Mysore J. Agric. Sci., 56 (2) : 271-279 (2022)

Screening of Finger Millet [*Eleusine coracana* (L.) Gaertn.] Germplasm for Leaf and Neck Blast Disease Resistance under Natural Infection Condition

S. C. Ranganatha[1], K. M. Harinikumar[2], H. B. Mahesh[3], C. A. Deepak[4] and M. K. Prasannakumar[5]
[1&2]Department of Plant Biotechnology; [5]Plant Pathology, College of Agriculture, UAS, GKVK, Bengaluru
[3]Department of Genetics and Plant Breeding; [4]AICRP on Millets, ZARS, College of Agriculture, V.C. Farm, Mandya
e-Mail : ranga.agri@gmail.com

Abstract

The blast caused by *Pyricularia grisea* (teleomorph : *Magnaporthe grisea*) is an economically important and widespread disease of finger millet. Host resistance is the most economical and effective means of combating this disease. We field evaluated 300 finger millet germplasm accessions for leaf and neck blast resistance in Magadi, Ramanagara, Karnataka, India during the the rainy season, 2019 under natural field conditions using a progressive rating scale. Based on mean leaf blast severity of 300 accessions were categorised as122 resistant (R), 107 moderately resistant (MR), 48 susceptible (S) and 23 were highly susceptible (HS). Similarly based on mean neck blast severity, 51 resistant (R), 98 moderately resistant (MR), 136 susceptible (S) and 15 were highly susceptible (HS) groups wise identified 30 out of 300 germplasm accessions showed combined resistance to both leaf and neck blast disease. These germplasm accessions were also screened for leaf blast resistance in the uniform blast nursery under greenhouse conditions to assess the per cent mortality of seedlings. The per cent mortality of germplasm accessions ranges from 0 to 85. No mortality was observed in 38 germplasm accessions. The blast resistant germplasm accessions would be useful in finger millet disease resistance breeding programs.

Keywords : Finger millet, Germplasm accessions, Leaf blast, Neck blast, mortality

Once upon a time millets were neglected and underutilized and thus, they were called as orphan crops. However, because of renewed attention for healthier foods in recent time, millets have gained importance among all stakeholders including policymakers. In an era of climate change and prevalence of dietary induced malnutrition, the importance of millet crops is enhanced due to their stress adaptability, multifarious use and nutritive values. Almost 95 per cent of the global acreage of millet lies in the developing countries, mainly in Africa and Asia (http://www.millets.res.in/vision/vision2050).

Finger millet (*Eleusine coracana* L.) is more commonly known as *ragi* or mandua is an important millet crop grown extensively in various parts of India and Africa (Devi *et al.,* 2014). Finger millet constitutes the bulk of small millet production in India to the tune of 80 per cent of total minor millet production in the country (Anonymous, 2015). It ranks third after sorghum and pearl millet among millets in India (Dass *et al.,* 2013 and Abinaya, *et al.,* 2020). It is the fourth most important millet covering 10 per cent of the global millet area concentrated in more than 25 countries of Asia and Africa.

Finger millet is the most nutritious among all major cereals and it has been perceived as 'super cereal' by the United States National Academies. Finger millet is rich in minerals and high in micronutrient density (Kumar *et al.,* 2016). It is a very good source of health benefitting nutrients *viz.,* calcium (0.38 %), protein (6 % - 13 %), dietary fiber (18 %), carbohydrates (65 % - 75 %), minerals (2.5 % - 3.5 %), phytates (0.48 %), tannins (0.61 %) and phenolic compounds (0.3 - 3 %). In addition to these components, finger millet is also a good source of vitamins, essential amino acids and trypsin inhibitory factors. Because of these nutrients the crop renders many health beneficial properties such as anti-diabetic, anti-tumerogenic, anti-diarrheal, anti-inflammatory, anti-ulcer, atherosclerogenic effects, anti-oxidant and anti-microbial properties to the users (Chandra *et al.,* 2016 and Bal *et al.,* 2020).

Though finger millet is considered as one of the hardiest crop, it is affected by several diseases and insects which are major impediments toward realizing the high yield potential of finger millet cultivars. In India, production of finger millet is being mainly affected by the blast, foot rot, brown spot, streak and mottling viruses. Among these, blast caused by fungus *Pyricularia grisea* (Cooke) Sacc is the most devastating disease affecting different aerial parts of the plant at all stages of plant growth starting from seedling to grain formation. Depending upon the severity, blast disease can cause loss to the tune of 50 - 90 per cent, whereas other two diseases *i.e.*, foot rot and brown spot diseases cause considerable losses to the crop (Jabbar Sab *et al.,* 2018; Bal *et al.,* 2020).

