



Screening of Pearl Millet Hybrids, Parents and their Performance in Hybrids against Blast Disease under Field Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In pearl millet, incidence of blast disease caused by *Pyricularia grisea* Sacc., has increased at a considerable rate in the recent past, especially on the commercial hybrids in various Pearl millet growing states of India. The experimental material comprised of five female lines, ten male (restorer) lines of pearl millet, their 50 hybrids developed by line x tester design and one standard check hybrid (GHB 1231). They were evaluated in randomized block design with three replications at Main Pearl Millet Research Station, J.A.U., Jamnagar during *kharif* 2023 for field screening of foliar blast disease. Among the total hybrids, 19 hybrids were found to be highly resistant, one was hybrid found resistant, 10 were hybrids found moderately resistant, 20 hybrids were found susceptible and none of the hybrid was found highly susceptible to blast. Crosses reveal that female parent decides blast reaction of their hybrids. Among the parents JMSA₅ 20212 is highly resistant against the foliar blast disease as well as high *per se* performance and good general combiner for all the characters

Keywords: Pearl millet; blast resistance; hybrid; pathogen resistance.

1. INTRODUCTION

Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is one of the most widely grown millet and an important crop in India and Africa, extensively cultivated in arid and semi-arid regions and its fourth major growing cereal crops after rice, wheat and sorghum. India is the largest producer of pearl millet in the world. The crop is best suited for areas with low soil fertility, drought, high temperature, low pH or high salinity. In general, incidence of various diseases and pests affects the growth and productivity of pearl millet crop [1-3]. Incidence of blast disease caused by *Pyricularia grisea* Sacc. (Teleomorph: *Magnaporthe grisea*), has increased at a considerable rate in the recent past, especially on the commercial hybrids in various states of India, which was once considered a minor disease of pearl millet [4]. The fungus becomes much more severe during humid weather conditions and can infect at all growth stages from seedling to adult plant, thereby reducing grain yield [5]. Even though the pathogen is

highly variable in its nature, it is also highly specialized in its host range [6,7]. As a result, *Magnaporthe grisea* strains from rice or any other crops do not infect pearl millet and vice versa [8]. Therefore, to increase production and productivity of pearl millet, development of new variety/hybrid for blast resistance is of great significance. All the points keep in mind present study was conducted to identify blast resistant hybrids, parents and their performance in hybrids in field condition.

2. MATERIALS AND METHODS

The experimental material comprised of five CGMS (Female) lines viz., ICMA₁ 94555, ICMA₁ 95444, ICMA₁ 11222, ICMA₁ 20209, JMSA₅ 20212; ten restorer (male) lines of pearl millet viz., J-2372, J-2496, J-2562, J-2597, J-2569, J-2580, J-2634, J-2637, J-2639, J-2641 and their 50 F₁s hybrids developed by line x tester design and one standard check hybrid (GHB 1231). They were evaluated in randomized block design (RBD) with three replications at Main Pearl Millet

Table 1. Foliar blast severity rating score (1-9)

Blast Score	Symptoms and lesions	Disease reaction
1	No lesion to small brown specks of pinhead size	Highly Resistant
2	Large brown specks	
3	Small, roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter with a brown margin	Resistant
4	Typical blast lesions, elliptical, 1-2 cm long, usually confined to the area between main veins, covering <2% of the leaf area	Moderately resistant
5	Typical blast lesions covering <10% of the leaf area	
6	Typical blast lesions covering 10-25% of the leaf area	
7	Typical blast lesions covering 26-50% of the leaf area	Susceptible
8	Typical blast lesions covering 51-75% of the leaf area and many leaves dead	Highly susceptible
9	>75% leaf area covered with lesions and most leaves dead	

Research Station, J.A.U., Jamnagar during *kharif* 2023 for field screening of foliar blast disease. One susceptible check (ICMA₁ 94555) was sown for every ten rows. In order to facilitate spread of the disease, no plant protection measures were taken against blast in the experimental plot. The blast scoring was recorded at hard-dough stage of the crop.

