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EVALUATION OF MAIZE HYBRIDS FOR RESISTANCE AGAINST FALL ARMYWORM, *SPODOPTERA FRUGIPERDA* (J.E. SMITH)

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ABSTRACT

A screening experiment was carried out to evaluate maize hybrids against fall armyworm, *Spodoptera frugiperda* at Zonal Agricultural Research Station (ZARS), Vishweshwaraiah Canal Farm, Mandya during 2022-23. Thirty maize hybrids that include 19 public sector and 11 private sector hybrids were evaluated against fall armyworm. The grouping of maize hybrids into different categories of susceptibility was followed based on the extent of leaf damage induced by fall armyworm (FAW). Five plants in each hybrid lines were observed for the damage caused by FAW which was recorded at fortnightly intervals using the scale of 0 to 9 as described by Davis and Williams (1992). Out of 30 hybrids, five were grouped under least susceptible category whose damage score ranged from 1.23 in JP 2007 to 3.13 in MAH 21-592. The standard check, MAH-14-5 showed the damage score of 3.15. Nineteen hybrids were grouped in to moderately susceptible category with a damage score ranging from 4.18 in Apsa 91 to 6.38 in MAH 21-580. Remaining five hybrids were grouped under highly susceptible category with highest mean whorl damage score of 7.3, which was recorded in MAH 21-627 followed by 7.18 in GK 3264. The screening experiment provided valuable insights into the performance of different maize hybrids against fall armyworm infestation. It identified hybrids with varying levels of susceptibility, which can guide farmers and breeders in selecting appropriate varieties for pest management strategies, ultimately contributing to sustainable maize production.

Key words : Fall armyworm, *Spodoptera frugiperda*, Maize, Hybrids, Screening.

Introduction

Maize is the second most important food grain crop under the family gramineae, scientifically referred as *Zea mays*, (L). It is the third most important cereal grain crop after wheat and rice in the world. It supplies more than 5% dietary energy. Maize is known as "Queen of cereals" as it possesses the high yielding capacity and also, it possesses great genetic diversity compare to the other crops, because of this, it can be cultivated under different agro-ecological zones (Azerefegne *et al*., 2002). Small-scale farmers in both the Western and Eastern Hemispheres heavily cultivate this crop. However, the growers' livelihoods are currently at risk due to a decline in crop production, primarily attributed to the invasion and rampant infestation of the fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith). The fall armyworm poses a remarkable ability to consume over 350 plant species, including maize, sorghum. Inadequate management of this pest results in substantial annual maize yield losses, estimated between 8.3 and 20.6 million tonnes, equating to 21–53 percent of total production (Day *et al*., 2017).

The nature of damage and symptoms of attack due to fall armyworm are that the larvae feed on all the life stages of the crop and whorl feeding was noticed during vegetative stage of the crop. These whorls maybe latter develop into a mass of holes, ragged edges and filled with larval frass. The early instars feed up on the leaf

lamina, skeletonize it causing a characteristic' window-pane' damage. This window-panning is most commonly observed damage symptom at the early whorl stage. Larger holes, ragged whorl leaves are seen when damage caused by late larval instars and finally produce a sawdust-like larval droppings. Fall armyworms can also attack silk and developing tassel hindering fertilization of the ear. The late instar larvae attack the cobs at a point where silk protrudes from the cob and it starts feeding. Later it bores through the kernels causing significant kernel damage. This may lead to secondary infections by fungus and bacteria and thus reducing the grain quality. Aditya and Singh (2019) reported that all the developmental stages of maize plant were attacked but severe damage was occurred on young plants (15 days old plants). The damage caused by FAW infestations on maize plants, as described, can be devastating, leading to significant yield losses and reduced grain quality. However, the development and adoption of resistant maize hybrids offer a promising solution.

