



# Screening of Maize (*Zea mays* L.) Genotypes for Resistance Against Fall Armyworm (*Spodoptera Frugiperda*) Under Field Conditions

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**Citation** | Ain. N. U, Rehman. A, Naveed. M, Rehman. Z. U, Ibrar. I, Parveen. N, Jabbar. M, Hanif. M, Chaudhry. M, Ali. B, “Screening of Maize (*Zea mays* L.) Genotypes for Resistance Against Fall Armyworm (*Spodoptera Frugiperda*) Under Field Conditions”, IJASD, Vol. 8 Issue. 2 pp 253- 263, April 2026

**Received** | March 12, 2026 **Revised** | April 11, 2026 **Accepted** | April 15, 2026 **Published** | April 19, 2026.

Full armyworm (*Spodoptera frugiperda*) has emerged as one of the most destructive invasive insect pests threatening global maize production, particularly under changing climatic conditions. The present study was conducted to evaluate the resistance response of ten maize genotypes against fall armyworm under natural field infestation conditions. The experiment was laid out in a Randomized Complete Block Design with three replications. Data were recorded for phenological traits, yield-related parameters, and fall armyworm damage characteristics including infestation percentage, leaf damage score, and ear damage score. Significant variation was observed among maize genotypes for all studied traits. Days to tasseling ranged from 55 to 61 days, while days to silking varied from 58 to 64 days. PH ranged from 198 to 232 cm and CL varied between 15.9 and 20.1 cm. Significant differences were also observed for yield-related traits, where grain yield ranged from 4860 to 7825 kg ha<sup>-1</sup>. Genotype G5 produced the highest grain yield (7825 kg ha<sup>-1</sup>), maximum cob length (20.1 cm), highest number of grains per cob (536), and maximum 100-grain weight (34.6 g). In contrast, G8 produced the lowest grain yield (4860 kg ha<sup>-1</sup>) with poor yield-related performance. Fall armyworm infestation percentage ranged from 21.2 to 62.5%, while leaf damage score and ear damage score varied from 2.3–7.4 and 2.1–6.8, respectively. Genotype G5 exhibited the lowest infestation percentage (21.2%), minimum leaf damage score (2.3), and lowest ear damage score (2.1), indicating strong resistance/tolerance against fall armyworm. Conversely, G8 was identified as the most susceptible genotype with highest infestation percentage (62.5%), leaf damage score (7.4), and ear damage score (6.8). Correlation analysis revealed strong negative associations of fall armyworm infestation and ear damage with grain yield, while yield showed positive association with cob length, number of grains per cob, and 100-grain weight.

**Keywords:** Fall Army Worm, Maize, Yield, Cob, Infestation, Disease

## Introduction:

**Importance of Maize:** Maize (*Zea mays* L.) is one of the most important cereal crops in the world and serves as a major source of food, feed, and industrial raw material. Globally, maize

contributes substantially to food security because of its high yield potential, adaptability to diverse agroecological conditions, and wide utilization in livestock and poultry industries [1]. In Pakistan, maize is the third most important cereal crop after wheat and rice and plays a significant role in the agricultural economy. The demand for maize is continuously increasing due to rapid expansion of the poultry and feed sectors, which require large quantities of quality grain [2].

### **Fall Armyworm: An Emerging Threat to Maize Production:**

Despite the increasing importance of maize, its productivity is severely constrained by insect pests, among which fall armyworm (*Spodoptera frugiperda* J.E. Smith) has emerged as one of the most destructive invasive pests worldwide. Native to the Americas, FAW has rapidly spread across Africa and Asia, including Pakistan, causing serious economic losses in maize production systems [3][4]. The pest has a wide host range, high reproductive potential, strong migratory ability, and voracious feeding behavior, making its management extremely difficult under field conditions [5].