The blast severity was recorded on the five randomly selected and tagged plants of each line at hard-dough stage of the crop. The blast disease severity was assessed by using foliar blast severity rating (1-9) score [4,9].

3. RESULTS AND DISCUSSION

The recorded data divulged that, out of 66 genotypes screened, 25 genotypes were found

to be highly resistant. Among 25 pearl millet genotype, 1 was designated female (JMSA₅ 20212), 4 were designated males (J-2372, J-2496, J-2569 and J-2580) and 19 were hybrids (ICMA₁ 11222 × J-2372, ICMA₁ 11222 × J-2496, ICMA₁ 11222 × J-2562, ICMA₁ 11222 × J-2597, ICMA₁ 11222 × J-2569, ICMA₁ 11222 × J-2580, ICMA₁ 11222 × J-2634, ICMA₁ 11222 × J-2637, ICMA₁ 11222 × J-2639, ICMA₁ 11222 × J-2641, JMSA₅ 20212 × J-2372, JMSA₅ 20212 × J-2496, JMSA₅ 20212 × J-2562, JMSA₅ 20212 × J-2597, JMSA₅ 20212 × J-2569, JMSA₅ 20212 × J-2580, JMSA₅ 20212 × J-2634, JMSA₅ 20212 × J-2637 and JMSA₅ 20212 × J-2641). The check hybrid GHB 1231 was also highly resistance toward the blast. One female parent (ICMA₁ 11222), one male parent (J-2639) and one cross (JMSA₅ 20212 × J-2639) were found in resistance group.

Table 2. Foliar blast score (1-9) analysis in parents and crosses of pearl millet

Score (1-9)	Disease Reaction	Females	Males	Crosses
1.0	Highly Resistant	JMSA ₅ 20212	J-2372 J-2496 J-2569 J-2580	ICMA ₁ 11222 × J-2372, ICMA ₁ 11222 × J-2496, ICMA ₁ 11222 × J-2562, ICMA ₁ 11222 × J-2597, ICMA ₁ 11222 × J-2569, ICMA ₁ 11222 × J-2580, ICMA ₁ 11222 × J-2634, ICMA ₁ 11222 × J-2637, ICMA ₁ 11222 × J-2639, ICMA ₁ 11222 × J-2641, JMSA ₅ 20212 × J-2372, JMSA ₅ 20212 × J-2496, JMSA ₅ 20212 × J-2562, JMSA ₅ 20212 × J-2597, JMSA ₅ 20212 × J-2569, JMSA ₅ 20212 × J-2580, JMSA ₅ 20212 × J-2634, JMSA ₅ 20212 × J-2637, JMSA ₅ 20212 × J-2641, GHB-1231 (check) =Total 20 crosses
2.1-3.0	Resistant	ICMA ₁ 11222	J-2639	JMSA ₅ 20212 × J-2639 = Total 1 cross
3.1-5.0	Moderately resistant	JMSA ₁ 20209	J-2597 J-2634	JMSA ₁ 20209 × J-2372, JMSA ₁ 20209 × J-2496, JMSA ₁ 20209 × J-2562, JMSA ₁ 20209 × J-2597, JMSA ₁ 20209 × J-2569, JMSA ₁ 20209 × J-2580, JMSA ₁ 20209 × J-2634, JMSA ₁ 20209 × J-2637, JMSA ₁ 20209 × J-2639, JMSA ₁ 20209 × J-2641 =Total 10 crosses
5.1-7.0	Susceptible	ICMA ₁ 95444	J-2562 J-2637	ICMA ₁ 94555 × J-2372, ICMA ₁ 94555 × J-2496, ICMA ₁ 94555 × J-2562, ICMA ₁ 94555 × J-2597, ICMA ₁ 94555 × J-2569, ICMA ₁ 94555 × J-2580, ICMA ₁ 94555 × J-2634, ICMA ₁ 94555 × J-2637, ICMA ₁ 94555 × J-2639, ICMA ₁ 94555 × J-2641, ICMA ₁ 95444 × J-2372, ICMA ₁ 95444 × J-2496, ICMA ₁ 95444 × J-2562, ICMA ₁ 95444 × J-2597, ICMA ₁ 95444 × J-2569, ICMA ₁ 95444 × J-2580, ICMA ₁ 95444 × J-2634, ICMA ₁ 95444 × J-2637, ICMA ₁ 95444 × J-2639, ICMA ₁ 95444 × J-2641 = Total 20 crosses
7.1-9.0	Highly Susceptible	ICMA ₁ 94555	J-2641	

