***Original Research Article***

**"Field Evaluation of Promising Pearl Millet Hybrids and Varieties Against Blast"**

**Abstract:** The pearl millet is one of the important cereal crop grown mainly in *kharif* season. It is grown for its grain and fodder but its production is hampered by the Blast disease caused by *Pyricularia* *grisea*, blast has become a serious problem in past years so, the 35 promising hybrids / varieties were evaluated in the field condition against the *P*. *grisea* at college of agriculture, RVSKVV, Gwalior in two consecutive years kharif 2022 and 2023. The experiment was conducted using RBD design with two replications. Disease was measured in Percent Disease Index (PDI) at 60 days after sowing. None of the hybrids/ varieties were found free from the disease in both the years of testing. During 2022 the minimum blast PDI was recorded in the hybrid/ varieties 86M94 (16.67%) which was superior over 28 entries and during 2023 the minimum blast PDI was noted in 86M20 (10.00%) followed by 86M94(10.22%) which was significantly superior over 22 entries. Also, the mean blast PDI across the hybrids and varieties during the year 2022 and 2023 was (40.09%) and (28.87%) which clearly indicate that the pressure of disease was less in the year 2023 than in 2022. However, on the basis of two years pooled data the minimum blast PDI was recorded in 86m94 (13.44%) while it was maximum in Pratap (61.33%). 86M94 was significantly superior over 22 entries *viz*., NBH 27, MPMH-17, MP-7878, MP-7792, JBV-2, Krishna 7711, AHB-1200, RHB-233, PB I756, PB 1705, ICMV 1555, Raj 171, 86M01, HHB 67 improved, JVB-4, MPMH-21, AHB-1269, RHB- 234, JVB-3, Dhanshakti, Proagro-9444 and Pratap (MH-1642) while it was statistically at par with the 12 entries *viz*, 86M95, 86M13, 86M96, 86M84, Proagro 9001, 86M20, KBH-108, PB1852, 86M89, 86M86, Pusa comp-612 and ABV-04. Hybrid 86M94 was found numerical best against blast and showed consistent performance in both the years of testing.

**Key words:** Pearl millet, Blast, Hybrids, Percent Disease Index (PDI).

**Introduction:** Pearl millet (*Pennisetum* *glaucum*) is one of the major cereal crop following rice, wheat, maize, barley, and sorghum (Satyavathi *et. al.,* 2021). It is predominantly cultivated during the *kharif* season in the arid and semi-arid regions of Asia and Africa. The crop is highly resilient and survive under harsh environmental conditions as under erotic rainfall with high temperature (Parihar *et. al.,* 2022), due to crops better adaptability in harsh environmental condition it becomes the farmers choice where other crops can’t survive (Rajpoot *et. al.,* 2023). It a vital staple food for millions, particularly in resource-poor farming systems (Anuradha *et. al*., 2017; Patro *et. al*., 2020). In addition to its value as a food crop, pearl millet is also extensively used as a fodder crop. Nutritionally, pearl millet grains are rich in energy and essential nutrients. Per 100 grams, the grains provide approximately 360 kcal of energy, along with 12 g moisture, 12 g protein, 5 g fat, 2 g minerals, 1 g fiber, 67 g carbohydrates, 42 mg calcium, 242 mg phosphorus, and 8 mg iron (Shweta, 2015), highlighting its role in food and nutritional security. The grains of pearl millet is rich source of protein, iron and zinc and is least expensive among all cereals (Verma *et.al*., 2021). India is the largest producer of pearl millet, with a national average productivity of 1510 kg/ha (Anon., 2023). Major pearl millet growing Indian states are Haryana, Gujarat, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka, Andhra Pradesh, Madhya Pradesh and Telangana (Parihar *et. al.,*2023). Among the states, Madhya Pradesh stands out for its high productivity, recording an average yield of 2599 kg/ha (Anon., 2023). The key pearl millet-producing districts in Madhya Pradesh include Morena, Bhind, Gwalior, Sheopur, Shivpuri, Alirajpur, Barwani, Datia, and Dhar.

