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Screening of foxtail millet germplasm against blast caused by *Pyricularia setariae*

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Abstract
Foxtail millet is second most important next to finger millet in important among all the small millets. Since it is a rich source of carbohydrates, proteins, minerals and vitamins, it has got medicinal importance with many health benefits. The leaf blast caused by *Pyricularia setariae* is a major constraint in production of foxtail millet. In this context, the present study was carried out on screening of the foxtail millet germplasm to identify resistant sources. Out of 150 germplasm screened for their resistance against natural incidence of leaf blast, nine germplasm were found highly resistant, 62 germplasm were found resistant, 12 germplasm were found moderately resistant, 17 germplasm were found moderately susceptible, 26 germplasm were found susceptible and 24 germplasm were found highly susceptible to blast disease.

Keywords: Foxtail millet, screening, germplasm and blast

Introduction
Foxtail millet (*Setaria italica* (L.) Beauv.) is one of the oldest cereal crop and economically important crop which belonging to family poaceae. It is a native to China (Vavilov, 1926) [9]. It is also called as Italian millet, German millet, Chinese millet and Hungarian millet (Baker, 2003) [1]. It ranks second in global millet production and continues to play an important role in global agriculture, providing around six million tons of food to millions of people mainly on poor or marginal soils in Southern Europe and also in temperate, subtropical and tropical Asia (Marathee, 1993) [6].

It is widely cultivating in semi-arid tracts of China, India, Russia, Africa and the United States. It can grow in sandy to loamy soils with a pH of 5.5–7.0 and grow rapidly in warm weather however, it has a shallow root system because of which it is can't recovered easily from drought situation (Anon, 2014) [1].

Due to its high nutritional value, it was grown for both food and fodder purposes. Because of the wide range of cultivation, the crop has been prone to many fungal diseases such as leaf blast, brown spot, rust, downy mildew and udbatta. In addition, bacterial streak threaten the crop. Among all the diseases, leaf blast is one of the most economically important and causing considerable yield loss as reported by Farman (2002) [2].

Sharma *et al.* (2014) [7] screened about 154 foxtail millet accessions for blast resistance under field conditions, Out of which, 34 entries showed resistant and 96 were moderately resistant during 2009; whereas, in 2010, number of accessions in the resistant and moderately resistant categories were 46 and 65, respectively and remaining were showed susceptible reaction. Somashekhar Konda (2015) [8] screened 78 germplasm for foxtail millet blast disease resistance under natural conditions during *Kharif* 2014. Out of those, 69 germplasm were found highly resistant, eight were resistant, one was moderately susceptible and none of the entries showed immune response. Out of 150 germplasm screened for their resistance against leaf blast under natural field conditions, 3 germplasm were found highly resistant, 51 found resistant, 79 found moderately susceptible, 11 found susceptible and 5 were found highly susceptible to blast disease (Mallikarjun *et al.*, 2020) [5].

Cultivating resistant varieties is the most effective and cheapest strategy for combating any disease. Thus, foxtail millet germplasm screening was undertaken to classify the resistant sources. The leaf blast caused by *Pyricularia setariae* is a major constraint in production of foxtail millet. In this context, the present study was carried out on screening of the foxtail millet germplasm to identify resistant sources.

Materials and Methods

A total of 150 germplasm of foxtail millet were sown during *Kharif* 2019 at ZARS, GKVK, Bengaluru and were evaluated for their reaction against leaf blast under natural field condition. Each germplasm was sown in single row of 3m length and one row of standard susceptible and resistant lines were sowed after every 10 lines of germplasm. Reaction of these germplasm and varieties to blast disease was recorded at panicle emergence stage by using disease severity scale given by Kiran Babu *et al*., (2013) [4]

On the basis of disease grade, the germplasm and varieties were grouped into the following categories.

Disease Grade	Varietal Reaction
1.0	Highly Resistance (HR)
1.1 to 3.0	Resistant (R)
3.1 to 5.0	Moderately Resistant (MR)
5.1 to 6.0	Moderately Susceptible (MS)
6.1 to 7.0	Susceptible (S)
>7.0	Highly Susceptible (HS)

Results and Discussion

Screening of foxtail millet germplasm and released varieties for blast resistance

