chickpeas also contribute significantly to the maintenance of soil productivity (Ali and Kumar, 2005).

In Pakistan's districts of Khushab, Layyah, Bhakkar, and Mianwali (in Punjab) as well as Shikarpur, Khairpur, and Larkana (in Sindh), chickpea (*C. arietinum* L.) is a significant grain legume crop (Ahmed et al., 2012). This Thal region is traditionally the largest chickpea-producing area, encompassing about 0.724 million hectares and accounting for more than 90% of the cultivated area and production in Punjab (GOP, 2023). Chickpeas are high in vitamins, especially B, and they fix atmospheric nitrogen, which improves soil fertility (Kailas and Chaudhary, 2021). There are eleven distinct insect pests that are known to be the primary harmful pests of the

chickpea crop. The most dangerous of them is the pod borer, *Helicoverpa armigera* (Hubner), which damages pods by an average of 30 to 40%, and under favorable conditions, up to 80 to 90% (Patil et al., 2017).

It is known to have evolved resistance to a variety of widely used insecticides (Hossain et al., 2010). A global pest with significant economic impact on this crop is the gram pod borer. This pest attacks crops from the beginning of their vegetative stage until they reach maturity (Singh and Yadav, 2006).

H. armigera poses a serious threat to the crop and has the ability to withstand, digest, and resist harmful pesticides. From seedlings to mature plants, chickpea plants are susceptible to pod borer infestations, which can harm various plant parts such as leaves, flowers, and pods (Patil et al., 2017). When relative to other host plants, chickpeas had the highest percentage of larvae survival and pupation (Ullah et al., 2015).

Host plant resistance (HPR) is essential, whether used in isolation or in conjunction with other management strategies. Research on the host plants' resilience to the pod borer in the chickpea crop has provided sources that may withstand the accept the presence of pests. It is exceedingly challenging to forecast an exact IPM approach due to the complexity of resistance. With this in mind, the current research has been conducted to screen elite cultivars against the pod borer *H. armigera* in natural environment

It is imperative to implement pest management strategies that drastically minimize the use of insecticides (Abbas et al., 2020). A pest management system that uses all appropriate techniques and methods in a compatible manner to keep pest populations below those that are causing economically unacceptable damage or loss is known as integrated pest management, or IPM. This system takes into account the associated environment as well as the population dynamics of the pest species (Chandrashekar et., 2014).

Chickpea yields are significantly reduced when gram pod borer infestation occurs. Currently used control strategies, such as insecticides have drawbacks like pest 3Rs principle (resistance, resurgence and residues).Furthermore it is necessary to explore alternative solution like screening, botanical control while being economically and environmentally viable.

Chickpea production is being impacted globally by climate change, which is changing crop distribution patterns and pest dynamics. Given how versatile they are; pod borers might proliferate. Heat, drought and frost, are major abiotic stresses that adversely affect chickpea production (Maphosa et al., 2020). The most effective strategy is to develop chickpea varieties with tolerance to diverse biological and environmental stresses. Therefore, there is an urgent need for high-yielding varieties capable of performing well under both biotic and abiotic stresses to bridge the yield gap (Rubiales et al., 2018).

There is a need of the hour to investigate environmentally friendly and sustainable control strategies that are effective against the gram pod borer but have not yet been thoroughly investigated or put into practice due to the knowledge gap for the research on controlling the chickpea gram pod borer.

The objectives of current studies were as fellows.

a) To screen different varieties of chickpea pod borer.
b) To determine the role of abiotic factors on chickpea pod borer.

MATERIALS AND METHODS

Two experiments of host plant resistance and impact of abiotic factors on pod borer population was carried out at Arid Zone Research Institute (AZRI) Bhakkar and at 36/TDA farmer's field Bhakkar, Punjab. The district of Bhakkar is located in Punjab province and borders Khyber Pakhtun Khawa (KPK). Situated at an altitude of 159 meters relative to mean sea level, between latitudes 31.62660 North and longitudes 71.06170 East. The climate in Bhakkar is arid. The temperature ranges from 24.6 0C to 46.0 0C, with an average annual rainfall of over 213 mm. Temperatures in the chickpea crop-growing season vary from 25.0 to 33.0 ^{o}C. "Screening trail of chickpea against pod borer "was sown on 25-10-2023.