Fall armyworm larvae primarily feed on leaves during vegetative stages, producing characteristic windowpanes, ragged holes, and whorl damage. Under severe infestation, the pest also attacks tassels, ears, and developing grains, leading to significant yield reduction and deterioration of grain quality [6]. Previous studies have reported maize yield losses ranging from 20–73% depending upon infestation intensity, environmental conditions, crop stage, and genotype susceptibility [7][8].

### **Climate Change and Fall Armyworm Dynamics:**

Climate change has further intensified the threat of fall armyworm in maize-growing regions. Rising temperatures, irregular rainfall patterns, prolonged dry periods, and changing humidity conditions favor the rapid multiplication, survival, and spread of FAW populations [9]. Warmer climatic conditions accelerate insect development, increase the number of generations per year, and enhance migratory potential, thereby increasing pest pressure on maize crops [10]. In South Asian countries, including Pakistan, climate variability is expected to expand the geographical distribution and seasonal activity of FAW, creating additional challenges for sustainable maize production [11].

Climate stress also weakens plant defense mechanisms and may increase the susceptibility of maize genotypes to insect attack. Therefore, identification of maize genotypes possessing stable resistance or tolerance under changing climatic conditions has become an urgent priority for breeders and crop protection scientists. Developing resistant cultivars can reduce pesticide dependence, minimize environmental pollution, and improve resilience of maize production systems under climate change scenarios [1][5].

### **Host Plant Resistance as a Sustainable Management Strategy:**

Among different FAW management strategies, host plant resistance is considered one of the most effective, economical, and environmentally friendly approaches. Resistant maize genotypes can reduce larval survival, feeding intensity, and reproductive success of the insect pest, thereby minimizing yield losses and reducing dependence on chemical insecticides [12]. Continuous use of insecticides against FAW not only increases production costs but also causes environmental contamination, pesticide resistance, and destruction of beneficial organisms [5].

Several studies have demonstrated the existence of genetic variability for FAW resistance in maize germplasm, indicating the possibility of developing resistant hybrids and varieties through breeding approaches [13][14]. Traits such as reduced leaf damage, lower ear injury, early maturity, better grain filling, and maintenance of yield under infestation are important indicators of resistance and tolerance [15].

**Novelty Statement:** The present study provides a comprehensive field-based evaluation of maize genotypes against fall armyworm under natural infestation conditions using integrated

phenological, yield-related, and insect damage parameters. Unlike many previous studies focusing only on leaf injury, this research combines fall armyworm infestation percentage, leaf damage, ear damage, and yield performance to identify stable resistant/tolerant genotypes. The study also highlights the importance of climate change-driven pest pressure and emphasizes the need for climate-resilient maize genotypes suitable for sustainable crop production systems.

### **Objectives of the Study:**

To evaluate maize genotypes for resistance/tolerance against fall armyworm under field conditions.

To assess the effect of fall armyworm infestation on yield and yield-related traits of maize genotypes.

To identify resistant and susceptible maize genotypes based on infestation and damage parameters.

To determine the relationship between fall armyworm damage and grain yield performance.

To identify promising maize genotypes for future resistance breeding programs.

### **Materials and Methods:**

#### **Experimental Site and Plant Material:**

The present study was conducted under field conditions to evaluate the resistance response of maize genotypes against fall armyworm (*Spodoptera frugiperda* J.E. Smith). Ten maize genotypes including YH-5427, NK-8441, DK-6714, FH-1046, P-1543, SB-989, MMRI-Yellow, EV-1098, FH-988 and HC-9091 were used as experimental material. The genotypes were selected on the basis of their agronomic variability and presumed response against insect attack.