One hundred and fifty germplasm were screened for blast disease resistance under natural conditions during *Kharif* 2019. The germplasm were screened by sowing in augmented design with one line of each resistant and susceptible lines were sowed after every 10 lines of germplasm. These germplasm were grouped into different categories based on their disease grade as mentioned in material and methods by using blast disease scoring scale given by Kiran Babu *et al*. (2013). Among these one fifty germplasm, nine germplasm *viz*., GS9, GS15, GS19 ISe1026, ISe1136, Se1227, ISe1638, ISe1647 and ISe1808 were found highly resistant, sixty two germplasm *viz*., GS5, GS22, GS26, GS29, GS30, GS55, GS56, GS59, GS73, GS74, GS75, GS79, GS86, GS88, GS89, GS90, GS92, GS93, GS97, GS98, GS99, GS100, GS101, ISel 1037, ISel 1059, ISel 1137, ISel 161, ISel 162, ISe1129, ISe1151, ISe1169, ISe1177, ISe1187, ISe1204, ISe1209, ISe1234, ISe1254, ISe1258, ISe1269, ISe1286, ISe1299, ISe1305, ISe1320, ISe1335, ISe1387, ISe1408, ISe1418, ISe1419, ISe1581, ISe1597 ISe1610, ISe1629, ISe1655, ISe1666, IISe1664, ISe1674, ISe1685, ISe1704, ISe1736, ISe1767, ISe1745 and ISe1805 were found resistant, twelve germplasm *viz.*, GS18, GS35,GS72, GS87, ISe1331, ISe1332, ISe1455, ISe1468, ISe1563, ISe1575, ISe1593 and ISe1725 were found moderately resistant, seventeen germplasm *viz.*, GS14, GS17, GS20, GS21, GS23, GS24, GS25, GS54, GS76, GS95, GS96, ISe1773, ISe1780, ISe1789, Se1820, Se1846 and ISe1851 were found moderately susceptible, twenty-six germplasm *viz.*, GS11, GS13, GS32, GS33, GS34, GS36, GS38, GS39, GS41, GS44, GS49, GS52, GS53, GS61, GS69, GS70, GS71, GS82 GS83, GS85, ISe1400, ISe1406, ISe1474, ISe1511, ISe1547 and ISe1687 were found susceptible, and twenty-four germplasm *viz.*, GS1, GS2, GS3, GS4, GS10, GS6, GS8, GS37, GS42, GS45, GS46, GS47, GS48, GS51, GS60, GS62, GS63, GS64, GS67, GS84 ISe1858, ISe1881, ISe1888 and ISe1892 were found highly susceptible to blast disease(Table 1 and Plate 1).

Similarly, Mallikarjun *et al.* (2020) [5] reported that, out of 150 germplasm screened for their resistance against natural incidence of leaf blast, three were found highly resistant, 51 were found resistant, 79 were found moderately susceptible, 11were found susceptible and five were found highly susceptible to blast disease. Somashekhar Konda (2015) [8] also screened seventy eight germplasm for blast disease resistance under natural conditions during *Kharif* 2014. Out of those, 69 were found to be highly resistant and eight were resistant. Only one germplasm was moderately susceptible, none of the germplasm showed immune, susceptible and highly susceptible reaction against the leaf blast. Jain (2000) also found three resistant foxtail millet cultivars out of thirteen cultivars screened for resistance against *Pyricularia setariae*. Similarly, Sharma *et al.* (2014) [7] found that out of 154 accessions of foxtail millet screened for blast resistance under field conditions during 2009, 34 were resistant and 96 were found moderately resistant. Whereas, in 2010, 46 accessions found resistant and 65 accessions were showed moderately resistant reactions.

Table 1: Reaction of foxtail millet germplasm screened against blast caused by *Pyricularia setariae* during *Kharif* 2019 under natural field conditions

Sl. No.	Disease Grade	Leaf area per cent covered	Reaction	Number of germplasm	Germplasm
1	1.0	< 1%	Highly Resistant	9	GS9, GS15, GS19 ISe1026, ISe1136, Se1227, ISe1638, ISe1647 and ISe1808
2	1.1-3.0	1-10%	Resistant	62	GS5, GS22, GS26, GS29, GS30, GS55, GS56, GS59, GS73, GS74, GS75, GS79, GS86, GS88, GS89, GS90, GS92, GS93, GS97, GS98, GS99, GS100, GS101, ISel 1037, ISel 1059, ISel 1137, ISel 161, ISel 162, ISe1129, ISe1151, ISe1169, ISe1177, ISe1187, ISe1204, ISe1209, ISe1234, ISe1254, ISe1258, ISe1269, ISe1286, ISe1299, ISe1305, ISe1320, ISe1335, ISe1387, ISe1408, ISe1418, ISe1419, ISe1581, ISe1597 ISe1610, ISe1629, ISe1655, ISe1666, IISe1664, ISe1674, ISe1685, ISe1704, ISe1736, ISe1767, ISe1745 and ISe1805
3	3.1-5.0	11-30%	Moderately Resistant	12	GS18, GS35,GS72, GS87, ISe1331, ISe1332, ISe1455, ISe1468, ISe1563, ISe1575, ISe1593 and ISe1725
4	5.1-6.0	31-40%	Moderately Susceptible	17	GS14, GS17, GS20, GS21, GS23, GS24, GS25, GS54, GS76, GS95, GS96, ISe1773, ISe1780, ISe1789, Se1820, Se1846 and ISe1851
5	6.1-7.0	41-50%	Susceptible	26	GS11, GS13, GS32, GS33, GS34, GS36, GS38, GS39, GS41, GS44, GS49, GS52, GS53, GS61, GS69, GS70, GS71, GS82 GS83, GS85, ISe1400, ISe1406, ISe1474, ISe1511, ISe1547 and ISe1687
6	>7	51- 100%	Highly Susceptible	24	GS1, GS2, GS3, GS4, GS10, GS6, GS8, GS37, GS42, GS45, GS46, GS47, GS48, GS51, GS60, GS62, GS63, GS64, GS67, GS84 ISe1858, ISe1881, ISe1888 and ISe1892

Field layout of germplasm Highly Resistant germplasm Highly Susceptible germplasm

Plate 1: Reaction of foxtail millet germplasms screened against leaf blast under field conditions during *Kharif* 2019

Conclusion

The study clearly indicated that out of 150 germplasm screened for their resistance against natural incidence of leaf blast, 9 germplasm were found highly resistant, 62 germplasm were found resistant, 12 germplasm were found moderately resistant, 17 germplasm were found moderately susceptible, 26 germplasm were found susceptible and 24 germplasm were found highly susceptible to blast disease. Thus these germplasm can be utilized for development of Resistant varieties against blast of foxtail millet.

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