The research involved evaluating 12 distinct chickpea cultivars for *Helicoverpa armigera*. The data presented is pool data of two locations. Cultivars were seeded in the field October Rabi seasons in 2023–2024 to evaluate the differing levels of resistance of several chick pea cultivars to *H. armigera.* Every entry was planted in a 4×1.2 meter row plot with 30cm spacing. A Randomized Complete Block Design with three replications was used. The crop was grown using standard agronomic techniques (base fertilizer N: P: K: 50:60:40 kg/ha) (Jaba et al., 2017). Weeding and intercultural operations was done as required. Without using any insecticides, the chickpea crop was grown to allow the pest's population and that of its natural adversaries to grow unhindered. In the course of the investigation, the parameters

Germination, Crop stand, plant height, plant type, Number of pods per plant, number of branches per plant, Fruit full branches, Larval population and Damage pods were recorded.

Plant Height

Five randomly chosen plants were observed for height, with one replication of each treatment.

Total Branches and Fruit Full Branches

The observation of branches and fruit full branches were noted from five plants that were chosen at random for each treatment.

Larval Population

The observation of larval population was recorded from randomly selected five plants/replication of each treatment.

Total and Damage Pods

Five randomly chosen plants were used for each treatment replication, and the observation of total pods and pod damage was noted.

Observation of Pod Damaged

A random selection of five plants per treatment were used to record the observation of the larvae population, total pods, and pod damage (Jaba, et al. 2017). After the number of damaged (bored) and total pods were recorded the percentage of pod damage was computed using the following formula (Jaba et al. 2017).

$$\%\text{Pod damage} = \frac{Number\ of\ damaged\ pods}{Number\ of\ total\ pods} \text{ x } 100$$

Observation of Damage Grains

The damaged and total numbers of grains was counted and the percent grain damage was determined using the following formula:

$$\%\text{Grain damage} = \frac{Number\ of\ damaged\ grains}{Number\ of\ total\ grains} \times 100$$

Observation of Yield Data

The observation of 100 seed weight, grain yield per plot which was converted to yield per ha by using following formula:

$$\text{Grain yield (kg/ha)} = \text{Grain yield/m}^2\text{ (kg) x } 10000$$

Statistical Analysis

Data recorded was analyzed statistically and using Statistix 8.1 software.

Impact of Abiotic Factors in Expression of Resistance

Abiotic Observations

To track how different Abiotic variables, affect the number of pod borer insects in the chickpea crop, meteorological information about the highest and minimum relative humidity (R.H.), lowest air temperature, and total precipitation during the relevant months were received from the AZRI, Bhakkar meteorological observatory.

Statistical Analysis

The relationship between weather trends and pod borer frequency various genotypes of chickpeas in 2023–24 was calculated by calculating a basic correlation (Steel et al.,1997) between the pod borer population and abiotic parameters (temperature, relative humidity, rainfall, and maximum and lowest temperatures). The Least Significant Difference test was used to compare the means at P = 0.05. Square roots was created from the data before the analysis is conducted. For the research year, the cumulative impact of the three abiotic variables temperature, relative humidity, and rainfall will be quantified for the pod borer population.