Table 3. Foliar blast score on parents and their performance in hybrid combinations of pearl millet in field condition

Parents (Female)	Blast Score (1-9)	Parents (male)	Blast Score (1-9)	Hybrids	Blast Score (1-9)
ICMA ₁ 94555	7.53	J-2372	1.20	ICMA ₁ 94555 × J-2372	5.27
		J-2496	1.33	ICMA ₁ 94555 × J-2496	5.34
		J-2562	6.60	ICMA ₁ 94555 × J-2562	5.60
		J-2597	4.80	ICMA ₁ 94555 × J-2597	5.27
		J-2569	1.53	ICMA ₁ 94555 × J-2569	6.27
		J-2580	1.47	ICMA ₁ 94555 × J-2580	5.13
		J-2634	3.60	ICMA ₁ 94555 × J-2634	5.53
		J-2637	5.40	ICMA ₁ 94555 × J-2637	5.13
		J-2639	2.47	ICMA ₁ 94555 × J-2639	6.13
		J-2641	7.87	ICMA ₁ 94555 × J-2641	5.40
ICMA ₁ 95444	6.53	J-2372	1.20	ICMA ₁ 95444 × J-2372	5.33
		J-2496	1.33	ICMA ₁ 95444 × J-2496	5.40
		J-2562	6.60	ICMA ₁ 95444 × J-2562	6.20
		J-2597	4.80	ICMA ₁ 95444 × J-2597	5.53
		J-2569	1.53	ICMA ₁ 95444 × J-2569	5.87
		J-2580	1.47	ICMA ₁ 95444 × J-2580	5.47
		J-2634	3.60	ICMA ₁ 95444 × J-2634	5.33
		J-2637	5.40	ICMA ₁ 95444 × J-2637	5.40
		J-2639	2.47	ICMA ₁ 95444 × J-2639	6.53
		J-2641	7.87	ICMA ₁ 95444 × J-2641	6.60
ICMA ₁ 11222	2.13	J-2372	1.20	ICMA ₁ 11222 × J-2372	1.20
		J-2496	1.33	ICMA ₁ 11222 × J-2496	1.20
		J-2562	6.60	ICMA ₁ 11222 × J-2562	1.40
		J-2597	4.80	ICMA ₁ 11222 × J-2597	1.80
ICMA ₁ 11222	2.13	J-2569	1.53	ICMA ₁ 11222 × J-2569	1.20
		J-2580	1.47	ICMA ₁ 11222 × J-2580	1.20
		J-2634	3.60	ICMA ₁ 11222 × J-2634	1.47
		J-2637	5.40	ICMA ₁ 11222 × J-2637	1.20
		J-2639	2.47	ICMA ₁ 11222 × J-2639	1.07
		J-2641	7.87	ICMA ₁ 11222 × J-2641	1.40
JMSA ₁ 20209	3.47	J-2372	1.20	JMSA ₁ 20209 × J-2372	3.33