#### **Experimental Design and Crop Husbandry:**

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Each experimental unit consisted of four rows, each 5 m in length. Row-to-row and plant-to-plant spacing were maintained at 75 cm and 25 cm, respectively. All recommended agronomic practices, including irrigation, fertilizer application, weed management and intercultural operations, were applied uniformly to all plots throughout the growing season. Fertilizer was applied at the recommended dose of 250–120–125 kg NPK ha<sup>-1</sup>. Nitrogen was applied in split doses, whereas full phosphorus and potassium were incorporated at sowing. No insecticide was applied against fall armyworm during the entire crop season in order to allow natural infestation and accurate screening of genotypic response. Figure 1

#### **Establishment and Confirmation of Fall Armyworm Infestation:**

Natural infestation of fall armyworm was allowed to develop under field conditions. To maintain relatively uniform pest pressure, susceptible maize border rows were planted around the experimental field. Regular scouting was conducted from the early vegetative stage to monitor the spread of infestation. Data collection was initiated only after infestation was observed across all experimental plots. Initial infestation counts were recorded to confirm comparable insect pressure among genotypes. Similar procedures have been used in field screening studies of maize against fall armyworm [15][16].

#### **Recording of Phenological Traits:**

##### **Days to Tasseling:**

Days to tasseling were recorded as the number of days from sowing to the stage when 50% of plants in a plot showed tassel emergence [17].

##### **Days to Silking:**

Days to silking were recorded as the number of days from sowing until 50% of plants in a plot exhibited silk emergence from the ears [17].

**Recording of Morphological and Yield Traits:****Plant Height (cm):**

Plant height was measured at physiological maturity from the soil surface to the tip of the tassel using a measuring scale. Data were recorded from randomly selected plants and averaged for statistical analysis [18].

**Cob Length (cm)**

Cob length was measured in centimeters from the base to the tip of the cob using a measuring ruler after harvesting [19].

**Number of Grains per Cob:**

The total number of grains per cob was counted manually from representative harvested cobs collected from each plot.

**Hundred-Grain Weight (g):**

Hundred-grain weight was determined by randomly selecting 100 grains from each plot and weighing them using an electronic balance. Grain moisture was standardized before recording observations [20].

**Grain Yield per Hectare (kg ha<sup>-1</sup>):**

Grain yield was recorded on plot basis after harvesting and shelling, and then converted into kg ha<sup>-1</sup> after adjustment to standard grain moisture content. Yield conversion was performed using standard agronomic procedures [21].

**Recording of Fall Armyworm Damage Parameters:****Fall Armyworm Infestation Percentage:**

Fall armyworm infestation percentage was calculated using the following formula:

$$\text{FAW Infestation Percentage} = \frac{\text{Number of infested plants}}{\text{Total observed plants}} \times 100$$

Plants showing visible symptoms of feeding damage, larval presence or whorl injury were considered infested [4].

**Leaf Damage Score:**

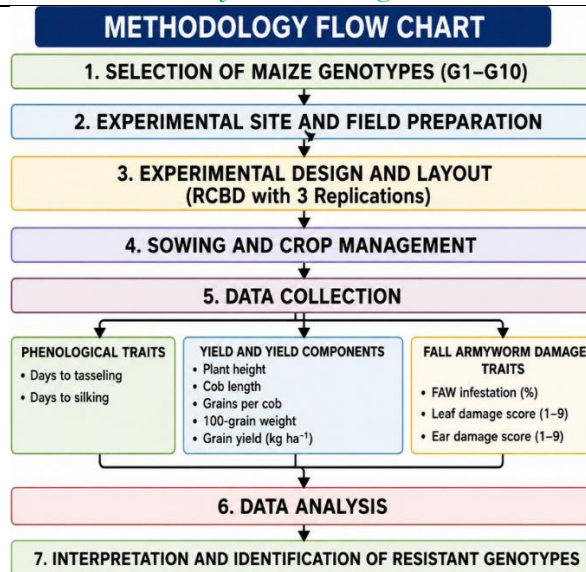
Leaf damage was assessed using the standard Davis 1–9 visual rating scale, where 1 represented no visible damage and 9 represented severe whorl destruction and extensive leaf feeding. Observations were recorded from randomly selected plants at vegetative stage [22]. Modified Davis scales are widely accepted for maize fall armyworm screening.

**Ear Damage Score:**

Ear damage score was recorded at maturity using a 1–9 severity scale, where lower values indicated slight or no ear injury and higher values indicated severe cob and kernel damage caused by fall armyworm feeding [23].