RESULTS AND DISCUSSION

Response of different genotypes of chickpea against pod borer population on different dates of observation. The results (Table 1) indicated variability in chickpea genotypes regarding pod borer infection on several observation days in 2024. The greatest populations of pod borer were continuously observed in TGK-1504 and TG-1626, peaking at 5.26 and 5.00 larvae per plant in April, while TG-1762 and TG-1707 also had relatively high infestations on multiple occasions. The lowest populations were recorded in TGK-1804, TGK-1803, TG-1908, and TG-1823, with values ranging from 0.20 to 0.33 larvae per plant during initial observations. Intermediate amounts were observed in genotypes including TG-1805, TG-1826, TG-Striker, and Noor-2009. Statistical analysis demonstrated that numerous treatments were comparable; however, a discernible trend indicated that TGK-1504 and TG-1626 exhibited the highest susceptibility, whereas TGK-1804, TGK-1803, TG-1908, and TG-1823 displayed relative resistance.

Varietal Performance of Different Chickpea Genotypes against Pod Borer Population

The mean number of pod borer population throughout 2024 was displayed in the findings (Table 2). The data clearly show that in 2024, TGK-1804 and TGK-1803 had the least pod borer populations, with 1.38 and 1.42 pod borer per plant, respectively, while TG-1908 had the highest population with 1.5185 pod borer per plant. These two groups were comparable in terms of mean pod borer populations. The genotype TGK-1504 recorded the maximum pod borer population of 3.22 per plant, which was statistically equivalent to the genotype TG-1626, which demonstrated a 3.052 pod borer population per plant during 2024. The genotypes TG-1805, TG-1826 and TG-Striker showed 2.33, 2.39 and 2.44 pod borer population followed by Noor-2009 showed 2.56 pod borer population per plant, respectively at par with each other. The genotypes TG-1707 and TG-1762 showed 2.61 and 2.74 pod borer population per plant, respectively at par with each other. On the basis of mean number of pod borer population during 2024 all the chickpea genotypes were categorized in descending order as follows: TGK-1504 (3.22), TG-1626 (3.05), TG-1762 (2.74), TG-1707 (2.61), Noor-2009 (2.55), TG-Striker (2.44), TG-1826 (2.39), TG-1805 (2.33), TG-1823 (1.96), TG-1908 (1.52), TGK-1803 (1.42), TGK-1804 (1.38).

Table 1. Response of different germplasm of chickpea against pod borer population on different dates of observation on average basis.

Treat	05-03-24	12-03-24	19-03-24	26-03-24	02-04-24	09-04-24	16-04-24	23-04-24	30-04-4
TGK-1804	0.20 b	1.26 ef	1.20 f	0.53 f	0.27 h	1.40 g	2.93 f	2.53 e	2.13 e
TGK-1803	0.20 b	1.20 f	1.47 ef	0.60 f	0.33 h	1.47 g	3.00 f	2.47 e	2.07 e
TG-1908	0.20 b	1.13 f	1.53 ef	0.73 f	0.47 h	1.53 g	3.13 f	2.60 e	2.33 e
TG-1823	0.20 b	1.13 f	1.73 e	1.33 e	1.07 g	2.27 f	3.73 e	3.20 d	2.93 d
TG-1805	0.33 ab	1.53 de	2.13 d	1.73 d	1.47 f	2.73 de	4.13 d	3.60 cd	3.33 cd
TG-1826	0.33 ab	1.60 cd	2.20 d	1.80 cd	1.53 ef	2.27 e	4.20 cd	3.80 c	3.40 cd
TG-STRIKER	0.33 ab	1.67 bcd	2.267 d	1.87 cd	1.60 def	2.87 cde	4.27 cd	3.73 cd	3.33 cd
NOOR-2009	0.33 ab	1.67 bcd	2.40 cd	2.00 bcd	1.73 cde	2.87 cde	4.40 bcd	4.00 bc	3.60 c
TG-1707	0.46 a	1.87 abc	2.47 bcd	2.07 bc	1.80 cd	2.93 cd	4.47 bc	3.93 bc	3.53 c
TG-1762	0.46 a	1.93 ab	2.27 abc	2.20 b	1.93 c	3.00 c	4.60 b	4.07 bc	3.80 bc
TG-1626	0.46 a	2.00 a	2.87 a	2.60 a	2.33 b	3.40 b	5.00 a	4.47 ab	4.33 ab
TGK-1504	0.46 a	2.067 a	2.80 ab	2.87 a	2.60 a	3.73 a	5.27 a	4.73 a	4.47 a
CV (%)	29.08	10.72	10.23	10.36	10.61	5.57	4.37	9.73	10.06
L.S.D $_{0.05}$	0.0791	0.139	0.179	0.1433	0.1236	0.1169	0.1461	0.2856	0.2688

