

## SCREENING OF PEARL MILLET [*Pennisetum glaucum* (L.)] HYBRIDS, POPULATIONS, INBREDS FOR MULTIPLE DISEASES RESISTANCE

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### SUMMARY

Pearl millet [*Pennisetum glaucum* (L.)] is the oldest cultivated crop prone to attack by many pathogens viz., *Moesziomyces penicillariae*, *Sclerospora graminicola* and *Puccinia substriata*. There is an urgent need to have multiple resistance against these pathogens. In order to find out economical and ecofriendly method to manage the disease; attempts were made to identify the multiple resistant sources of downy mildew, smut and rust by germplasm screening. The field screening involved artificial inoculation of hybrids, populations, inbreds and B-lines for downy mildew, smut and natural conditions are required for rust. Amongst 143 genotypes which comprised of IVT, FYT, multicut, population, inbred and B-lines, screened against downy mildew, smut and rust, under IVT genotype 197×198 showed multiple resistance whereas genotypes screened under FYT, six genotypes viz., 71×494, 131×364, 775×319, HHB223, HHB299 and HHB234 showed multiple resistance against all the three diseases. Amongst inbreds multiple resistance was observed in S-374, S-464, S-494, S-524, S-534, S-614, S-616, S-638, S-648, S-660 and S-668 and in case of B-lines genotype 72B, 74B, 76B and 47B were resistant. Amongst multicut and population genotypes none showed complete multiple resistance against downy mildew, rust and smut.

**Keywords :** pearl millet, screening, downy mildew, smut, rust

Pearl millet [*Pennisetum glaucum* (L.)] is one of the oldest cultivated crops of Asian and African countries. India is considered to be the secondary center of pearl millet diversity (Appa Rao and De Wet, 1999). It is a rainfed crop and thrives well in the rainfall as low as 250 mm on relatively poor soils. Being tolerant to drought and salinity, it is by and large grown in different countries of the world. As a warm season crop it has a great potential as a food source in the temperate zones. This millet is one of the most important with greatest potential of all the millets which provide staple food for millions of people in semiarid tropics regions and it is considered as poor man's food especially for working class. Besides grain, its fodder is of excellent quality. Due to its adaptability under very wide range of agro-climatic conditions this crop is grown in the states of Haryana, Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Rajasthan, Tamil Nadu, parts of Delhi, Punjab and Uttar Pradesh. Pearl millet yield is affected by many diseases of fungal, bacterial, viral and nematode pathogens however, economically important diseases include downy mildew

(*Sclerospora graminicola*), blast (*Pyricularia grisea*), rust (*P. substriata* var. *penicillariae*), ergot (*Claviceps fusiformis* Lov. (syn. *Claviceps microcephala* (Wallr.) Tul.)) and smut (*Moesziomyces penicillariae*). Keeping in view the losses caused by these pathogens one of the best measures is to use the host plant resistance for disease management. The present investigation was therefore undertaken to evaluate the pearl millet genotypes to find out resistance against downy mildew, smut and rust.

### MATERIALS AND METHODS

During *kharif*, 2017 the experiment for screening against downy mildew, smut and rust was conducted with a total of 143 pearl millet entries which included 18 IVT entries, 27 FYT, 18 Multicut, 21 Population, 40 inbreds and 23 B-lines. The test entries were sown on 16-07-2017 with row to row spacing of 50 cm and plant to plant distance of 10 cm in each row. Artificial screening was done against all the three disease *i.e.* downy mildew, smut and rust.

**Screening for smut :** For artificial screening fifteen earhead at boot leaf stage of each entry were randomly selected from each replication and were inoculated by aqueous sporidial suspension of *Moesziomyces penicillariae*. The sporidial suspension ( $10^6$  sporidia/ml) was prepared by dipping the smut infected earheads in water for 24 h so that spores germinate before inoculation. After inoculation of the earheads at boot leaf stage, the earheads were covered with a parchment paper bag and water was sprinkled regularly to maintain high humidity. The parchment paper bags were removed 15-20 days after inoculation and smut severity was recorded using smut severity (%) rating scale as given by Thakur and King (1988).