**Statistical Analysis:**

The collected data were subjected to analysis of variance (ANOVA) appropriate for Randomized Complete Block Design as described by Steel, et al (1997). Pearson correlation analysis was conducted to determine the relationship between fall armyworm damage and yield-related traits.



**Figure 1.** Display of methodology used for evaluation of 13 maize genotypes for resistance to fall army worm

## Results and Discussion:

### Interpretation of Analysis of Variance (ANOVA):

The analysis of variance revealed highly significant differences among maize genotypes for all studied traits, including phenological, yield-related and fall armyworm resistance parameters (Table 1). The highly significant mean sum of squares for days to tasseling and days to silking indicated the presence of considerable genetic variability among genotypes for maturity-related traits. Such variability is important because maturity duration influences the exposure period of maize plants to fall armyworm infestation and consequently affects the level of damage [23].

Plant height and cob length also exhibited highly significant differences among genotypes, demonstrating substantial variation in plant architecture and ear development. Significant variability in these traits suggests that the tested germplasm possessed diverse growth potential and adaptation capacity under fall armyworm stress conditions. Similar findings were reported by [24], who observed considerable genetic variation among tropical maize lines for agronomic and resistance-related traits.

The highly significant variation for number of grains per cob, 100-grain weight and grain yield confirmed that fall armyworm infestation differentially affected reproductive performance and yield potential of the tested genotypes. Genotypes with lower damage scores maintained better grain development and yield stability, whereas susceptible genotypes suffered severe yield reductions. Previous studies have similarly reported that FAW infestation causes substantial yield losses by reducing kernel formation and grain filling [6].

The present study demonstrated significant genetic variability among maize genotypes for fall armyworm resistance and yield-related traits under field conditions. The significant differences observed for FAW infestation percentage, leaf damage score and ear damage score indicate that maize genotypes differed substantially in their response to FAW attack. This variability is highly important for resistance breeding because identification of resistant germplasm is considered one of the most economical and environmentally safe approaches for FAW management.

The significant variation for leaf damage score among genotypes suggests differences in antibiosis, antiemesis or tolerance mechanisms operating against fall armyworm infestation. Resistant genotypes generally exhibited lower leaf damage and maintained better vegetative growth, whereas susceptible entries suffered severe feeding injury. Similar findings were

reported by previous studies, which validated leaf damage scoring as an effective phenotyping method for identifying resistant maize germplasm against FAW. Likewise, emphasized that standardized leaf damage scales provide reliable assessment of host plant resistance under field conditions.

The highly significant differences observed for ear damage score indicate that FAW infestation extended beyond vegetative stages and affected reproductive structures. Ear damage is considered particularly important because it directly influences grain formation and marketable yield. [6] reported that FAW damage during reproductive stages can substantially reduce grain development and final yield. Similar results were also documented by [25], who observed severe yield penalties in susceptible maize genotypes exposed to high FAW infestation pressure.

The significant variation observed for grain yield, number of grains per cob and 100-grain weight suggests that maize genotypes differed greatly in their ability to maintain productivity under FAW stress. Genotypes exhibiting lower infestation and damage scores maintained better grain filling and higher yield, indicating the existence of tolerance mechanisms. Yield stability under insect stress is considered a critical criterion for selecting resistant cultivars because some genotypes may tolerate damage without severe yield reduction [26]. Therefore, simultaneous consideration of resistance and yield traits is essential for effective maize improvement programs.

The strong variability observed among maize genotypes confirms the usefulness of field screening for identifying resistant and high-yielding germplasm. Genotypes exhibiting lower infestation percentage, lower leaf and ear damage scores and higher grain yield can be utilized in future breeding programs for development of FAW-resistant maize hybrids. Resistant cultivars can reduce dependence on insecticides, minimize environmental hazards and support sustainable maize production systems [5].