The most susceptible stage for leaf blast is a seedling stage, whereas for neck blast is pre-flowering stage. Growing cultivars with durable resistance are the best means of combating the blast disease of finger millet. Resistance is often assessed at the seedling stage, which did not correlate well with neck infection. Hence, a neck blast is more destructive than leaf blast. Resistance in finger millet to *M. grisea* is often evaluated in the field under natural infection and no systematic artificial inoculation was made. Screening under natural infection conditions may provide escapes and the true resistance may not be identified. The neck blast is routinely assessed at the dough stage of the crop as percent disease incidence *i.e.*, number of plants infected (incidence does not differentiate levels of susceptibility, number and size of lesions across test lines) (Kiran Babu, *et al.,* 2013).

Looking for region-specific resistant varieties and their incorporation in the cropping system is ecologically sustainable, economical, efficient and thus the most suitable approach for managing the diseases (Sushri *et al.,* 2020). Under this study, an attempt has been taken to identify the sources of resistance against the leaf blast and neck blast diseases at natural field conditions those could be utilized in resistance breeding programs.

Material and Methods

Seed Source and Uniform Leaf Blast Screening Nursery (UBN)

Seed of the 300 germplasm accessions of the finger millet along with check varieties Udurumallige (Susceptible), PR 202 (Moderately resistant) and GPU 28 (Resistant) were collected from the AICRP on Millets, V.C. Farm, Mandya, Karnataka, India (Table 1). The 300 finger millet germplasm accessions along with check varieties were screened for leaf blast disease resistance in a uniform blast nursery at KVK, Magadi, Ramanagara, Karnataka, India. Each germplasm accession was sown in a row of 1m length with row-to-row spacing of 15cm, after every 10 germplasm accession checks were sown for disease development and comparison. High humidity and leaf wetness were provided by perfoirrigation twice a day on rain-free days, 30 min each during morning and evening hours to facilitate disease development. During the second week (12DAS), observation on percent mortality was recorded.

Fig. 1 : Leaf blast screening in nursery bed at KVK, Magadi, Karnataka

Field Evaluation of Finger Millet Germplasm Accessions for Leaf and Neck Blast Disease Resistance

The 300 finger millet germplasm accessions along with checks (Udurumallige, PR 202 and GPU 28) were evaluated for leaf and neck blast disease resistance at KVK, Magadi, Ramanagara, Karnataka, India during rainy season, 2019. Each germplasm accession was grown in three rows of 3 m length with row-to row spacing of 30 cm and plant to plant spacing within the row of 10 cm in a randomized complete block design (RCBD) with three replications. The susceptible line (Udurumallige) was planted at every tenth row to increase disease incidence by supplying pathogen inoculum. Excess seedlings were removed, keeping only 30 plants / row at 15 days after emergence. High humidity and leaf wetness were provided by flood irrigation to facilitate disease development.

The germplasm accessions of finger millet were screened under natural epiphytotic conditions and no artificial inoculation was made. Percentage of diseased leaf area was visually assessed 45 days after sowing (DAS) and leaf blast severity was recorded using a progressive 1 to 9 scale (Kiran Babu *et al.,* 2013), where 1 = no lesions to small brown specks of pinhead size (0.1 - 1.0 mm), less than 1 per cent leaf area affected; 2 = typical blast lesions covering 1 - 5 per cent leaf area covered with lesions; 3 = 6 - 10 per cent, 4 = 11 - 20 per cent, 5 = 21 - 30 per cent, 6 = 31 - 40 per cent, 7 = 41 - 50 per cent, 8 = 51 - 75 per cent and many leaves dead; and 9 = typical blast lesions covering >75 per cent leaf area or all the leaves dead.

Fig. 2 : Leaf blast disease scoring in field at KVK, Magadi, Karnataka

Similarly, neck blast severity was recorded based on the relative lesion size on the neck using a 1 to 5 progressive rating scale (Kiran Babu *et al.,* 2013), where 1 = no lesions to pin head size of lesions on the neck region, 2 = 0.1 to 2.0 cm size of typical blast lesion on the neck region, 3 = 2.1 to 4.0 cm, 4 = 4.1 to 6.0 cm, and 5 = >6.0 cm size of typical blast lesion on the neck region. Data were recorded in field at the physiological maturity on five randomly selected individual plants of each accession.