Materials and Methods

The investigations relating to the present study on screening of hybrids associated with resistance against fall armyworm, *Spodoptera frugiperda* (J. E. Smith.) were carried out at "F" block, ZARS, Vishweshwaraiah Canal. Farm, Mandya, Karnataka during 2022 2023. Mandya is classified under southern dry zone and geographically located between 12°45' and 13° 57' North latitude and to 76° 45' and 78° 24' longitude and receives average annual rainfall of 721 mm. The screening was conducted to evaluate 30 maize hybrids *viz.*, JP 2007, MAH 20-40, MAH 21-548, PAC-741, MAH 21-592, MAH 21-577, JHS 666, ADV 9293, GK 3264, MAH 21-627, NAH 2049- I, MAH 21-581, MAH 15-84, Apsa 91, GK 3122, MAH 4271, MAH 14-138, MAH 19-2, KMH 244, NAH 1137, MAH 21-588, KMH 517, MAH 21-585, TOP 28, MAH 21-596, NAH 2049-II, MAH 21-616, Byrava super, MAH 21-580 and MAH 14-5 was used as a standard check against fall armyworm in ZARS, Mandya during September 2022. The maize hybrids were sown in Randomized Block Design (RBD) in the field with a spacing of 60×30 cm between rows and plants, respectively in two replications. The cultivation of maize crop was done by following all the recommended practices except the plant protection measures. The maize hybrids were allowed for natural infestation of fall armyworm. Observation on fall armyworm was recorded at 15 days interval on five randomly selected plants up-to 60 days. A 0-9 Davis and Williams (1992) scale, was used to evaluate leaf damage (Table 1). According to the damage

Table 1 : Visual rating scales for leaf damage assessment (Davies and Williams, 1992).

Scale	Description
0	No visible leaf damage
1	Only pin hole on whorl leaves
2	Pin hole and small circular lesions on whorl leaves
3	Pin holes, small circular lesions and a few small < 1.3 cm (< 1/2") elongated lesions on whorl and/ or furl leaves
4	Small elongated and a few mid-sized 1.3—2.5 cm (1/2"—1") elongated lesions on whorl and/ or furl leaves
5	Small elongated and several mid-sized 1.3—2.5 cm (1/2"—1") elongated lesions on whorl and/ or furl leaves
6	Small and mid-sized elongated lesions plus a few large > 2.5 cm (> 1") elongated lesions on whorl and/ or furl leaves
7	Many small and mid-sized elongated lesions plus several large > 2.5 cm (> 1") elongated lesions on whorl and furl leaves
8	Many small and mid-sized elongated lesions on whorl leaves plus many large > 2.5 cm (1") elongated lesions on whorl and furl leaves
9	Whorl and furl leaves almost destroyed

Table 2 : Categorization of susceptibility of maize hybrids based on leaf damage scale.

Explanation/ definition of damage	Leaf damage rating scale
Least susceptible	1-4
Moderately susceptible	>4-7
Highly susceptible	>7-9

scale observed, the hybrids were classified into three categories *i.e.*, least susceptible, moderately susceptible, highly susceptible (Paul and Deole, 2020) (Table 2).

Results and Discussion

The mean leaf damage data (up to 60 DAS) recorded is given in Table 3. The hybrid JP 2007 recorded minimum leaf damage (1.23) whereas; MAH 21-627 has recorded

Table 3 : Screening of maize hybrids against fall armyworm *Spodoptera frugiperda* at different days after sowing.