Table 1 Mean Sum of Square (MSS) values for studied genotypes for yield and disease related characters

Source of Variation	Replications	Genotypes
DT	1.248*	12.86**
DS	1.1*	13.45**
PH	18.52*	486.72**
CL	0.21*	5.84**
NGC	112.35*	8245.41**
HGW	0.42*	18.62**
GY	84520*	2145680.35**
FAWIP	6.41*	512.64**
LDS	0.18**	8.46**
EDS	0.14*	7.82**

DT= Days to tasseling, DS= Days to silking, PH= Plant Height, CL= cob length, NGC= number of grains per cob, HGW= Hundred Grain Weight, Gy (Grain yield), FAWIP (Fall army worm percentage), LDS=leaf damage score, EDS=Ear damage score

**Interpretation of Correlation Analysis:**

The correlation analysis showed clear relationships among fall armyworm damage, yield, and yield-related traits (Table 2). Cob length showed a strong positive association with grain yield ( $r = 0.7^*$ ) and 100-grain weight ( $r = 0.8^*$ ), indicating that genotypes with longer cobs generally produced heavier grains and higher yield. Cob length also showed a very strong negative correlation with ear damage score ( $r = -1.0$ ), suggesting that FAW ear injury severely reduced cob development. Days to silking showed a positive correlation with ear damage score ( $r = 0.7$ ) and leaf damage score ( $r = 0.8^*$ ), indicating that late-silking genotypes were more

affected by FAW damage. Similarly, days to tasseling showed strong positive association with FAW infestation percentage ( $r = 0.9^{**}$ ) and ear damage score ( $r = 0.7$ ), which suggests that late-maturing genotypes remained exposed to FAW for a longer period and suffered more damage (Table 1).

Ear damage score showed a strong negative correlation with grain yield ( $r = -0.9^*$ ) and number of grains per cob ( $r = -0.8^*$ ). This indicates that ear damage directly reduced kernel formation and final yield. FAW infestation percentage also showed a very strong negative association with grain yield ( $r = -1.0$ ), confirming that higher infestation pressure caused severe yield reduction. Hundred-grain weight was positively associated with grain yield ( $r = 0.8$ ), while it was negatively correlated with FAW infestation percentage ( $r = -0.8^*$ ) and leaf damage score ( $r = -0.8^*$ ). This means FAW damage not only reduced plant growth but also affected grain filling. Number of grains per cob showed a strong positive correlation with grain yield ( $r = 1.0$ ), confirming that kernel number was the most important yield-contributing trait in this study. Plant height showed positive correlation with hundred-grain weight ( $r = 1.0$ ), number of grains per cob ( $r = 0.7^*$ ) and grain yield ( $r = 0.5$ ), while it showed a negative association with days to silking ( $r = -0.8^*$ ) and leaf damage score ( $r = -0.4^*$ ). This suggests that taller and vigorous plants were comparatively more tolerant to FAW damage and maintained better yield performance.

The present correlation analysis revealed that fall armyworm infestation and damage parameters were negatively associated with grain yield and yield-related traits. The strong negative correlation of grain yield with FAW infestation percentage and ear damage score indicates that FAW injury directly reduced the productive capacity of maize genotypes. Similar findings were reported by [6], who observed that FAW-induced leaf damage can reduce maize yield depending on crop stage and damage intensity. Recent field studies have also shown that ear damage is more closely associated with yield reduction than leaf damage because it directly affects grain formation and marketable yield.

The strong negative association between ear damage score and number of grains per cob shows that FAW feeding at reproductive stages may reduce kernel setting and cob filling. This relationship is important because resistance against FAW should not be judged only from low leaf damage; genotypes must also maintain cob development and grain yield under infestation. [24] also emphasized that FAW resistance breeding should combine low damage scores with stable agronomic performance. Similarly, [26] reported that multi-trait selection is more effective than single-trait selection for identifying FAW-resistant maize genotypes.

