

Screening of Pearl millet germplasms against downy mildew disease

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Abstract

Pearl millet or bajra [*Pennisetum glaucum* (L.) R. Br.] is one of the most important staple food for lakhs of poor people living in the semi-arid zones of India. Pearl millet is infected by a large number of diseases caused by fungal, bacterial, viral and nematode pathogens. Among these, downy mildew caused by *Sclerospora graminicola* (Sacc.) Schroet is the most destructive and widespread in India. Considering this, the present study on downy mildew of pearl millet was carried out screening of pearl millet germplasms under field condition against downy mildew disease. Total 95 pearl millet germplasms were evaluated under field conditions against downy mildew during *kharif*, 2017. Among 95 germplasms, 61 germplasms were found highly resistant, 22 germplasms were found resistant, 12 germplasms were found susceptible and none of germplasm was found highly susceptible.

Keywords: Pearl millet, Downy mildew, *Sclerospora graminicola*, Germplasm.

Introduction

Pearl millet is mainly grown in Gujarat, Rajasthan, Uttar Pradesh, Haryana and Maharashtra in *kharif* and *rabi* seasons (Anonymous, 2016^a). While, in Gujarat, it is grown in 9.32 lakh hectares with a production of 10.97 lakh tonnes and productivity of 1177 kg/ha (GOG,2016).

The crop is nutritionally rich with a good balance of starch, protein and fat. Pearl millet provides 11 to 12 per cent of worlds' supply of protein (Yadav *et al.*, 2011). The downy mildew pathogen was first reported on pearl millet in India in 1907 by E. J. Butler. However, during recent years the disease has been found to be very destructive and become a limiting factor for the cultivation of hybrid bajra (Sivaprakasan *et al.*, 1975. symptoms were rarely seen as local lesions or isolated spots on leaf blade spots vary in shape and size and were at first chlorotic, produce sporangia and later became necrotic (Girard, 1975). The disease is affecting not only foliar parts, but also the ear head. In many affected plants, ears fail to form or if formed, they are malformed into green leafy structures; hence it is also known as the 'green ear'

disease. Abandoning the crop in its premature stages is not quite uncommon due to the ravages of this disease (Sivaprakasan *et al.*, 1975). Since the economic returns from this resource poor pearl millet crop are meagre; growing resistant varieties is the only alternative for combating this downy mildew disease. Therefore, it becomes necessary to screen the germplasms.

Materials and methods

The experiment was conducted at Centre for Crop Improvement, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *Kharif*, 2017 to study the screening of pearl millet germplasms against downy mildew in sick plot with higher oospore inoculum load. Each germplasm was sown in two replications. Recommended agronomic practices were adopted for successful raising the crop. Later on monitoring for downy mildew symptom development in the seedlings till the crop maturity was constantly examined. The total and downy mildew infected seedlings were counted to determine the disease incidence at 15 days interval. Irrigation was provided through sprinkler system frequently for

Pollution and Effects on Community Health

maintaining high relative humidity (> 90 % relative humidity) to promote the infection and disease development. Downy mildew highly susceptible cultivar 7042S was used as infector rows (Inoculum donor) with a view to develop the maximum disease pressure. These rows were planted three weeks earlier than the test rows. The infector rows were sown uniformly throughout the entire length of the field. The test material of the respective trial was sown about three weeks after the sowing of infector rows.

Observations recorded

In order to relate the productivity loss due to downy mildew severity, disease severity scores was taken on individual plant basis at crop maturity using a 1 to 5 scale.

Where,

- 1 = No infection,
- 2 = 20 % productive tillers infected,
- 3 = 50 % productive tillers infected,
- 4 = 80 % productive tillers infected, and
- 5 = All tillers infected or total plant killed.

Disease scoring was carried on every 15 days interval up to crop maturity. The observed on per cent diseases index was worked out as described below (Anonymous, 2016^b).

$$\text{Disease severity (\%)} = \frac{[(1-1).n_1 + (2-1).n_2 + (3-1).n_3 + (4-1).n_4 + (5-1).n_5]}{[(5-1). N] \times 100}$$

Where, n₁, n₂, n₃, n₄, and n₅ are total number of plants in each of 1 to 5 rating class and N is the total number of plants in a plot. Observations on downy mildew incidence were recorded at 15 days interval up to crop maturity (90 days). The following formula was used to calculate per cent diseases incidence (Sharma *et al.*, 2007).

$$\text{Per cent disease incidence} = \frac{\text{Number of infected plants}}{\text{Total Number of plants}} \times 100$$

The indicator rows (susceptible genotype '7042S ' to assess the level of disease pressure) were planted along with the test rows at regular interval (after 10 rows).

Disease scoring

Disease scoring was done by counting total number plants in a row by rating the infected plants against downy mildew infestation from 1 to 5 rating scale as given below.