Fig. 3 : Neck blast disease scoring in field at KVK, Magadi, Karnataka

Data Analysis

Data on percent mortality was visually assessed in uniform blast nursery using 0 to 100 per cent rating scale under greenhouse condition. Data on leaf and neck blast severity were recorded using a progressive rating scale from randomized complete block design (RCBD) with three replicates in the field by randomly selecting 5 individual plants of each germplasm accession. Leaf and neck blast disease scoring was analysed by taking a mean of 5 individual plants disease rating of each germplasm accession.

Results and Discussion

Uniform Leaf Blast Screening Nursery (UBN)

The 300 germplasm accessions of finger millet were screened for leaf blast resistance in a uniform blast nursery under green house conditions and no artificial inoculation was made. Per cent mortality of seedlings were visually assessed 12 days after sowing (DAS). The percent mortality of finger millet germplasm accessions ranges from 0 to 85 (Table 1). No mortality was observed in 38 germplasm accessions out of 300 finger millet germplasm accessions *viz*., IC0476870, IC0476567, IC0477556-X, IC0477156, ICO476223-X, ICO477152, ICO476682, ICO476510, ICO477460, ICO4765582-X, ICO477024, ICO477997, ICO477207, ICO477113, ICO477487, GEC285, ICO477328, ICO476979-X, ICO477273, ICO477045, ICO477491, ICO476986, ICO476838, ICO477308, GEC128, ICO476798, ICO477120, GEC260, ICO477327, ICO476934, ICO477654, GEC27, ICO477838, IC0477156CO476872, ICO277067, ICO476720, ICO476728-X, ICO477117, IC0476870, IC0476567, IC0477556-X, ICO476223-X and ICO477152.

TABLE 1

Percent mortality, Scoring of leaf blast and neck blast disease of finger millet germplasm accessions

Germplasm accession number	Percent mortality	Leaf blast	Score	Neck blast	Score
IC-478423	25	5.2	S	1	R
GEC269	40	3.4	MR	1	R
IC0477159	40	6.4	S	1	R
GEC262	40	6.4	S	1	R
IC0477124	35	5.8	S	2.2	MR
GEC122	50	5.2	S	1	R
IC0476940	15	3.6	MR	1	R
GEC113	85	8.2	HS	2.2	MR
IC0587971	15	3.2	MR	3	MR
GEC119	45	5.4	S	2.6	MR
IC0477483	40	4.4	MR	3.2	S
IC0476870	0	4.4	MR	1	R
IC0476409	15	5.2	S	1	R
IC0476972	15	5.6	S	3.4	S
IC0476719	10	2.2	R	1	R
IC0476958	10	2.8	R	1.2	R
GEC284	30	5.6	S	1	R
GEC2	40	2.6	R	3.2	S
GEC110	60	3	R	2.2	MR
IC0477271	10	2.8	R	3	MR
GEC273	40	5.2	S	4	S
IC0476567	0	2.6	R	1.2	R
IC-478440	10	5.4	S	3.6	S
IC0477556-X	0	4.8	MR	3.6	S
GEC120	60	5.4	S	3.4	S
IC0476505	15	2.8	R	2.8	MR
IC0588005	20	3	R	1.2	R
IC0477385	40	3	R	1.2	R
IC0587983	45	5.2	S	2.6	MR
IC0477860	25	3	R	1.6	R
IC0476151	50	5.2	S	2.6	MR
IC0477164	40	2.6	R	1.2	R
GEC288	10	2.8	R	1.4	R
IC0476752	10	5.4	S	3	MR
IC0477331	40	4.2	MR	3.8	S
IC0476171	25	2.4	R	1.6	R
IC-587929	80	3.4	MR	1.2	R
IC0477052	40	2.8	R	3.6	S
IC-478327	20	2.2	R	2.8	MR