Days to tasseling and days to silking showed positive associations with FAW damage traits, especially FAW infestation percentage and leaf damage score. This suggests that late-maturing genotypes may remain vulnerable for a longer period, increasing the chances of larval feeding and damage accumulation. Similar observations have been reported in maize–FAW studies where crop stage, sowing time and genotype duration influenced FAW infestation and yield response [27]. Therefore, early or medium-maturing genotypes with synchronized tasseling and silking may help reduce the damage window and maintain better yield under FAW pressure.

Cob length, number of grains per cob and 100-grain weight were positively associated with grain yield, indicating that these traits contributed strongly to yield improvement. These traits are also useful indirect selection criteria when screening maize genotypes under FAW stress. The negative association of FAW infestation and leaf damage with 100-grain weight suggests that severe vegetative injury may disturb photosynthetic area, assimilate production and grain filling. [14][15] reported that standardized leaf damage scoring is useful for FAW phenotyping, but it should be combined with yield traits for reliable resistance classification.

The positive correlation of plant height with grain yield, number of grains per cob and 100-grain weight suggests that vigorous genotypes may tolerate FAW damage better by

maintaining biomass production and reproductive growth. However, plant height alone should not be used as a resistance criterion because excessive height may increase lodging risk. Instead, plant height should be interpreted together with damage scores and yield traits.

**Table 2.** Correlation analysis of 13 maize genotypes for yield and disease related parameters under infestation of Fall Army Worm

	CL	DS	DT	EDS	FAWIP	GY	HGW	LDS	NGC
DS	-0.6								
DT	-0.6	0.4							
EDS	-1.0	0.7	0.7						
FAWIP	-0.4*	0.5**	0.9**	0.8*					
GY	0.7*	-0.5	-0.5	-0.9*	-1.0				
HGW	0.8*	-0.7	-0.9*	-0.2	-0.8*	0.8			
LDS	-0.8	0.8*	0.1	0.5	0.5	-0.2	-0.8*		
NGC	0.8	-0.3	-0.9	-0.8*	-0.4	1.0	0.2*	-1.0	
PH	0.4*	-0.8*	-0.6*	-0.1	-0.5	0.5	1.0	-0.4*	0.7*

DT= Days to tasseling, DS= Days to silking, PH= Plant Height, CL= cob length, NGC= number of grains per cob, HGW= Hundred Grain Weight, (HGW), GY (grain yield), FAWIP (Fall army worm percentage), LDS=leaf damage score, EDS=Ear damage score

#### Interpretation of Mean Data:

The results showed clear variation among the ten maize genotypes for phenological, yield-related, and fall armyworm damage traits Figure 2. For maturity traits, G5 was the earliest genotype, with minimum days to tasseling and silking, while G8 was the latest genotype. Early maturity may help maize genotypes escape prolonged fall armyworm exposure, whereas late genotypes may remain vulnerable for a longer period.

For yield-related traits, G5 showed the best overall performance with maximum plant height, cob length, number of grains per cob, 100-grain weight, and grain yield. It produced the highest grain yield of 7825 kg ha<sup>-1</sup>, followed by G9, G2, and G3. These genotypes also showed better cob development and grain filling, indicating strong yield potential under fall armyworm pressure.