Despite its importance, pearl millet production is affected by several abiotic and biotic stresses. Among biotic stress the crop is affected by various pathogen causing diseases *viz*., downy mildew, blast, smut, rust and ergot. The disease blast, caused by *Pyricularia* *grisea* (Cooke) Sacc., affects all growth stages of the crop and can result in significant yield losses (Meena *et. al.,* 2019; Patro *et. al.,* 2020). In the recent years the blast disease incidence has been observed in states like Rajasthan, Haryana, Gujarat, Maharashtra, Madhya Pradesh, Uttar Pradesh, Karnataka and Andhra Pradesh. The symptoms are observed in different parts of the plant like leaf initially then in stem and in nodes as well. Blast disease emerging as a major limiting factor in recent years. The symptoms appears as grayish, water-soaked lesions that enlarge and become necrotic, resulting in extensive chlorosis and premature drying of young leaves. The increasing incidence of blast has been attributed to the evolution of new pathogenic races, driven by changing climatic conditions. This continuous evolution compromises the effectiveness of existing resistant varieties, necessitating ongoing monitoring and breeding efforts. The development and deployment of blast-resistant hybrids and varieties is considered the most effective, economical, and environmentally sustainable approach for managing the disease (Pramanik *et al.,* 2019; Mishra *et al*., 2020; Upadhyay *et al.,* 2020; Pramanik *et al.,* 2021). In light of this, there is a critical need to evaluate newly developed pearl millet hybrids/varieties for resistance to blast disease, particularly under field conditions in key production zones.

**Materials and Methods:** Field experiment was conducted at college of agriculture, RVSKVV, Gwalior during 2022 and 2023. 35 promising pearl millet hybrids / varieties (seed material) received from the department of plant pathology and procured from the market. Planted in single row under Randomized Block Design (RBD) with two replications. The row length was 4 meters and the distance was 50 x 10 cm from row to row and plant to plant respectively. NPK fertilizer was applied at 60:40:20 kg/ha.

Blast severity was assessed at 60 DAS using the 0–9 scale presented in table 1 (Mayee and Datar, 1986). For each cultivar, five randomly selected plants per replication were scored, and Percent Disease Index (PDI) was calculated using Wheeler's (1969) formula.

**Percent Disease Index (PDI) = Sum of individual disease ratings X 100**

**No. of leaves assessed x Maximum grade**

T**able 1: Blast severity rating scale: 0-9**

|  |  |
| --- | --- |
| **Score** | **Percent leaf area infected** |
| **0** | No lesion |
| **1** | No lesion to small brown specks of pinhead size |
| **2** | larger brown specks |
| **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 |
| **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 |
| **8** | Typical blast lesions covering 51–75% of the leaf area and many leaves dead |
| **9** | All leaves dead |