Germplasm accession number	Percent mortality	Leaf blast	Score	Neck blast	Score
GEC137	70	2.6	R	2.2	MR
IC0477042	45	7.8	HS	3.8	S
GEC139	85	5.2	S	3.2	S
GEC291	50	5.2	S	3.6	S
IC0477309	45	4.6	MR	2.4	MR
GEC157	25	4.2	MR	2.4	MR
IC0477156	0	3.8	MR	3.8	S
IC0476661	50	2.4	R	1.8	R
IC-478238	65	2.8	R	3.2	S
IC0476809	15	3.4	MR	1.8	R
ICO477560	40	3.6	MR	2.8	MR
IC-477943	45	5.2	S	3.2	S
GEC25	35	3	R	1.8	R
ICO477369	10	2.4	R	3.6	S
ICO477658	10	3.2	MR	2	R
ICO476520	15	2.6	R	3.2	S
IC-587930	5	2.8	R	1.8	R
GEC296	20	2.8	R	2.4	MR
IC-478459	30	3.4	MR	3.6	S
GEC280	40	2.2	R	1.2	R
GEC138	30	2	R	2	R
ICO476223-X	0	3.6	MR	3.4	S
ICO476923	5	3.4	MR	3.4	S
ICO476975	10	4.4	MR	2.8	MR
GEC150	20	3.8	MR	3.6	S
ICO477495	55	4.2	MR	3.4	S
IC-478568	40	3	R	2.4	MR
ICO588010	5	2.8	R	2.6	MR
ICO477405	70	3	R	2	R
ICO476597	30	3.2	MR	4	S
GEC185	30	2.8	R	2	R
ICO477152	0	4.6	MR	2.6	MR
ICO587976	30	2.6	R	2.6	MR
IC-477642	35	4.2	MR	2.8	MR
ICO588007	65	2.4	R	2.6	MR
ICO476682	0	2.6	R	2.6	MR
ICO476412	30	4.2	MR	3.2	S
GEC31	20	2.4	R	2.4	MR
ICO476821	10	2.4	R	2.6	MR
ICO477361	30	2.6	R	3.4	S
ICO476035	60	2.2	R	2.2	MR
ICO476833	10	4.4	MR	2	R

Germplasm accession number	Percent mortality	Leaf blast	Score	Neck blast	Score
ICO477065	15	5.6	S	3.8	S
ICO476720	50	5.4	S	3.2	S
GEC26	5	5.6	S	3	MR
ICO476850	30	3.6	MR	2	R
ICO587971	75	8	HS	4.6	HS
ICO477503	10	3.2	MR	4	S
IC-478425	5	7.8	HS	4.2	HS
ICO477149	25	7.8	HS	3.8	S
ICO477082	25	7.4	HS	4	S
GEC134	25	3.2	MR	3.4	S
ICO476737	15	2.8	R	3.2	S
ICO476187	15	4.2	MR	3.2	S
GEC141	15	4.6	MR	3.6	S
GEC266	15	3.6	MR	3.8	S
ICO477347	50	3.4	MR	4.4	HS
IC-478815	35	3.8	MR	4	S
ICO476510	0	3.4	MR	2.8	MR
GEC20	5	2.6	R	2.6	MR
ICO588009	20	2.8	R	3	MR
IC-478231	30	3.4	MR	3.4	S
ICO476846	25	3.4	MR	1.8	R
ICO475815	20	2.8	R	2.6	MR
GEC24	20	3.2	MR	3.6	S
ICO477460	0	3	R	2	R
ICO476921	30	2.8	R	3.4	S
GEC287	20	2.8	R	2.2	MR
GEC189	25	3.2	MR	3.8	S
ICO4765582-X	0	2.8	R	3.2	S
ICO477024	0	5.2	S	3.2	S
ICO476572	20	2.8	R	2	R
ICO477677	5	2.6	R	2.8	MR
ICO477710	25	2.8	R	3	MR
ICO476519	45	7.6	HS	3.8	S
GEC127	20	4.6	MR	3.4	S
IC-478271	30	3.8	MR	3.6	S
ICO477347	20	3.6	MR	3.4	S
ICO476827-X	15	2.6	R	1.8	R
ICO477361	35	3	R	4	S
ICO477258	15	3.2	MR	2.8	MR
ICO476957	30	2	R	2	R
ICO477039	20	2.8	R	3.2	S
GEC161	10	2.8	R	2	R
ICO477221	25	2.8	R	3.4	S
ICO477997	0	3.4	MR	3.4	S
GEC147	15	2.6	R	3.4	S
GEC35	65	2.4	R	3	MR
ICO477963	25	2.8	R	2.2	MR
IC-478795	20	3.6	MR	3.8	S
ICO476864	15	3	R	2.2	MR
GEC136	15	3.4	MR	3.6	S
ICO476886	40	2.8	R	4	S
IC-478738	55	2.8	R	3.6	S
ICO476871	40	2.4	R	1.2	R
ICO477207	0	3.4	MR	3.6	S
ICO476801	25	2.8	R	3.4	S
GEC261	20	7.4	HS	3.8	S
ICO477155	15	2.8	R	3.2	S
ICO477113	0	3	R	3.4	S
ICO477308	10	2.6	R	3.4	S
ICO476835	30	2.4	R	3.2	S
GEC149	40	5.4	S	4.2	HS
ICO477139	15	3.8	MR	3.8	S
IC-478581	25	3	R	3	MR
ICO477677	30	2.4	R	3.4	S
ICO476953	30	3.6	MR	3.2	S
IC-478132	65	5.6	S	3.4	S
GEC274	40	5.4	S	3.8	S
GEC41	15	2.4	R	4	S
ICO477487	0	3.6	MR	3.4	S
ICO588004	75	2.4	R	2.8	MR
ICO476404	25	2.6	R	3.8	S
GEC135	15	2.6	R	3	MR
GEC267	10	2.6	R	3.6	S
GEC264	30	5.4	S	2.8	MR
ICO477166	70	3.6	MR	3.8	S
ICO476580	60	3.6	MR	3.8	S
GEC156	20	4.2	MR	3.6	S
IC-478143	25	3.4	MR	3.8	S
ICO476847	65	2.8	R	3.8	S
ICO476460	40	4	MR	3.8	S
GEC275	20	8	HS	4.2	HS
ICO477977	40	7.2	HS	2.8	MR
GEC41	20	3.2	MR	3.6	S
ICO476901	80	2.6	R	3.6	S