Table – 1: Incidence of downy mildew disease in pearl millet germplasms

Sr. No.	Germplasms	Downy mildew incidence (%)					Mean Incidence(%)	Reaction
		30 DAS	45 DAS	60 DAS	75 DAS	90 DAS		
1	16976	3.57	3.57	5.36	5.36	5.36	4.64	HR
2	16110	0.00	0.00	0.00	0.00	0.00	0.00	HR
3	42246	0.00	0.00	0.00	0.00	0.00	0.00	HR
4	18037	0.00	0.00	0.00	0.00	0.00	0.00	HR
5	15805	11.51	11.51	14.58	16.39	16.39	14.08	S
6	15078	6.52	6.52	8.70	8.70	8.70	7.83	R
7	22923	1.67	1.67	5.00	6.67	6.67	4.33	HR
8	1220	1.67	1.67	9.38	9.38	9.38	6.29	R
9	20229	0.00	0.00	1.67	1.67	1.67	1.00	HR
10	15787	0.00	0.00	0.00	0.00	0.00	0.00	HR
11	1421	0.00	0.00	0.00	0.00	0.00	0.00	HR
12	5972	0.00	0.00	0.00	0.00	0.00	0.00	HR
13	1342	7.77	7.77	10.90	12.51	12.51	10.29	S
14	17840	0.00	0.00	0.00	0.00	0.00	0.00	HR
15	18580	0.00	0.00	0.00	0.00	0.00	0.00	HR
16	1225	0.00	0.00	0.00	0.00	0.00	0.00	HR
17	22822	7.13	7.13	12.69	12.69	12.69	10.46	S
18	42182	0.00	0.00	0.00	0.00	0.00	0.00	HR
19	42479	0.00	0.00	0.00	0.00	0.00	0.00	HR
20	1202	0.00	0.00	0.00	0.00	0.00	0.00	HR
21	1206	5.23	5.23	8.84	8.84	8.84	7.39	R
22	5969	0.00	0.00	0.00	0.00	0.00	0.00	HR
23	15067	0.00	0.00	0.00	0.00	0.00	0.00	HR
24	16010	0.00	3.85	3.85	5.77	5.77	3.85	HR
25	20437	0.00	0.00	0.00	0.00	0.00	0.00	HR
26	15695	0.00	0.00	0.00	0.00	0.00	0.00	HR
27	16625	3.23	3.23	4.84	4.84	4.84	4.19	HR
28	42299	5.56	5.56	9.26	9.26	9.26	7.78	R
29	15691	0.00	0.00	0.00	0.00	0.00	0.00	HR
30	41530	0.00	0.00	0.00	0.00	0.00	0.00	HR
31	15041	0.00	0.00	0.00	0.00	0.00	0.00	HR
32	16745	3.70	3.70	5.56	7.41	7.41	5.56	R
33	16322	7.67	7.67	10.75	10.75	10.75	9.52	R
34	17130	0.00	0.00	0.00	0.00	0.00	0.00	HR
35	17659	0.00	0.00	0.00	0.00	0.00	0.00	HR
36	15924	14.58	14.58	18.75	18.75	18.75	17.08	S
37	15743	4.55	4.55	9.09	9.09	9.09	7.27	R
38	18839	10.26	10.26	14.56	14.56	14.56	12.84	S
39	15708	1.43	1.43	2.86	2.86	2.86	2.29	HR
40	16101	0.00	0.00	0.00	0.00	0.00	0.00	HR
41	42852	0.00	0.00	0.00	0.00	0.00	0.00	HR
42	17734	12.14	12.14	13.81	13.81	13.81	13.14	S
43	21334	0.00	0.00	0.00	0.00	0.00	0.00	HR
44	16317	0.00	0.00	0.00	0.00	0.00	0.00	HR
45	42078	4.69	6.25	6.25	7.81	7.81	6.56	R
46	18023	0.00	0.00	0.00	0.00	0.00	0.00	HR
47	22559	0.00	0.00	0.00	0.00	0.00	0.00	HR