Parents (Female)	Blast Score (1-9)	Parents (male)	Blast Score (1-9)	Hybrids	Blast Score (1-9)
		J-2496	1.33	JMSA ₁ 20209 × J-2496	4.27
		J-2562	6.60	JMSA ₁ 20209 × J-2562	3.20
		J-2597	4.80	JMSA ₁ 20209 × J-2597	4.20
		J-2569	1.53	JMSA ₁ 20209 × J-2569	3.07
		J-2580	1.47	JMSA ₁ 20209 × J-2580	4.20
		J-2634	3.60	JMSA ₁ 20209 × J-2634	4.73
		J-2637	5.40	JMSA ₁ 20209 × J-2637	4.40
		J-2639	2.47	JMSA ₁ 20209 × J-2639	4.87
		J-2641	7.87	JMSA ₁ 20209 × J-2641	3.20
JMSA ₅ 20212	1.07	J-2372	1.20	JMSA ₅ 20212 × J-2372	1.20
		J-2496	1.33	JMSA ₅ 20212 × J-2496	1.40
		J-2562	6.60	JMSA ₅ 20212 × J-2562	1.60
		J-2597	4.80	JMSA ₅ 20212 × J-2597	1.73
		J-2569	1.53	JMSA ₅ 20212 × J-2569	1.27
		J-2580	1.47	JMSA ₅ 20212 × J-2580	1.20
		J-2634	3.60	JMSA ₅ 20212 × J-2634	1.20
		J-2637	5.40	JMSA ₅ 20212 × J-2637	1.33
		J-2639	2.47	JMSA ₅ 20212 × J-2639	2.67
		J-2641	7.87	JMSA ₅ 20212 × J-2641	1.73

Blast score: 0.0-5.0 Resistant; 5.1-9.0 Susceptible

Among the total genotypes, 13 genotypes were found moderately resistant and in this same category, one was designated female (JMSA₁ 20209), two was designated male (J-2597 and J-2634) and 10 were hybrids (JMSA₁ 20209 × J-2372, JMSA₁ 20209 × J-2496, JMSA₁ 20209 × J-2562, JMSA₁ 20209 × J-2597, JMSA₁ 20209 × J-2569, JMSA₁ 20209 × J-2580, JMSA₁ 20209 × J-2634, JMSA₁ 20209 × J-2637, JMSA₁ 20209 × J-2639 and JMSA₁ 20209 × J-2641).

A total of 23 genotypes were found susceptible and among these one was female (ICMA₁ 95444), two males (J-2562 and J-2637) and 20 hybrids (ICMA₁ 94555 × J-2372, ICMA₁ 94555 × J-2496, ICMA₁ 94555 × J-2562, ICMA₁ 94555 × J-2597, ICMA₁ 94555 × J-2569, ICMA₁ 94555 × J-2580, ICMA₁ 94555 × J-2634, ICMA₁ 94555 × J-2637, ICMA₁ 94555 × J-2639, ICMA₁ 94555 × J-2641, ICMA₁ 95444 × J-2372, ICMA₁ 95444 × J-2496, ICMA₁ 95444 × J-2562, ICMA₁ 95444 × J-2597, ICMA₁ 95444 × J-2569, ICMA₁ 95444 × J-2580, ICMA₁ 95444 × J-2634, ICMA₁ 95444 × J-2637, ICMA₁ 95444 × J-2639 and ICMA₁ 95444 × J-2641). And one designated female line (ICMA₁ 94555) and one male (J-2641) were found in highly susceptible group. None of the hybrid was found highly susceptible to blast.

In case of hybrids, we categorized the combinations based on type of cross viz., resistant × resistant = resistant (21), resistant × susceptible = resistant (9), susceptible × resistant = susceptible (14) and susceptible × susceptible = susceptible (6) recorded the blast score (score 1.0 to 5.0 consideration as resistance reaction and 5.1 to 9 consider as susceptible reaction). This type of cross reveals that female parent decides blast reaction of their hybrids. These results are supported by Boratkar et al., [10].

4. CONCLUSION

Among the total hybrids, 19 hybrids were found to be highly resistant, one was hybrid found resistant, 10 were hybrids found moderately resistant, 20 hybrids were found susceptible and none of the hybrid was found highly susceptible to blast. Crosses reveal that female parent decides blast reaction of their hybrids. Among the parents JMSA₅ 20212 is highly resistant against the foliar blast disease as well as high *per se* performance and good general combiner for all the characters.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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