Germplasm accession number	Percent mortality	Leaf blast	Score	Neck blast	Score
ICO477201	5	5.2	S	3.4	S
IC-477924	75	3.6	MR	3.4	S
ICO476584	70	2.4	R	1.6	R
ICO477390	45	5.2	S	3.6	S
ICO477340-X	45	5.2	S	2.8	MR
GEC285	0	3.6	MR	3	MR
ICO476936	10	2.6	R	3.8	S
ICO477328	0	2.8	R	3.8	S
ICO476505	20	5.2	S	4.2	HS
ICO477149	40	5.2	S	3.8	S
ICO477216	20	4.2	MR	2.4	MR
ICO477469	15	5.6	S	3.8	S
ICO587968	20	4.2	MR	3.8	S
ICO477135	25	2.6	R	3	MR
ICO476979-X	0	2.8	R	3	MR
ICO476986	25	3.6	MR	3	MR
ICO477273	0	3	R	3	MR
IC-478404	10	2.4	R	1.4	R
ICO476538	40	3.6	MR	3.6	S
ICO477112	5	2.4	R	1.4	R
GEC118	25	2.4	R	3	MR
ICO477045	0	2.6	R	3.2	S
ICO476925	15	3.8	MR	3	MR
ICO476535	20	2.4	R	1.6	R
ICO477393	40	2.6	R	2.8	MR
ICO477604	35	3	R	2.4	MR
ICO476814	25	2.6	R	4.2	HS
ICO476998	10	2.8	R	3	MR
GEC263	20	3.8	MR	2.6	MR
ICO476751	30	2.4	R	1.8	R
GEC143	10	3	R	2.4	MR
ICO588008	5	2.2	R	2.2	MR
ICO477113	10	3	R	2.6	MR
ICO477491	0	3.8	MR	3	MR
ICO476986	0	4.6	MR	3.2	S
ICO477349	25	4.8	MR	3	MR
GEC125	20	4.2	MR	2.8	MR
GEC146	15	5.2	S	4.6	HS
ICO477378	50	2.8	R	3.4	S
ICO477176	35	3	R	3.6	S
ICO477175	35	3.8	MR	3.4	S
ICO476838	0	3.4	MR	2.4	MR
ICO477308	0	3.2	MR	3.8	S
IC-478531	15	3.4	MR	3	MR
ICO477233	25	5.4	S	2.8	MR
ICO476592	25	5.2	S	3.6	S
ICO476871	20	3.2	MR	2.6	MR
ICO475836	10	3.8	MR	3.6	S
GEC281	15	4.2	MR	2.4	MR
ICO588006	15	4	MR	3	MR
GEC128	0	3.6	MR	3.6	S
ICO476714	30	5	MR	3.6	S
ICO476901	45	4.6	MR	2.8	MR
GEC23	85	4.2	MR	3.4	S
ICO476216	30	4.2	MR	3.8	S
GEC289	50	2.8	R	3.2	S
GEC196	10	4.2	MR	3.6	S
IC-478597	85	2.4	R	3.6	S
ICO476798	0	2.4	R	2.2	MR
GEC278	40	3.8	MR	2.6	MR
GEC19	65	2.4	R	1	R
ICO476932	5	3.8	MR	2.2	MR
ICO477138	40	4	MR	3.4	S
IC-478601	10	3.8	MR	2.4	MR
ICO477297	20	2.8	R	2.4	MR
GEC279	20	5.4	S	2	R
GEC116	5	2.4	R	3	MR
ICO476467	35	2.8	R	2.6	MR
GEC117	10	2.8	R	3.4	S
ICO477634	30	3	R	3.4	S
ICO476909	45	4	MR	3.6	S
ICO477206	65	2.8	R	2.8	MR
ICO476669-X	40	3.4	MR	3.2	S
ICO476257	25	2.4	R	3	MR
ICO476560	40	2.4	R	2.6	MR
ICO477120	0	5.4	S	2	R
ICO477095	30	5.4	S	3	MR
IC-478204	10	5.6	S	4	S
ICO476636	25	4	MR	2.6	MR
IC-477921	10	4.2	MR	1.6	R
ICO477028	10	4	MR	2.8	MR
GEC265	50	7.2	HS	3.6	S
GEC199	30	5.2	S	3.2	S
GEC21	5	5.2	S	3.2	S