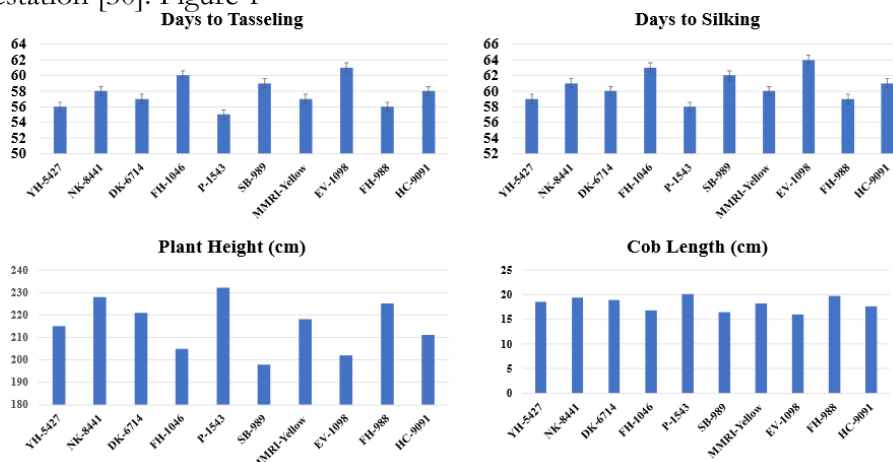
Fall armyworm infestation and damage traits showed that G5, G9, G2, and G3 were comparatively resistant/tolerant because they had lower FAW infestation percentage, leaf damage score, and ear damage score. G5 recorded the lowest FAW infestation percentage, lowest leaf damage score, and lowest ear damage score, making it the most promising genotype. In contrast, G8 was the most susceptible genotype, with the highest FAW infestation percentage, highest leaf damage score, highest ear damage score, and lowest grain yield. G6 and G4 also showed higher damage and lower yield, indicating susceptibility.

The data indicate that G5 may be considered the best resistant/tolerant genotype, while G8 may be used as the susceptible check. Genotypes G9, G2, and G3 also performed well and may be selected for further evaluation.

The present findings revealed substantial variability among maize genotypes for resistance against fall armyworm and yield performance. The differential response of genotypes for FAW infestation percentage, leaf damage score, and ear damage score indicates that genetic variability exists for resistance/tolerance mechanisms. Such variability is essential for breeding programs because host plant resistance is considered one of the most economical and environmentally sustainable approaches for managing fall armyworm in maize [28]. Recent studies have also emphasized that maize genotypes differ significantly in their response to fall armyworm damage under natural and artificial infestation conditions.

The lower leaf damage score recorded in G5, G9, G2, and G3 suggests the presence of resistance or tolerance attributes that reduced larval feeding injury. Leaf damage scoring

based on a 1–9 scale is widely used in maize FAW screening, and lower scores are generally associated with better resistance response [29]. Similar studies reported that resistant maize genotypes usually maintain lower leaf injury, better plant vigor, and improved growth under FAW infestation [30]. Figure 1



**Figure 2.** Mean data of 13 maize genotypes for yield and disease related parameters under infestation of Fall Army worm

Ear damage score was also an important trait in this study because it directly affected grain development and final yield Figure 3. G8, G6, and G4 showed higher ear damage and lower grain yield, indicating that reproductive damage was more harmful than vegetative injury alone. This agrees with previous findings had a stronger negative association with ear damage than with leaf damage. Similarly, observed that ear damage is closely associated with grain quality and cob deterioration under FAW pressure.

The superior performance of G5 was mainly due to its combined expression of low FAW infestation, low leaf and ear damage, longer cobs, higher grains per cob, heavier grains, and maximum grain yield. This confirms that resistance screening should not rely only on damage score; yield-related traits must also be considered. [26] emphasized the importance of multi-trait selection indices for identifying FAW-resistant maize genotypes because resistance breeding involves several interacting traits. Similarly, [28] reported that combining resistance traits with yield potential is more useful for selecting maize genotypes suitable for breeding programs.

