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

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 × 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 $JMSA_5$ 20212 is highly resistant against the foliar blast disease as well as high *per se* performance and good general combiner for all the characters

Key words: Pearl millet, blast resistance, hybrid

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. 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 (Thakur *et al.*, 2009). 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 (Lukose *et al.*, 2007). Even though the pathogen is highly variable in its nature, it is also highly specialized in its host range. As a result, *Magnaporthe grisea* strains from rice or any other crops do not infect pearl millet and vice versa (Mehta *et al.*, 1953). 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.

MATERIAL AND METHODS

The experimental material comprised of five CGMS (Female) lines viz., $ICMA_1$ 94555, $ICMA_1$ 95444, $ICMA_1$ 11222, $ICMA_1$ 20209, $JMSA_5$ 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 F_1s hybrids developed by line × tester design and one standard check hybrid (GHB 1231). They were evaluated in randomized block design (RBD) with three replications at Main Pearl Millet Research Station, J.A.U., Jamnagar during *kharif* 2023 for field screening of foliar blast disease. One susceptible check ($ICMA_1$ 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 (Thakur *et al.*, 2009 and Thakur *et al.*, 2011).

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	Resistant
3	Small, roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter with a brown margin	
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	Susceptible
7	Typical blast lesions covering 26-50% of the leaf area	
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	

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 ($ICMA_1$ 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 and $JMSA_5$ 20212 × J-2641). The check hybrid GHB 1231 was also highly resistance toward the blast. One female parent ($ICMA_1$ 11222), one male parent (J-2639) and one cross ($JMSA_5$ 20212 × J-2639) were found in resistance group.

Among the total genotypes, 13 genotypes were found moderately resistant and in this same category, one was designated female ($JMSA_1$ 20209), two was designated male (J-2597 and J-2634) and 10 were hybrids ($JMSA_1$ 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 and JMSA$_1$ 20209 × J-2641).

A total of 23 genotypes were found susceptible and among these one was female (ICMA$_1$ 95444), two males (J-2562 and J-2637) and 20 hybrids (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 and ICMA$_1$ 95444 × J-2641). And one designated female line (ICMA$_1$ 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*. (2022).

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 JMSA$_5$ 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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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

Contd…

Table 3*Contd*…

$ICMA_1$ 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
		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