From these findings it is concluded that TGK-1804, TGK-1803 and TG-1908 with 1.38, 1.4222 and 1.52 pod borer per plant appeared to be comparatively resistant genotypes; TG-1826, TG-Striker and Noor-2009 with 2.39, 2.44 and 2.56 pod borer per plant appeared to be comparatively intermediate and TG-1762, TG-1626 and TGK-1504 with 2.74, 3.052 and 3.22 pod borer per plant showed signs of relative susceptibility, and they were chosen for the last round of screening trials in 2024.

Fruit Bearing Branches Per Plant

The Table 3 showed that maximum fruit bearing branches were observed in TGK-1804 which 10.47 fruit bearing branches per plant followed by the TGK-1803 which 10.47 fruit bearing branches per plant. Thus two treatments were significantly at par with each other. While the minimum was fruit bearing branches observed in TGK-1504 which 6.20 fruit bearing branches per plant followed by the TG-1626 which 6.20 fruit bearing branches per plant thus two treatments were significantly at par with each other. In the next treatment TG-1908 which 8.80 fruit bearing branches par plant were observed followed by TG-1823 and TG-1805 which 8.80 and 7.93 fruit bearing branches per plant. As a result, the three treatments had similar statistical results. In the next treatment TG-1826 which 7.533 fruit bearing branches par plant were observed followed by TG-Striker and Noor-2009 which 7.20 and 6.933 fruit bearing branches per plant. As a result, the three treatments had similar statistical results. In the next treatment TG-1707 which 6.60 fruit bearing branches par plant were observed followed by TG-1762 which 6.533fruit bearing branches per plant. Thus two treatments were statistically at par with each other.

Plant Height (PH) Per Plant

The Table 3 showed that maximum plant height was observed in TGK-1804 which 51.867 plant height per plant followed by the TGK-1803 and TG-1908 which 47.67 and 46.07 plant height per plant. Thus three treatments were

significantly at par with each other. As the minimum height of the plants was being noted in TGK-1504 which 34.8 plant height per plant. In the next treatment TG-1823 which 45.73 plant height par plant were observed followed by TG-1805 which 45.467 plant height per plant. Two treatments were therefore statistically equivalent to one another. In the next treatment TG-1826 which 43.80 plant height par plant were observed followed by TG-Striker and Noor-2009 which 43.80 and 42.47 plant height per plant. Three treatments were thus statistically equivalent to one another. In the next treatment TG-1707 which 39.267 plant height par plant were observed followed by TG-1762 and TG-1626 which 39.267 and 36.87 plant height per plant. Thus three treatments were statistically at par with each other.

Table 2. A comparison of the data on the mean pod borer population across different chickpea varieties at different observation dates in 2024.

Treatment	Average No. of pod borer population/plant
TGK-1804	1.38 f***
TGK-1803	1.42 f***
TG-1908	1.52 f***
TG-1823	1.96 e
TG-1805	2.33 d
TG-1826	2.39 cd**
TG-Striker	2.44 cd**
Noor-2009	2.56 bcd**
TG-1707	2.61 bc
TG-1762	2.74 b*
TG-1626	3.05 a*
TGK-1504	3.22 a*
CV (%)	5.97
L.S.D $_{0.05}$	0.1122

Means sharing similar letters are not significantly different by LSD test at P=0.05
*=Susceptible genotypes
**=Intermediate resistant genotypes
***=Resistant genotypes

Table 3. Data regarding metrological factors of chickpea as fruit bearing and plant height per plant.