S. no.	Hybrids	Leaf damage rating at 15 DAS	Leaf damage rating at 30 DAS	Leaf damage rating at 45 DAS	Leaf damage rating at 60 DAS	Mean
1	MAH 21-581	6.2	6.2	2.7	2.2	4.33
2	MAH 21-596	6.2	8.4	4.4	3.3	5.58
3	MAH 21-592	3.6	3.1	3.3	2.5	3.13
4	GK 3122	4.2	7.7	3.5	2.4	4.45
5	MAH 19-2	4.5	6.8	4.7	3	4.75
6	NAH 2049-II	5.6	7.5	5.7	3.5	5.58
7	NAH 1137	5.4	7.9	4.3	2.4	5.00
8	Byrava Super	5.2	7.5	7.4	5.1	6.30
9	MAH 4271	5.5	6	4.7	2.2	4.60
10	GK 3264	8.1	8.1	7.4	5.1	7.18
11	MAH 21-627	8.0	8.0	7.8	5.4	7.30
12	KMH 517	6.2	7.1	5.3	2.5	5.28
13	MAH 15-84	4.9	7.4	3.1	1.9	4.33
14	MAH 14-5	3.8	4	2.5	2.3	3.15
15	MAH 20-40	0.9	1.2	1.5	1.5	1.28
16	NAH 2049-I	5.0	5.0	4.1	3.1	4.30
17	MAH 21-616	5.1	7.5	5.6	4.2	5.60
18	TOP 28	5.6	7.2	6	2.9	5.43
19	MAH 14-138	4.6	6.8	4.8	2.4	4.65
20	ADV 9293	7.4	7.7	7.5	5.8	7.10
21	PAC 741	2.3	3	3.9	2.7	2.98
22	Apsa 91	4.5	4.6	4.9	2.7	4.18
23	JHS 666	7.5	7.3	7.2	6.2	7.05
24	MAH 21-588	4.6	6.4	6.2	3.4	5.15
25	MAH 21-577	7.9	7.9	7.4	5	7.05
26	MAH 21-580	8.3	8.3	6.5	2.4	6.38
27	MAH 21-585	7.1	5.7	4.3	4.2	5.33
28	JP 2007	0.8	1.5	1.5	1.1	1.23
29	MAH 21-548	0.5	2.1	2.1	1.5	1.55
30	KMH 244	4.1	4.1	6.7	4.5	4.85
SE m ±		0.439	0.378	0.381	0.307	
CD @ p=0.05		1.275	1.098	1.107	0.893	

maximum leaf damage (7.30). The ascending order of mean leaf damage was JP 2007 (1.23) < MAH 20-40 (1.28) < MAH 21-548 (1.55) < PAC 741 (2.98) < MAH 21-592 (3.13) < MAH 14-5 (3.15) < Apsa 91 (4.18) < MAH 21-581 (4.33) < MAH 15-84 (4.33) < NAH 2049-I (4.30) < GK 3122 (4.45) < MAH 4271 (4.60) < MAH 14-138 (4.65) < MAH 19-2 (4.75) < KMH 244 (4.85) < NAH 1137 (5.00) < MAH 21-588 (5.15) < KMH 517 (5.28) < MAH 21-585 (5.33) < TOP 28 (5.43) < MAH 21-596 & NAH2049-II(5.58) < MAH 21-616 (5.60) < Byrava super (6.30) < MAH 21-580 (6.38) < MAH 21-577 & JHS 666 (7.05) < ADV 9293 (7.10) < GK 3264 (7.18) < MAH 21-627 (7.30). According to the whorl

damage score, 6 hybrids were grouped under least susceptible group with a mean damage score of 1 to 4 and 19 hybrids were categorized as moderately susceptible group, which recorded a damage rating score ranging from >4 to 7. The remaining 5 hybrids were grouped under highly susceptible category with the damage score ranging from >7 to 9. The hybrids were classified under the various categories based on mean whorl damage score in which 20 per cent are least susceptible, 63.33 per cent are moderately susceptible and 16.66 per cent are highly susceptible (Fig. 1). The maize hybrids namely, JP2007, MAH-20-40, MAH 21-548, PAC-741, MAH 14-5 and MAH 21-592 were

Table 4 : Classification of maize hybrids against fall armyworm based on leaf damage rating.