**Screening for downy mildew :** In the *kharif* season of 2017, 7042 S infector row was sown on 26-6-2017 and later test rows and indicator rows were sown on 16-07-2017. A total of 143 pearl millet genotypes were evaluated against downy mildew under sick experimental field. At the time of sowing, a fine powder of oosporic material was added to the furrows. All agronomic practices were followed. Total number of plants at 15-20 days and number of plants infected with downy mildew were recorded at 30 and 60 days after sowing.

**Screening for rust :** Screening of pearl millet genotypes against rust was done under natural conditions and rust severity was recorded at the grain filling stage.

## RESULTS AND DISCUSSION

In order to manage the disease, incorporation of multiple resistance in suitable genotype is the demand of current era and it is the most economical method to save the crop through various stresses. In the present study, amongst 143 genotypes screened against downy mildew, smut and rust of pearl millet, in IVT amongst 18 hybrids 6, 7 and 7 were resistant to downy mildew, smut and rust whereas in FYT amongst 27 genotypes screened 20, 13 and 14 genotypes showed no disease severity against downy mildew, smut and rust. In screening of pearl millet multicut against downy mildew, smut and rust, 11, 14 and 10 multicut genotypes were found to be resistant amongst the 18 multicut genotypes. In case of pearl millet population 11, 13 and 14 population genotypes were free of downy mildew, smut and rust. Out of 40 inbreds screened against downy mildew, smut and rust, 23, 24 and 24 genotypes were found free of disease. Amongst 23 B-lines screened, 12, 13

TABLE 1  
Screening of pearl millet initial varietal trial (IVT) genotypes against downy mildew, smut and rust

Disease severity %	Downy mildew		Smut		Rust	
	Name of genotype	No. of entries	Name of genotype	No. of entries	Name of genotype	No. of entries
0	HHB 197, HHB 226, 197×198, 197×199, 199, HBL 11	6	36×544, 196×198, 196×194, 197×198, HHB223, 198, 200	7	36×544, HHB 196×194, 197×198, 197×200, 198, HBL 11	7 197,
<10	36×544, 196×198, 196×194, 196×200, 197×200, HHB 223, 534, 544, 200	9	195×200, HHB 197, HHB 226, 197×200, HBL 11	5	196×200, 534, 199	3
10-25	195×200, 198	2	36×534, 196×200, 197×199, 544	4	195×200, HHB 226, HHB 223, 544, 200	5
>25	36×534	1	534, 199	2	36×534, 196×198, 197×198	3

and 16 were found free of downy mildew, smut and rust.

Use of multiple resistant cultivars is the most cost effective method for the management of any disease. Out of 143 genotypes screened against downy mildew 83 were downy mildew free which included 6 IVT, 20 FYT, 11 multicut, 11 population genotypes, 23 inbreds and 12 B-lines. Various reports are available in literature about the identification of resistance sources against downy mildew disease in pearl millet (Singh *et al.*, 1987). Similarly, Sharma *et al.*, (2007) evaluated 147 germplasm lines for their resistance and found that, 25 were highly resistant and amongst them, 10 lines: IP 9, IP 55, IP 104, IP 253, IP 262, IP 336, IP 346, IP 498, IP 545 and IP 558 were completely free from downy mildew, 32 were resistant, 52 were

susceptible and 38 were highly susceptible to downy mildew infection at both 30 and 60 days after planting.

In screening against smut caused by *M. penicillariae* 7 IVT, 13 FYT, 14 multicut, 13 population genotypes, 24 inbreds, and 13 B- lines showed zero smut severity whereas 5, 4, 2, 5, 10 and 5 in IVT, FYT, multicut, population, inbreds and B- lines showed less than 10 per cent smut severity. Out of 143 genotypes that were screened against smut, 84 were found free from smut in IVT, FYT, multicut, population, inbreds and B- lines. Maximum smut severity was recorded in 36×534 in IVT, 71×359 and 823×359 in FYT, 98109SL in population and S-319 in inbred genotype. Thakur *et al.*, (1986) screened 1500 pearl millet accessions against *M. bullatus* for 1-6 years of multi location testing in India and West

TABLE 2  
Screening of pearl millet final yield trial (FYT) genotypes against downy mildew, smut and rust