Treatments	Fruit Bearing Branches	Plant height per plant
TGK-1804	10.47 a	51.87 a
TGK-1803	10.47 a	47.67 ab
TG-1908	8.80 b	46.07 ab
TG-1823	8.80 bc	45.73 abc
TG-1805	7.93 bc	45.47 abc
TG-1826	7.53 cd	43.80 bc
TG-Striker	7.20 cde	43.80 bc
Noor-2009	6.93 cde	42.47 bcd
TG-1707	6.60 de	39.27 cde
TG-1762	6.53 de	39.27 cde
TG-1626	6.20 e	36.87 de
TGK-1504	6.20 e	34.87 e
CV (%)	9.3	9.21
L.S.D $_{0.05}$	0.5849	3.2409

Total Pods and Damage Pods Per Plant

The findings displayed the total number of pods and damaged pods for each plant of various genotypes of chickpea.

Total pods per plant

The Table 4 and Figure 1 showed that maximum total pods were observed in TGK-1804 which 68.60 total pods per plant as the lowest possible number of pods overall was noted in TGK-1504 which 17.60 total pods per plant followed by TG-1762 and TG-1626 which 20.60 and 19,80 total pods per plant. Thus three treatments were statistically at par with each other. In TGK-1803 which 43.27 total pods per plant were observed. The next TG-1908 which 35.33 total pods per plant was not significantly different with TG-1908. In the next treatment TG-1823 which 30.27 total pods par plant were observed followed by TG-1805 which 30.26 total pods per plant. Thus two treatments were statistically at par with each other. In the next treatment TG-1826 which 26.27 total pods par plant were observed followed by TG-Striker which 25.27 total pods per plant were observed. Thus these two treatments were statistically at par with each other. In the next treatment Noor-2009 which 21.20 total pods per plant were observed followed by TG-1707 which 21.133 total pods per plant. Thus these two treatments were statistically at par with each other.

Damage Pods Per Plant

The Table 4 and Figure 1 showed that maximum damage pods were observed in TGK-1804, 2.93 which damage pods per plant followed by TGK-1803 and TG-1908 which 2.933 and 2.800 damage pods per plant. Consequently, three treatments were statistically equivalent to one another, and the least amount of damage pods were found inTGK-1504 which 1.00 damage pods per plant followed by TG-1762 and TG-163 which 1.00 and 1.20 damage pods per plant. Thus three treatments were statistically at par with each other. In the next treatment TG-1823 which 2.53 damage pods per plant were observed followed by TG-1805 which 2.33 damage pods per plant. Thus these two treatments were statistically at par with each other. In the next treatment TG-1826 which 1.87 damage pods per plant were observed followed by TG-Striker and Noor-2009 which 1.87 and 1.73 damage pods per plant. Thus these three treatments were statistically at par with each other.

Table 4. Response of different chickpea genotypes on number of pods per plant.

Treatments	Total Pods	Damaged Pods
TGK-1804	68.60 a	2.93 a
TGK-1803	43.27 b	2.93 a
TG-1908	35.33 c	2.80 ab
TG-1823	30.27 d	2.53 bc
TG-1805	30.27 d	2.33 c
TG-1826	26.27 e	1.87 d
TG-Striker	25.27 e	1.87 d
Noor-2009	21.20 f	1.73 d
TG-1707	21.13 f	1.53 de
TG-1762	20.60 fg	1.20 ef
TG-1626	19.80 fg	1.00 f
TGK-1504	17.60 g	1.00 f
CV (%)	6.8	11.53
L.S.D $_{0.05}$	1.6811	0.1862