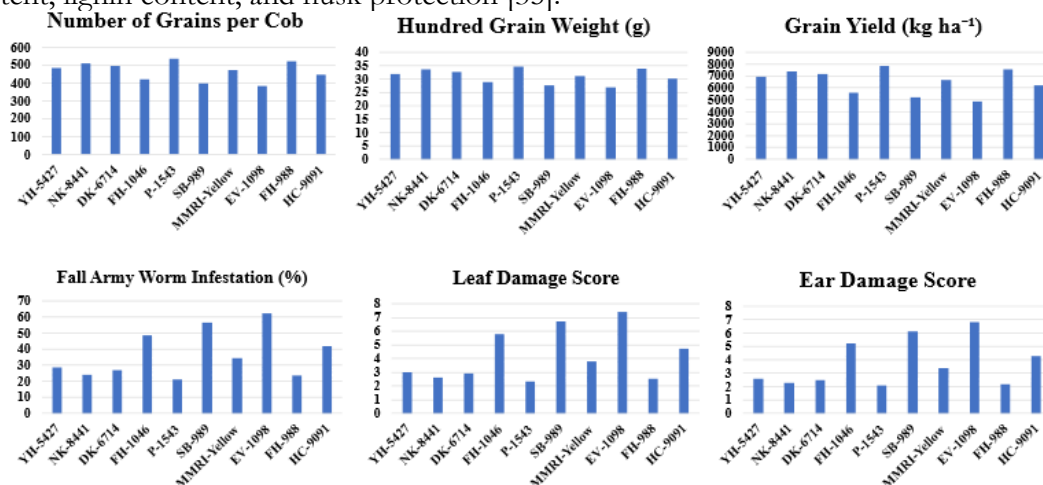
Grain yield was highest in G5, followed by G9, G2, and G3, while the lowest yield was observed in G8. The reduced yield in susceptible genotypes may be due to higher foliar injury, reduced photosynthetic area, poor cob development, and direct ear damage. [6] reported that fall armyworm leaf damage can reduce yield depending on crop stage and damage severity, while [8] reported maize yield losses of about 22% under FAW infestation. Other studies have also reported that severe FAW infestation can reduce maize productivity through damage to leaves, whorls, ears, and kernels [31].

The early maturity of G5 may also have contributed to its better performance. Early tasseling and silking can reduce the exposure period of plants to pest pressure, especially under high FAW population buildup. Late genotypes such as G8 may remain longer in vulnerable vegetative and reproductive stages, resulting in higher infestation and greater yield loss. Similar findings have been reported by studies showing that crop stage, sowing time, and environmental conditions influence FAW infestation severity and maize yield response [32][33][34].

The higher cob length, number of grains per cob, and 100-grain weight in G5, G9, G2, and G3 suggest that these genotypes maintained better reproductive growth despite FAW pressure. These traits are important yield components and can be used as indirect selection

criteria for identifying tolerant genotypes. In contrast, susceptible genotypes showed reduced grain number and grain weight, probably due to stress-induced reduction in assimilate supply and direct reproductive damage. Previous studies have also suggested that FAW injury can reduce grain filling and cob development, particularly when infestation continues from vegetative to reproductive stages.

Based on overall performance, G5 can be classified as resistant/tolerant, whereas G8 can be classified as susceptible. G9, G2, and G3 may be considered moderately resistant or promising genotypes because they combined lower damage scores with higher yield. However, these results should be validated under multi-location and multi-season trials because FAW infestation is strongly influenced by environment, pest population pressure, planting time, and crop growth stage. Further molecular, biochemical, and morphological studies may also help identify the traits responsible for resistance, such as leaf toughness, trichome density, phenolic content, lignin content, and husk protection [35].



**Figure 3.** Mean data of 13 maize genotypes for yield and pest-related parameters under infestation of Fall Army Worm

**Conclusion:**

The present study revealed significant variability among maize (*Zea mays* L.) genotypes for resistance against fall armyworm (*Spodoptera frugiperda* J.E. Smith) under natural field infestation conditions. Genotypes differed substantially for infestation percentage, leaf damage, ear damage, and yield-related traits, indicating the presence of useful genetic diversity for resistance breeding. Genotype G5 exhibited the lowest fall armyworm infestation and damage scores along with the highest grain yield, identifying it as the most promising resistant/tolerant genotype. In contrast, G8 was found to be highly susceptible due to severe infestation and reduced yield performance. The study further demonstrated that fall armyworm infestation negatively affected grain yield and associated traits. Therefore, resistant and high-yielding genotypes identified in this study may be utilized in future maize improvement programs aimed at developing climate-resilient and fall armyworm-resistant cultivars for sustainable maize production.

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