**Results and Discussion**: During kharif 2022 and 2023, none of the tested hybrid/ varieties were found to be free from blast. The disease pressure was higher in 2022, with an average PDI of 40.09%, compared to 27.5% in 2023 as shown in the table 2. Among all hybrids 86M94 consistently showed the best resistance, recording the lowest blast PDI in both years (16.67% in 2022 and 10.22% in 2023), with a pooled average of 13.44%. During kharif 2022 the minimum blast PDI was recorded in the entry 86M94 (16.67%) followed by 86M96 (21.11%), 86M13 (21.56%), 86M95 (23.33%) while the maximum blast PDI was recorded in the entry Pratap (MH-1642) (72.66%). 86M94 was significantly superior over 28 cultivars *viz*., KBH-108, NBH 27, 86M20, MP-7792, Pusa comp-612, MP-7878, JBV-2, Raj 171, 86M86, ABV-04, MPMH-17, PB I756, PB1852, RHB-233, AHB-1200, ICMV 1555, Krishna 7711, 86M01, HHB 67 improved, AHB-1269, MPMH-21, JVB-4, RHB- 234, JVB-3, Proagro-9444, PB 1705, Dhanshakti and Pratap while it was statistically at par with six entries *viz.,* 86M96, 86M13, 86M95, 86M84, 86M89 and Proagro 9001. During 2023 the minimum blast PDI was recorded in the hybrid 86M20 (10.00%) followed by 86M94 (10.22%) while maximum PDI was recorded in the hybrid in Pratap (MH-1642) (50.00%). In respect of blast 86M20 and 86M94 was significantly superior over 23 entries *viz*., Pusa comp-612, MPMH-17, 86M89, MP-7878, NBH 27, Krishna 7711, AHB-1200, MP-7792, 86M01, JVB-4, RHB-233, JBV-2, ICMV 1555, HHB 67 improved, PB I756, Dhanshakti, MPMH-21, AHB-1269, RHB- 234, JVB-3, Raj 171, Proagro-9444 and Pratap but were statistically at par with 10 entries viz., 86M95, PB1852, 86M13, Proagro 9001, 86M96, 86M86, 86M84, KBH-108, PB 1705, ABV-04. On the basis of two-year pooled data, the minimum blast PDI was calculated in the hybrid 86M94 (13.44%) while it was maximum in hybrid Pratap (MH-1642) (61.33%). In respect of blast disease hybrid 86M94 was significantly superior over 22 entries viz., NBH 27, MPMH-17, MP-7878, MP-7792, JBV-2, Krishna 7711, AHB-1200, RHB-233, PB I756, PB 1705, ICMV 1555, Raj 171, 86M01, HHB 67 improved, JVB-4, MPMH-21, AHB-1269, RHB- 234, JVB-3, Dhanshakti, Proagro-9444 and Pratap (MH-1642) while it was statistically at par with 12 entries viz., 86M95, 86M13, 86M96, 86M84, Proagro 9001, 86M20, KBH-108, PB1852, 86M89, 86M86, Pusa comp-612 and ABV-04. It is difficult to develop blast free pearl millet hybrid/ variety due to its (*Pyricularia* *grisea*) polygenic nature hence, it become essential to evaluate under artificial inoculation to choose suitable disease resistant cultivar for blast sensitive areas. The present finding is supported with those of Parihar *et.al.,* 2022 screened 32 pearl millet hybrid/ varieties against blast and reported wide variation of the disease PDI from (0) to (63.87%). None of the entry was investigated absolutely free from the disease. Ten hybrids viz., GHB 719, XMT 1497, GHB 744, GHB 905, KBH 108, 86M86, HHB 299, HHB 197, Pusa Composite 383 and RHB 173 were considered in the category of resistant as their blast severity PDI was investigated in the range of 11.11 to 33.33%. Parihar *et. al.,* 2019, also evaluated 50 promising hybrids/ varieties against blast and reported great variation in blast severity level from 0.0 to 99.99%. Kumar (2008) also evaluated 19 promising hybrid and varieties of pearl millet and reported the blast severity from 0-37.5%.