Role of Different Genotypes on the Yield

The study evaluated yield performance across various chickpea genotypes in terms of yield per plot (g), per hectare (kg), and per acre (kg). Table 5 showed that the genotype TGK-1804 consistently outperformed all others, recording the highest yield: 457.0 g/plot, 952.08 kg/ha, and 385.46 kg/acre. In contrast, TGK-1504 showed the lowest yield across all metrics: 149.00 g/plot, 310.42 kg/ha, and 125.67 kg/acre, followed closely by TG-1626 and TG-1762. Other high-performing genotypes included TGK-1803 (362.00 g/plot, 754.17 kg/ha, 305.33 kg/acre) and TG-1908 (344.33 g/plot, 717.36 kg/ha, 290.43 kg/acre), both statistically at par with each other. Mid-range yielders such as TG-1823, TG-1805, TG-1826, and TG-STRIKER showed similar results, ranging from approximately 298.00 to 341.00 g/plot and 620.83 to 710.42 kg/ha.

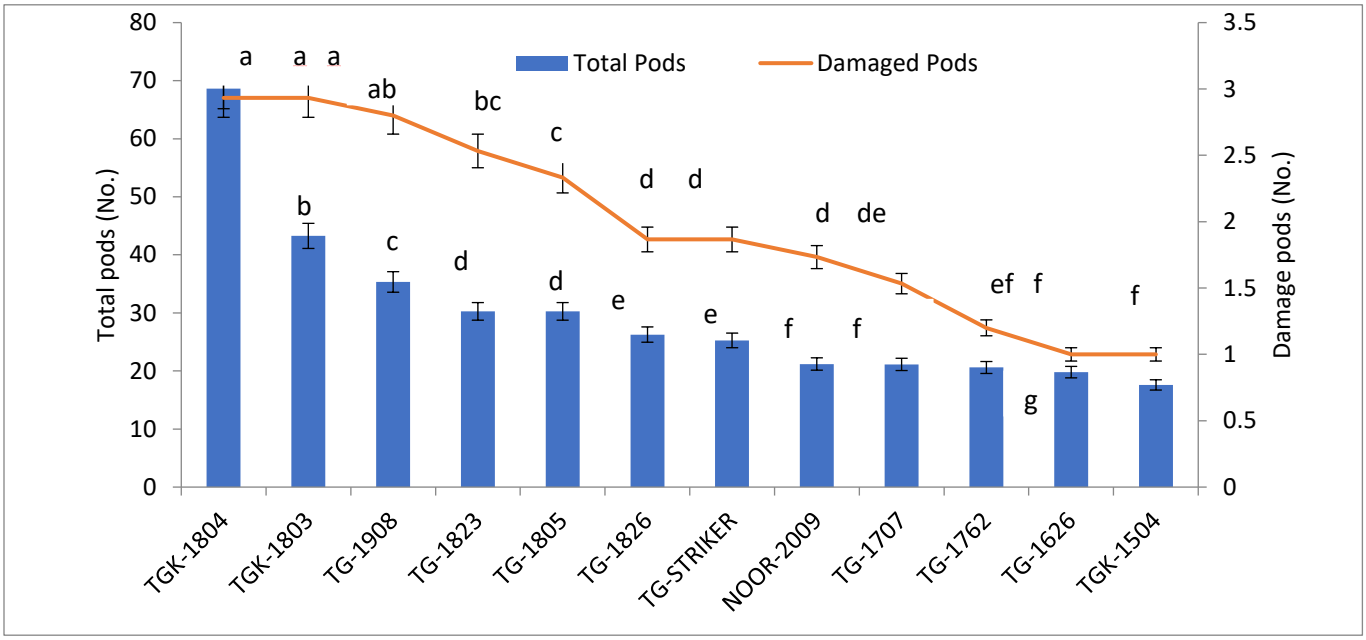

Figure 1. Response of different chickpea genotypes on number of pod per plant.

The lower-yielding genotypes included NOOR-2009 and TG-1707, with yields around 233.64–277.00 g/plot and 487.50–620.83 kg/ha. The findings highlight the significant impact of genotype selection on chickpea yield, with TGK-1804 emerging as the most promising candidate for high-yield cultivation.