Disease severity %	Downy mildew		Smut		Rust	
	Name of genotype	No. of entires	Name of genotype	No. of entries	Name of genotype	No. of entries
0	1×319, 1×434, 36×364, 71×359, 71×494, 101×319, 131×364, 231×449, 286×494, 311×564, 775×319, 775×564, 823×359, 823×564, HHB 223, HHB 299, AHTAK-164, AHT II K-16-7, HHB 272, HHB 234	20	71×494, 131×364, 301×494, 311×564, 775×319, 775×564, 823×564, HHB 223, HHB 299, AHT A-K- 16-12, HHB 226, HHB197, HHB 234	13	36×364, 71×494, 131×364, 231×449, 286×494, 301×494, 311×359, 775×319, HHB 223, HHB 299, HHB 226, HHB 272, HHB 234	14
<10	311×359, HHB 311, AHT A-K- 16-12, HHB 197, HHB 67 IMP	5	36×364, 231×449, AHTAK-164, HHB 67 IMP	4	1×434, 71×359, 131×364, AHT II K-16- 7	4
10-25	301×494, HHB 226	2	1×319, 1×434, 101×319, 286×494, 311×359, HHB311, AHT II K-16-7, HHB 272	8	101×319, 311×564, 823×359, 823×564, HHB 299, AHT A-K-16-12	6
>25	-	-	71×359, 823×359	2	1×319, HHB 67 IMP, HHB 197	3

TABLE 3  
Screening of pearl millet multicut genotypes against downy mildew, smut and rust

Disease severity %	Downy mildew		Smut		Rust	
	Name of genotype	No. of entries	Name of genotype	No. of entries	Name of genotype	No. of entries
0	HCF 87, BBNH 0601-5, Sweet type, HCF 81, HCF 86, BBNH 0601-8-2, BBNH0601-15, BBNH 0601-17, BBNH0601-1, Bawal Bajri, HC 10	11	HCF 87, HCF 82, BBNH 0601-6, Sweet type, BBNH 0601-8-2, BBNH0601-15, BBNH 0601-16, BBNH 0601-17, BBNH0601-1, HFP, HCF 85, Bawal Bajri, HC 10, HC 20	14	HCF 82, BBNH 0601-5, HCF 86, BBNH0601-15, BBNH 0601-16, BBNH0601-1, HFP, HCF 85, HC 10, HC 20	10
<10	HCF 82, BBNH 0601-6, BBNH 0601-7, BBNH 0601-16, HFP, HCF 85	6	BBNH 0601-7, BBNH 0601-8-2	2	Sweet type, Bawal Bajri	2
10-25	HC 20	1	BBNH 0601-5, HCF 86	2	BBNH 0601-7, HCF 81	2
>25					HCF 87, BBNH 0601-6, BBNH 0601-17	3

TABLE 4  
Screening of pearl millet population genotypes against downy mildew, smut and rust

Disease severity %	Downy mildew		Smut		Rust	
	Name of genotype	No. of entries	Name of genotype	No. of entries	Name of genotype	No. of entries
0	BRBC, ASRC, TPC-II, 98109 SL, WHC 901-445 (M), ATC HRC, HIC, HPC, LPBC, LPBC	11	BRBC, RTC, TPC-I, DMRC, WHC 901-445 (M), ATC HIC, UHC 901-445 (E), UHC (901-445 × 36 B) A4 R COMPOSITE, MPMR, LPBC, HC 20 CHECK	13	RTC, ASRC, TPC-I, TPC-II, 98109 SL, WHC 901, 445 (M) HRC, HIC, UHC 901-445 (E) UHC (901-445 × 36B), A4 R COMPOSITE, MPMR, LPBC, HC 20 CHECK	15
<10	LPRC, RTC, TPC-I, DMRC, UHC 901-445 (E), UHC (901-445 × 36B), A4 R COMPOSITE, MPMR, HC 10 CHECK, HC 20 CHECK	10	LPRC, TPC-II, HRC, HPC, HC 10 CHECK	5	DMRC, HPC, HC 10 CHECK	3
10-25			ASRC, LPBC	2	LPRC, BRBC, ATC, LPBC	4
>25			98109 SL	1		

TABLE 5  
Screening of pearl millet inbreds genotypes against downy mildew, smut and rust