Hybrids	Category	Classification
JP 2007, MAH 20-40, MAH 21-548, PAC-741, MAH 21-592, MAH 14-5	1-4	Least susceptible
NAH 2049- I, MAH 21-581, MAH 15-84, Apsa 91, GK 3122, MAH 4271, MAH 14-138, MAH 19-2, KMH 244, NAH 1137, MAH 21-588, KMH 517, MAH 21-585, TOP 28, MAH 21-596, NAH 2049-II, MAH 21-616, Byrava super, MAH 21-580	>4-7	Moderately susceptible
MAH 21-577, JHS 666, ADV 9293, GK 3264, MAH 21-627	>7-9	Highly susceptible
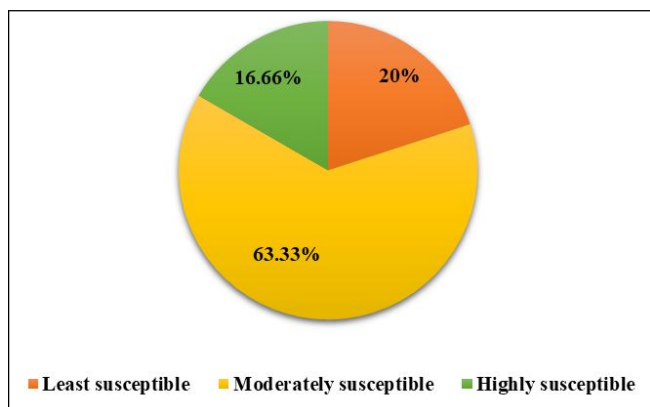
Fig. 1 : Maize hybrids under different categories.

grouped under least susceptible category (Table 4). The maize hybrids namely, MAH 21-577, JHS 666, ADV 9293, GK 3264 and MAH 21-627 were grouped under highly susceptible category, whereas remaining hybrids *viz.*, NAH 2049- I, MAH 21-581, MAH 15-84, Apsa 91, GK 3122, MAH 4271, MAH 14-138, MAH 19-2, KMH 244, NAH 1137, MAH 21-588, KMH 517, MAH 21-585, TOP 28, MAH 21-596, NAH 2049-II, MAH 21-616, Byrava super, MAH 21-580 were grouped under moderately susceptible category. The results of the present study are in conformity with Xinzhi *et al*. (2014) observed that, the plants infested with *S. frugiperda* larvae showed the damage and it was recorded at 7 and 14 days after infestation. Based on cluster analysis of *S. frugiperda* injury rating 'Mp708' and 'FAW7061' were the most resistant, whereas 'Ab24E' and 'EPM6' were the most susceptible to fall armyworm feeding. Similar results were obtained by Varma *et al*. (2022), where the lowest leaf damage rating scale was observed in hybrid maize cultivars *viz.*, GAYMH 3, GAYMH 1, GAWMH 2 and proved as resistant cultivars, whereas the highest leaf damage rating scale was observed in sweet corn hybrid GSCH 0918 and found susceptible under natural condition. Soujanya *et al*. (2022) also reported that the genotypes *viz.,* DMRE 63, DML-163-1, CML 71, CML 141, CML 337, CML 346 and wild ancestor *Zea mays* spp. parviglumis recorded lower LDR ratings against FAW.

Conclusion

Thirty maize hybrids were screened against fall armyworm, 6 were grouped under least susceptible category, 19 under moderately susceptible and 5 under and highly susceptible category. The hybrids grouped under least susceptible category had the damage score ranging from 1.23 to 3.13. Among the hybrids under least susceptible category, the hybrid JP 2007 recorded least leaf damage score of 1.23. The hybrids grouped under moderately susceptible category had the damage score ranging from 4.18 (Apsa 91) to 6.38 (MAH-21-580). The hybrids grouped under highly susceptible category had the damage score ranging from 7.05 (MAH-21-577 and JHS 666) to 7.30 (MAH-21-627). The hybrids showing least damage score can be used as a source of resistance against FAW.

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