Table 5. Effect of different genotypes /varieties on the yield and the yield contributing characters of chickpea.

Treat	Yield g/plot	Yield kg/ha	Yield kg/acre
TGK-1804	457.00 a	952.08 a	385.46 a
TGK-1803	362.00 b	754.17 b	305.33 b
TG-1908	344.33 bc	717.36 bc	290.43 bc
TG-1823	341.00 bcd	710.42 bc	287.62 bc
TG-1805	322.33 bcd	671.53 bcd	271.87 bcd
TG-1826	319.22 bcd	664.58 bcd	269.06 bcd
TG-Striker	298.00 cd	620.83 cd	251.35 cd
Noor-2009	277.00 de	577.08 de	233.64 de
TG-1707	234.00 ef	487.50 ef	197.37 ef
TG-1762	192.00 fg	400.00 fg	161.94 fg
TG-1626	170.00 g	354.17 g	143.39 g
TGK-1504	149.00 g	310.42 g	125.67 g
CV (%)	11.46	11.46	11.46
L.S.D $_{0.05}$	27.019	56.289	22.789

Means with similar letters (s) are not significantly different from each other at p=0.05

Pod Borer Population Fluctuation Versus Climate Factors During 2024

In order to ascertain the pod borer fluctuation trend per plant population in relation to weather circumstances, the findings of the study conducted in 2024 about pod population per plant vs climatic parameters are displayed in the (Table 6). During 2024, the highest pod borer population was noted, the 16th April, with 4.09 pod borer population per plant at 35.57 ^{0}C, 17.57 ^{0}C and 26.57 ^{0}C maximum, minimum and average temperature respectively and with 78.43% average R.H. with rainfall nill. While minimum pod borer population was noted, the 5th March, with 0.33 pod borer population per plant at 18.71 ^{0}C, 9.14 ^{0}C and 13.93 ^{0}C maximum, minimum and average temperature respectively and with 88.43% average R.H. with 1.57mm rainfall.

Table 6. Weekly averages of meteorological observations for different weather conditions and pod borer populations in 2024.

Date	Pod Borer	Maximum Temperature (^{0}C)	Minimum Temperature (^{0}C)	Average Temperature (^{0}C)	Relative Humidity (%)	Rain Fall (mm)
05.03.24	0.33	18.71	9.14	13.93	88.43	1.57
12.03.24	1.59	29.00	14.14	21.57	71.00	0.00
19.03.24	2.14	32.14	16.71	24.43	89.29	0.43
26.03.24	1.69	24.71	16.14	20.43	70.00	1.86
2.04.24	1.43	24.71	15.86	20.29	72.71	1.57
9.04.24	1.89	25.57	15.29	20.43	76.29	7.71
16.04.24	4.09	35.57	17.57	26.57	78.43	0.00
23.04.24	3.63	27.43	19.57	23.50	85.86	0.00
30.04.24	3.27	27.00	17.57	22.29	86.71	4.29

Weather Factors Influence on Pod Borer Population

The pod borer population data for the years 2023–24 was connected with meteorological variables and examined cumulatively to see how weather conditions affected the changes in the pod borer population on chickpea.

The data Table 7 revealed that during research year 2023-24 maximum temperature showed a positive and significant correlation with ® value 0.718, whereas average temperature showed a positive and significant correlation with highly significant correlation with (r) value 0.844. Whereas minimum temperature and relative humidity showed positive and non-significant correlation with (r) value 0.158 and 0.180respectively. Whereas average rainfall showed negative and non-significant correlation with (r) value 0.128 during year 2023-24.

Table 7. Correlation coefficient (r) between pod borer population per flowers basis on chickpea and various weather factors during 2024.