Disease severity %	Downy mildew		Smut		Rust	
	Name of genotype	No. of entires	Name of genotype	No. of entries	Name of genotype	No. of entries
0	S-319, S-374, S-419, S-434, S-449, S-464, S-524, S-534, S-574, S-584, S-594, S-614, S-616, S-620, S-636, S-650 S-638, S-648, S-656, S-658, S-660, S-668, S-494	23	S-374, S-389, S-404, S-464, S-479, S-494, S-524, S-534, S-544, S-564, S-612, S-614, S-616, S-638, S-646, S-648, S-650, S-668, S-584, S-594, S-654, S-666, S-658, S-660	24	S-359, S-374, S-404, S-419, S-464, S-494, S-509, S-524, S-534, S-544, S-574, S-594, S-610, S-614, S-616, S-620, S-636, S-638, S-648, S-656, S-660, S-664, S-666, S-668	24
<10	S-404, S-479, S-509, S-544, S-564, S-646, S-652, S-654, S-662, S-670	10	S-359, S-419, S-449, S-509, S-554, S-610, S-636, S-656, S-664, S-670	10	S-319, S-449, S-554, S-612, S-670	5
10-25	S-389, S-554, S-610, S-612, S-664, S-666	6	S-434, S-574, S-620, S-652, S-662	5	S-389, S-434, S-479, S-564, S-584, S-646, S-650, S-654, S-658	9
>25	S-359	1	S-319	1	S-652, S-662	2

TABLE 6  
Screening of pearl millet B-lines against downy mildew, smut and rust

Disease severity %	Downy mildew		Smut		Rust	
	Name of genotype	No. of entires	Name of genotype	No. of entries	Name of genotype	No. of entries
0	72B, 73B, 74B, 75B, 60B, 47B, 2333B, 71B, 99555B, 01222B	12	72B, 74B, 76B, 65B, 60B, 47B, 53B, 39B, 08111B, 01444B, 01222B, 99555B, 03999B	13	72B, 73B, 16 74B, 76B, 76B, 77B, 60B, 47B, 47B, 53B, 41B, 39B, 14B, 08111B, 03999B, 2333B, 99555B	77B,
<10	65B, 53B, 14B, 08555B, 01444B, 03999B	6	75B, 47B, 14B, 2333B, 99111B	5	65B, 2333B, 99111B	3
10-25	47B, 41B, 08111B, 99111B	4	73B, 77B, 41B, 08555B, 71B	5	75B, 08555B, 01222B, 71B	4
>25	39B	1				

Africa and found that six germplasm accessions *viz.*, SSC FS 252-S-4, ICI 7517-S-1, ExB 132-2-S-5-2-DM-1, ExB 46-1-2-S-2, ExB 112-1-S-1-1 and P-489-S-3 and four newly developed, resistant, agronomically elite lines *viz.*, ICMPS 100-5-1, 900-9-3, 1600-24 and 2000-5-2 showed consistently high levels of resistance. Rai *et al.*, (1998) developed male-sterile pearl millet lines ICMA 88006, derived from A<sub>1</sub> cytoplasm of ICMA1 (81A), and ICMA 92666 (and its maintainer line ICMA 92666) which were resistant to *M. bullatus* and other pathogens. Pandya and Bartaria, (2000) evaluated certain pearl millet lines under artificial inoculation and identified ICMB 92888, ICMB 92777 and IP 19874 as a source of smut resistance. Choursia (2007) screened 138 entries against smut and observed that only one entry MH 1317 remained absolutely free from smut while nineteen entries were in the category of 5.1- 10 per cent smut severity and maximum severity was recorded in MH 1391. Khanna *et al.*, (2018) evaluated 239 genotypes and observed 52 genotypes were completely free from smut and 27 genotypes showed more than 25 per cent smut severity. Based on screening of pearl millet entries against smut, the new hybrids are promoted for cultivation from time to time.

Amongst 143 genotypes comprising of IVT, FYT, multicut, population, inbreds and B- lines were screened against rust to find out the resistance source. From the screening it was revealed that 85 genotypes were free from rust which comprised 7 IVT, 14 FYT, 10 multicut, 14 population, 24 inbreds and 16 B-lines. Ramakrishnan and Sundaram (1956) reported PT81413 as highly resistant pearl millet cultivar and PT 829, MS 6897 as moderately resistant. Pannu (1996) reported four highly resistant cultivars *viz.*, 852B, ICMB-87001, DIC-14-P2.3 and PMIN 86-1.

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