**Table 2: Performance of blast in promising hybrids and varieties.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. no.** | **Hybrids/ Varieties** | **Blast percent disease index (PDI%) at 60 DAS** | | |
| **2022\*** | **2023\*** | **MEAN** |
| **1** | **MP-7878** | 33.33(35.26) | 27.11(31.21) | 30.22(33.24) |
| **2** | **86M86** | 38(38.02) | 15.34(22.71) | 26.67(30.37) |
| **3** | **MP-7792** | 33.11(35.13) | 28.89(32.42) | 31(33.78) |
| **4** | **Proagro-9444** | 59.11(50.28) | 48.44(44.1) | 53.77(47.19) |
| **5** | **86M94** | 16.67(23.75) | 10.22(18.65) | 13.44(21.2) |
| **6** | **86M95** | 23.33(28.88) | 10.45(18.85) | 16.89(23.87) |
| **7** | **AHB-1200** | 43.78(41.33) | 28.22(32.03) | 36(36.68) |
| **8** | **MPMH-17** | 38.44(38.29) | 22(27.96) | 30.22(33.13) |
| **9** | **HHB 67 improved** | 48.89(44.36) | 33.56(35.4) | 41.22(39.88) |
| **10** | **PB1852** | 38.67(38.4) | 11.34(19.67) | 25(29.04) |
| **11** | **PB 1705** | 60.89(51.35) | 17.78(24.92) | 39.33(38.14) |
| **12** | **NBH 27** | 32.67(34.86) | 27.11(31.21) | 29.89(33.04) |
| **13** | **Pratap (MH-1642)** | 72.66(58.56) | 50(45) | 61.33(51.78) |
| **14** | **ABV-04** | 38.22(38.15) | 18.67(25.57) | 28.44(31.86) |
| **15** | **Pusa comp-612** | 33.11(35.13) | 22.89(27.84) | 28(31.49) |
| **16** | **KBH-108** | 32.22(34.22) | 16.45(23.48) | 24.33(28.85) |
| **17** | **AHB-1269** | 48.89(44.36) | 42.44(40.65) | 45.66(42.51) |
| **18** | **JBV-2** | 33.56(35.4) | 33.33(35.26) | 33.44(35.33) |
| **19** | **PB I756** | 38.44(38.29) | 37.33(37.65) | 37.89(37.97) |
| **20** | **MPMH-21** | 48.89(44.36) | 41.11(39.82) | 45(42.09) |
| **21** | **Raj 171** | 33.56(35.4) | 44.89(42.07) | 39.22(38.74) |
| **22** | **Krishna 7711** | 44.44(41.71) | 27.34(31.41) | 35.89(36.56) |
| **23** | **Dhanshakti** | 62.22(52.13) | 40(39.19) | 51.11(45.66) |
| **24** | **Proagro 9001** | 26.67(30.96) | 14.67(22.29) | 20.67(26.63) |
| **25** | **86M96** | 21.11(27.35) | 15.11(22.55) | 18.11(24.95) |
| **26** | **86M89** | 26.44(30.91) | 22.22(28.12) | 24.33(29.52) |
| **27** | **86M13** | 21.56(27.66) | 12(20.27) | 16.78(23.97) |
| **28** | **86M84** | 25.78(30.32) | 15.34(22.71) | 20.56(26.52) |
| **29** | **86M01** | 47.78(43.72) | 31.55(34.16) | 39.66(38.94) |
| **30** | **86M20** | 32.67(34.86) | 10(18.44) | 21.33(26.65) |
| **31** | **RHB- 234** | 55.11(47.93) | 43.33(41.17) | 49.22(44.55) |
| **32** | **RHB-233** | 38.66(38.41) | 33.33(35.26) | 36(36.84) |
| **33** | **ICMV 1555** | 44(41.55) | 33.33(35.26) | 38.66(38.41) |
| **34** | **JVB-4** | 54.89(47.81) | 33.11(35.13) | 44(41.47) |
| **35** | **JVB-3** | 55.55(48.19) | 43.78(41.33) | 49.66(44.76) |
|  | **MEAN** | **40.09** | **27.5** | **33.8** |
| **SE(m)** | | **3.185** | **3.016** |  |
| **SE(d)** | | **4.504** | **4.266** |  |
| **CD** | | **9.192** | **8.706** | **11.168** |
| **CV** | | **11.530** | **13.778** |  |

**(\*data are the mean of two replication)**

**The figures in parenthesis are transformed values.**

**Conclusion**

None of the tested promising hybrid / varieties were found to be free from blast however, 86M94 emerged with minimum blast but it was at par with 12 others blast resistant hybrids *viz*., 86M95, 86M13, 86M96, 86M84, Proagro 9001, 86M20, KBH-108, PB1852, 86M89, 86M86, Pusa comp-612 and ABV-04. above hybrid are suitable for their cultivation in blast sensitive areas.