Weather factors	Pod borer Population
Max.Temp^{0}C	0.718^{*}
Mini.Temp^{0}C	0.158^{ns}
Avg.Temp^{0}C	0.844^{**}
Avg.R.H(%)	0.180^{ns}
Avg R.F(mm)	-0.128^{ns}

Where*=Significant at P ≤ 0.05; **=Significant at P ≥ 0.01; ns=Non Significant

In present studies chickpea genotypes TGK1804, TGK-1803and TG1908 showed highly resistance against pod borer population as compared to check varieties TG-Striker and Noor 2009. While TGK-1504, TG-1626 and TG-1762 showed average pod borer highly susceptible response. These findings concur with those of Nadeem et al. (2011), who assessed the sensitivity of a control variety and the ten advanced Kabuli genotypes to the *H. armigera* (Hubner) (Lepidoptera: Noctuidae) chickpea pod borer. The present results are in confirmatory with Sarvjeet, R. (2017), Chandile et al. (2017) and Sarwar, M. (2009) although they used different cultivars against pod borer.

According to our findings maximum yield was obtained by TGK-1804. While the minimum yield was obtained by TGK-1504.These results are in agreement with Sarvjeet, R. (2017) their result showed that at 1243 kg/ha, genotype GLW 32 had the significantly greatest grain yield. The present results are in confirmatory with Nadeem et al., (2011) who found that In comparison to the check, the genotypes that shown higher and moderate resistance as well as a higher yield also displayed the important resistance properties against CPB found in Kabuli type chickpea.

Weather has a major impact on the variation of insect pest populations. According to our findings during research year 2023-24 maximum temperature showed a positive and significant correlation, On the other hand, the average temperature had a highly significant positive correlation. In contrast, the lowest temperature and relative humidity, demonstrated a positive and non-significant connection. In contrast, the average rainfall for the years 2023–24 had a negative and non-significant association. Our results almost coincide with Bajya et al., (2010) according to their findings in chickpea, a positive correlation was seen between the population growth of *H. armigera* and the lowest temperature, precipitation, vapor pressure, and relative humidity in the morning and evening. Similar findings were reported by

Kumar (2018) according to him findings in the case of the chickpea variety KPG-59, the mean larval population of *H. armigera* was shown to have a positive connection with the maximum temperature, whereas the rainfall and larval population were shown to be negatively and significantly correlated. The current research' outcomes are consistent with Pandey et al. (2012). Their result showed that the population's maximum and minimum temperature have a strongly positive association (r=0.62 and r=0.64). The relative humidity in the morning and afternoon had correlation coefficients of r=-0.76 and r=0.73, respectively. There was a negative (0.09) but not statistically significant association between the larval population and the rainfall. Contradictory results were obtained by Reddy et al., (2009) demonstrated that there was a positive association (0.03) but not a significant one between the rainfall and the H. armigera larval population.

CONCLUSION

The current investigations' findings revealed a number of partially resistant cultivars, includingTGK1804, TGK-1803 and TG1908 showed highly resistance against pod borer population with 1.38,1.42 and 1.51per plant population average as compared to check varieties TG-Striker and Noor 2009.The number of pod borer in chickpea is affected by several meteorological conditions, with average and maximum temperature being major determinants. The data revealed that during research year 2023-24 maximum temperature has a substantial positive correlation with value 0.718.Understanding the behavior of pod borer during cropping season facilitates the adjustment of an appropriate pest management plan.

AUTHOR'S CONTRIBUTION

Project administration and Supervision: Muhammad Nadeem, Zaheer Sikandar. Writing original draft: Aqsa Bibi. Formal analysis: Niaz Hussain, Abdul Ghaffar. Investigation and Methodology: Muhammad Tariq Javeed, Saeed Ahmad, Aftab Ahmad Khan. Writing and Reviewing: Muhammad Hussnain Babar, Zubeda Parveen, Shaharyar Ahsan Every author has reviewed and consented to the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

All data produced throughout this research is presented in this published article as tables.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

This study does not include any personal data from individuals in any capacity. All authors have consented to its publication.

CONFLICT OF INTERESTS

All authors attest to the validity of manuscript contents and agree for submission.

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