Germplasm accession number	Percent mortality	Leaf blast	Score	Neck blast	Score
GEC260	0	3.8	MR	3.6	S
ICO476596-X	15	8	HS	3.8	S
IC-477716	30	8.8	HS	4.4	HS
ICO477327	0	8	HS	2.2	MR
GEC271	50	7.6	HS	1.8	R
ICO476617	40	7.8	HS	3.2	S
ICO476934	0	7.4	HS	3.8	S
ICO476223-X	5	7.6	HS	3	MR
IC-477727	10	7.6	HS	3.2	S
ICO476580	40	7.4	HS	2.4	MR
ICO476363	40	3	R	2.4	MR
IC-478422	20	5.6	S	3.6	S
ICO476937	5	5.4	S	2.8	MR
ICO587965	20	8.2	HS	4.6	HS
ICO476796	25	2.8	R	2.8	MR
ICO477536	35	4	MR	3	MR
ICO476879	25	5.6	S	3.2	S
ICO477097	30	8	HS	3.4	S
GEC109	25	2.8	R	3.2	S
ICO477237	10	2.6	R	1.4	R
ICO477644	10	2.2	R	3.4	S
ICO476700	30	2.6	R	3.8	S
ICO477010	15	2.8	R	3.4	S
ICO477312	40	6.2	S	4.2	HS
ICO477654	0	2.4	R	3	MR
ICO477255	10	2.8	R	3.6	S
ICO477676	30	5.2	S	3	MR
ICO476365	15	3.8	MR	2.2	MR
GEC45	20	4.2	MR	3.2	S
ICO476091	20	5.6	S	3.6	S
ICO475676	20	4.6	MR	1.2	R
ICO477177	20	7.6	HS	1.8	R
GEC27	0	5.4	S	2.4	MR
ICO477711	5	2.8	R	2.8	MR
ICO476510	5	3.2	MR	3.4	S
GEC39	20	2.4	R	2.2	MR
ICO476830	5	2.2	R	2.4	MR
ICO477573	20	2.6	R	3.4	S
ICO477024	60	3.6	MR	3.8	S
GEC276	35	4.4	MR	3.8	S
ICO476567	20	2.4	R	4	S
ICO477838	0	4.2	MR	3.6	S
ICO476539	55	4.2	MR	4.2	HS
GEC133	10	4.4	MR	3.2	S
ICO476872	0	4	MR	4.2	HS
ICO277067	0	3.8	MR	3.2	S
ICO476720	0	2.8	R	1.6	R
ICO476728-X	0	3.2	MR	2.4	MR
GEC286	20	4.8	MR	4.4	HS
GEC294	40	3.6	MR	3.2	S
ICO477117	0	4.6	MR	4.2	HS

Note : R= Resistant, MR= Moderately Resistant, S=Susceptible and HS=Highly Susceptible

Field Evaluation of Finger Millet Germplasm Accessions for Leaf Blast Disease Resistance

For assessing leaf blast severity, a 1 - 9 rating scale was used based on percent leaf area covered with lesions. The 1 to 9 rating scale was classified into four general categories of resistant (R) (1.0 - 3.0 score), moderately resistant (MR) (3.1 - 5.0 score), susceptible (S) (5.1 - 7.0 score) and highly susceptible (HS) (>7.0 score). Based on mean leaf blast severity, out of 300 finger millet germplasm accessions, 122 were resistant (R), 107 were moderately resistant (MR), 48 were susceptible (S) and 23 were found highly susceptible (HS) (Table 1). Among the 122 resistant, GEC138, ICO476957, IC0476719, IC-478327, GEC280, ICO476035, ICO588008, ICO477644 and ICO476830 accessions showed lowest mean leaf blast disease incidence among all germplasm accessions.