**References:**

Anonymous, (2023) Agriculture statistics at a glance 2023. Government of India Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare Economics, Statistics & Evaluation Division.

Anuradha, N., Satyavathi, C.T., Meena, M. C., Sankar, S. M., Bharadwaj, C., Bhat, J., et al. (2017). Evaluation of pearl millet [*Pennisetum glaucum* (L.) R. Br.] for grain iron and zinc content in different agro climatic zones of India. *Indian J. Genet. Plant Breed.* 77, 65–73.

Meena, R., Kaurav, A. S., Gopala, and Pandya, R. K. (2019). Evaluation of blast severity of pearl millet field in Morena and Sheopur districts of Madhya Pradesh. *Journal of Pharmacognosy and Phytochemistry*, 8(5), 689-691.

Mishra N, Tripathi MK, Tiwari S, Tripathi N, Trivedi HK. Morphological and molecular screening of soybean genotypes against yellow mosaic virus disease. Leg Res.; 2020.DOI: 10.18805/LR4240.

Parihar, P., Singh, P., Pandya, R. K and Harne, A. (2019). Performance of promising hybrids and varieties of pearl millet against blast (*Pyricularia grisea*). *International Journal of Chemical Studies.* 7(1): 1837-1838.

Parihar, P., Singh, P., Pandya, R. K., Tiwari, S., & Tripathi, M. K. (2022). Screening of pearl millet promising hybrids and varieties against blast (*Pyricularia grisea*) by disease indexing. J Pharm Innov J, 11(6), 664-7.

Parihar, P., Pandya, R. K., Singh, P., Tiwari, S., Tripathi, M. K., Tripathi, N., & Satyavathi, C. T. (2023). Elucidation of molecular variability among Pyricularia grisea isolates causing blast disease in forage pearl millet. Range Management and Agroforestry, 44(2), 278-287.

Pramanik A, Tiwari S, Tripathi MK, Tomar RS, Singh AK. Molecular characterization of groundnut (Arachis hypogea L.) germplasm lines for yield attributed traits. Indian J Genet. 2019;79(1):56-65

Pramanik A, Tiwari S, Tripathi MK, Mandloi S, Tomar RS. Identification of groundnut germplasm lines for foliar disease resistance and high oleic traits using SNP and gene-based markers and their morphological characterization. Legume 10.18805/LR-4666

Patro, T. S. S. K., Georgia, K. E., Kumar, S. R., Anuradha, N. and Rani, Y. S. (2020). Management of pearl millet blast through fungicides and biocontrol agents. *International Journal of Chemical Studies*, 8(4), 1357-1359.

Rajpoot, P., Tripathi, M. K., Tiwari, S., Bimal, S. S., Tripathi, N., Parihar, P., & Satyavathi, C. T. (2023). Characterization of pearl millet [Pennisetum glaucum (l.) R br.] genotypes against blast disease employing disease scoring and gene specific SSR markers. Scientist, 3(3), 16-30.

Satyavathi, C. T., Ambawat, S., Khandelwal, V. and Srivastava, R. K. (2021). Pearl millet: a climate-resilient nutricereal for mitigating hidden hunger and providing nutritional security. Frontiers in Plant Science, 12, 659938.

Shweta Malik. "Pearl millet-nutritional value and medicinal uses." International Journal of Advance Research and Innovative Ideas in Education 1.3(2015): 414-418.

Upadhyay S, Singh AK, Tripathi MK, Tiwari S, Tripathi N. Validation of simple sequence repeats markers for charcoal rot and Rhizoctonia root rot resistance in soybean genotypes. IJABR. 2020;10(2):137-144.

Verma, R., Tripathi, M. K., Tiwari, S., Pandya, R. K., Tripathi, N., & Parihar, P. (2021). Screening of pearl millet [Pennisetum glaucum (L.) R. Br.] genotypes against blast disease on the basis of disease indexing and gene specific SSR markers. Int J Curr Microbiol Appl Sci, 10(02), 1108-17.