Field Evaluation of Finger Millet Germplasm Accessions for Neck Blast Disease Resistance

For assessing neck blast severity, 1 - 5 rating scale was used based on the lesion size on the neck region just below the fingers. Although the size of lesions on neck region varied almost continuously, four general classes (1.0 - 2.0 = resistant; 2.1 - 3.0 = moderately resistant; 3.1 - 4.0 = susceptible and 4.1 - 5.0 = highly susceptible) were distinguished based on the relative size of lesions. Based on mean neck blast severity, out of 300 finger millet germplasm accessions, 51 were resistant (R), 98 were moderately resistant (MR), 136 were susceptible (S) and 15 were found highly susceptible (HS) (Table 1). Among 51 resistant accessions, IC-478423, GEC269, IC0477159, GEC262, GEC122, IC0476940, IC0476870, IC0476409, IC0476719, GEC284 and GEC19 were most significant with lowest mean neck blast disease incidence among all germplasm accessions.

Finger Millet Germplasm Accessions for Combined Resistance to Both Leaf and Neck Blast Diseases

Out of 300 finger millet germplasm accessions, 30 were showed combined resistance to both leaf and neck blast diseases. Among 30 resistant, IC0476719, IC0476567, IC0477164, GEC280, ICO476871, IC-478404, ICO477112, GEC19 and ICO477237 were most significant (lowest mean leaf and neck blast disease incidence) germplasm accessions.

Mortality of seedlings in the uniform blast nursery and disease incidence of leaf blast and neck blast were observed in the field and disease score was analysed for all the 300 finger millet germplasm accessions (Table 1). Per cent mortality of seedlings was visually assessed at 12 DAS (days after sowing). The percent mortality ranges from 0 to 85. The data shown that there is no mortality of seedlings in 38 germplasm accessions out of 300. This data indicates that there will be a no symptoms of leaf blast / resistance to leaf blast disease observed in 38 germplasm accessions at seedling stage in the nursery under greenhouse condition. This data also reveals that total per cent of transposable seedlings available for transplanting in the main field. Similarly, finger millet germplasm accessions were evaluated for leaf and neck blast disease resistance (Table 1). Out of 300, 122 germplasm accessions were showed immune reaction to leaf blast, 51 accessions for neck blast and 30 accessions to both the diseases in the field under natural infection condition. Among the germplasm accessions screened, minimum leaf blast grade (2.0) was found in the GEC138 and ICO476957 as resistant and maximum (8.8) was in IC-477716 as highly susceptible. Minimum neck blast grade (1.0) was found in the 11 germplasm accessions *viz*., IC-478423, GEC269, IC0477159, GEC262, GEC122, IC0476940, IC0476870, IC0476409, IC0476719, GEC284 and GEC19 as resistant and maximum (4.6) were in ICO587971, GEC146 and ICO587965 as highly susceptible. Several sources of blast resistance have been reported in finger millet and efforts have been made to incorporate resistance trait into improved cultivars and elite breeding lines. Although, good number of high yielding blast varieties like GPU 28, GPU 45 and GPU 48 were released for cultivation and it is likely that resistance may break down owing to development of new pathotypes of *Magnaporthe grisea*. In case of rice-blast patho-system, to understand the mechanisms of frequent breakdown of resistance in blast resistant cultivars, studies on extent of genetic diversity present in the population of *M. grisea* in a specific geographical region is very important. Development of durable blast resistant varieties should be made based on a complete understanding of pathogen diversity in the target area. Substantial work has been done with the rice blast pathosystem on pathogenic and genetic diversity, epidemiology and disease management through host-plant resistance. However, such studies are very limited with the finger millet-blast pathosystem (Kiran Babu *et al.,* 2012). Identification of the disease resistant accessions from the finger millet mini-core would permit use of diverse resistance sources for future breeding efforts and to ensure a better chance of success in finger millet improvement in developing cultivars with a broad genetic base (Kiran Babu *et al.,* 2013). Multiple pathotype-resistant accessions identified in the core collection could be used in breeding programs. Agronomically superior blast-resistant accessions can be directly released for cultivation in farmers' fields after thorough testing in yield trials in the relevant locations (Rajan Sharma *et al.,* 2013). Looking for region-specific resistant varieties and their incorporation in the cropping system is ecologically sustainable, economical, efficient and thus most suitable approach for managing the diseases by utilizing the resistant genotypes in resistance breeding programs (Sushri *et al.,*2020; Das *et al.,* 2021). From this current study, germplasm identified for resistance to finger and neck blast resistance will serve as important donor in a finger millet resistance breeding programme.

Breeding for improved blast-resistant varieties is an important goal of finger millet improvement programs in India. In this study, an attempt was made to identify the resistant germplasm accessions of finger millet against leaf blast and neck blast diseases at natural field conditions of Karnataka, which will serve as important donor in a finger millet resistance breeding programme. Therefore, these agronomically superior blast-resistant accessions can be directly released for cultivation in farmer's fields after intensive testing for yield in multiple locations.

References

Abinaya, K., Natarajan, S., Ganapathy, M. and Arivazhagan, 2020, Studies on intercropping in finger millet (*Eleusine coracana* L.) under sri principles. *Mysore J.Agric.Sci.,* **54** (3) : 73 - 79.

Bal, S. S., Kumar, S., Mishra, I. O. P., Mohapatra, P. M., Panigrahi, R. K. and Panda, P. K., 2020, Evaluation of finger millet genotypes against three major diseases in east and south eastern coastal plain zone of Odisha. *J. pharmaco. Phytochem.* **9** (3) : 635 - 638.

Chandra, D., Chandra, S., Pallavi and Sharma, A. K., 2016, Review of finger millet (*Eleusine coracana* (L.) Gaertn) : A powerhouse of health benefiting nutrients. *Food Sci., Human Well.* **5** : 149 - 155.

Das, I. K., Palanna, K. B., Patro, T. S. S. K., Ganapathy, K. N., Kannababu, N., Sunil Kumar and Tonapi, V. A., 2021, A multilocational evaluation of blast resistance in a diverse panel of finger millet in India. *Crop Prot.,* **139** : 105 - 401.

Dass, A., Sudhisri, S and Lenk, N, K., 2013 Integrated nutrient management to improve finger millet productivity and soil conditions in hilly region of eastern India. *J.Crop Improve.* **27** (5) : 528 - 546.

Devi, P. B., Vijayabharati, R., Sathyabama, S., Malleshi, N. G. and Priyadarsini, V. B., 2014, Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: a review. *J. Food Sci., Tech.,* **51** : 1021 - 1040.

Jabbar Sab and Nagaraja, A., 2018, Assessment of morphological and cultural variability of *Pyricularia grisea* (Cooke) Sacc. Isolates associated with finger millet blast disease. *Mysore J.Agric.Sci.,* **52** (2) : 391 - 401.

Kiran Babu, T., Thakur, R. P., Upadhyaya, H. D., Reddy, P. N., Sharma, R., Girish, A. G. and Sarma, N. D. R. K., 2013, Resistance to blast *(Magnaporthe grisea)* in a mini-core collection of finger millet germplasm. *Euro. J. Plant Path*., s10658-012-0086-2.

Kiran Babu, T., Thakur, R. P., Reddy P. N., Upadhyaya, H. D., Girish A. G. and Sarma N. D. R. K., 2012, Development of field screening technique and identification of blast resistance in finger millet core collection. *Ind. J. Pl. Prot.,* **40** (1) : 45 - 51.

Kumar, A., Metwal, M., Kaur, S., Gupta, A. K., Puranik, S., Singh, S., Singh, M., Gupta, S., Babu, B. K., Sood, S. and Yadav, R., 2016, Nutraceutical value of finger millet [*Eleusine coracana* (L.) Gaertn.] and their improvement using omics approaches. *Front. Pl. Sci.,* **7** : 934.

Rajan Sharma, Girish, A. G., Upadhyaya, H. D., Humayun, P., Babu, T. K., Rao, V. P. and Thakur, R. P., 2013, Identification of Blast resistance in a core collection of Foxtail millet germplasm. *Plant Dis*., **98** : 519 - 524.

Sushri, S. B., Sandeep Kumar, Mishra, I. O. P., Mohapatra, P. M., Senapati, N., Panda P. K. and Panigrahi, R. K., 2020, screening of finger millet germplasm leading to identification of sources of resistance against blast, foot rot and brown spot diseases under natural field conditions. *Int.J.Curr. Microbiol. App. Sci.,* **9** (8) : 2560 - 2567.

(*Received :* September 2021 *Accepted :* April 2022)