Pollution and Effects on Community Health

Sr. No.	Germplasms	Downy mildew incidence (%)					Mean Incidence (%)	Reaction
		30 DAS	45 DAS	60 DAS	75 DAS	90 DAS		
48	17479	6.16	6.16	7.77	7.77	7.77	7.13	R
49	15738	9.38	9.38	12.50	12.50	12.50	11.25	S
50	22726	2.27	2.27	2.27	2.27	2.27	2.27	HR
51	41215	0.00	0.00	0.00	0.00	0.00	0.00	HR
52	17928	0.00	0.00	0.00	0.00	0.00	0.00	HR
53	17703	0.00	0.00	0.00	0.00	0.00	0.00	HR
54	17933	0.00	0.00	0.00	0.00	0.00	0.00	HR
55	17633	0.00	0.00	0.00	0.00	0.00	0.00	HR
56	5984	3.84	3.84	7.68	7.68	7.68	6.14	R
57	6067	0.00	0.00	0.00	0.00	0.00	0.00	HR
58	17179	6.57	6.57	9.86	9.86	9.86	8.55	R
59	22827	5.11	6.78	8.56	8.56	8.56	7.52	R
60	16128	3.49	3.49	3.49	5.41	5.41	4.25	HR
61	15001	11.04	11.04	12.60	14.21	14.21	12.62	S
62	42063	5.36	7.14	10.71	10.71	10.71	8.93	R
63	16060	4.08	4.08	8.25	8.25	8.25	6.58	R
64	15325	9.33	9.33	11.33	13.00	13.00	11.20	S
65	17604	0.00	0.00	0.00	0.00	0.00	0.00	HR
66	6055	0.00	0.00	3.34	03.34	3.34	0.67	HR
67	15208	0.00	0.00	0.00	0.00	0.00	0.00	HR
68	6034	0.00	0.00	0.00	0.00	0.00	0.00	HR
69	16108	6.67	6.67	10.00	11.67	11.67	9.33	R
70	6000	0.00	0.00	0.00	0.00	0.00	0.00	HR
71	15277	0.00	0.00	0.00	0.00	0.00	0.00	HR
72	17328	3.56	3.56	10.69	10.69	10.69	7.84	R
73	17805	5.26	5.26	7.89	7.89	7.89	6.84	R
74	22847	0.00	0.00	0.00	0.00	0.00	0.00	HR
75	16194	0.00	0.00	0.00	0.00	0.00	0.00	HR
76	15388	0.00	0.00	0.00	0.00	0.00	0.00	HR
77	1105	0.00	0.00	0.00	0.00	0.00	0.00	HR
78	16659	6.90	6.90	12.14	12.14	12.14	10.05	S
79	15494	0.00	0.00	0.00	0.00	0.00	0.00	HR
80	16161	0.00	0.00	0.00	0.00	0.00	0.00	HR
81	17126	1.85	1.85	5.56	5.56	5.56	4.07	HR
82	41767	0.00	0.00	0.00	0.00	0.00	0.00	HR
83	1586	2.00	2.00	4.00	4.00	4.00	3.20	HR
84	15764	2.50	2.50	2.50	2.50	2.50	2.50	HR
85	16482	3.61	3.61	7.23	7.23	7.23	5.78	R
86	17406	4.22	4.22	7.67	10.17	10.17	7.29	R
87	40946	0.00	0.00	0.00	0.00	0.00	0.00	HR
88	17094	3.45	5.17	5.17	6.90	6.90	5.52	R
89	16088	7.89	7.89	7.89	7.89	7.89	7.89	R
90	15439	14.67	14.67	15.33	15.33	15.33	14.07	S
91	15220	0.00	0.00	0.00	0.00	0.00	0.00	HR
92	15611	6.67	6.67	8.33	10.00	10.00	8.33	R
93	15729	0.00	0.00	0.00	0.00	0.00	0.00	HR
94	15211	0.00	0.00	2.27	2.27	2.27	1.36	HR
95	16168	8.23	8.23	11.51	11.51	11.51	10.19	S
96	Susceptible check – 77.89 (7042S)							

Table - 2: Reaction of pearl millet germplasms against downy mildew disease based on disease incidence

Sr. No.	Disease reaction	Scales (Incidence)	Number of germplasms	Name of germplasms
1	Highly resistant	0-5 %	61	16976, 16110, 42246, 18037, 16625, 15691, 41530, 15041, 17130, 17659, 15708, 15695, 20229, 22923, 15787, 1421, 5972, 17840, 5969, 15067, 16010, 20437, 18580, 1225, 42182, 42479, 1202, 16101, 42852, 21334, 16317, 18023, 22559, 22726, 41215, 17928, 17703, 17933, 17633, 6067, 16128, 17604, 6055, 15208, 6034, 6000, 15277, 22847, 16194, 15388, 1105, 15494, 16161, 17126, 41767, 1586, 15764, 40946, 15220, 15729, 1521

2	Resistant	5-10 %	22	15078, 1220, 1206, 42299, 16745, 16322, 15743, 42078, 17479, 5984, 17179, 22827, 42063, 16060, 16108, 17328, 17805, 16482, 17406, 17094, 16088, 15611
3	Susceptible	10-25 %	12	15805, 1342, 22822, 15924, 18839, 17734, 15738, 15001, 15325, 16659, 15439, 16168
4	Highly susceptible	> 25 %	-Nil-	-Nil-

Table – 3: Severity of downy mildew disease in pearl millet germplasms

Sr. No.	Germplasms	Downy mildew disease severity					Mean severity (%)
		30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	
1	16976	3.03	3.03	3.41	3.41	3.41	3.26
2	16110	0.00	0.00	0.00	0.00	0.00	0.00
3	42246	0.00	0.00	0.00	0.00	0.00	0.00
4	18037	0.00	0.00	0.00	0.00	0.00	0.00
5	15805	9.68	10.48	12.10	12.50	12.90	11.53
6	15078	6.25	6.25	6.88	6.88	6.88	6.63
7	22923	1.67	1.67	2.50	2.92	2.92	2.33
8	1220	1.56	3.13	4.69	4.69	4.69	3.75
9	20229	0.00	0.00	0.76	0.76	0.76	0.45
10	15787	0.00	0.00	0.00	0.00	0.00	0.00
11	1421	0.00	0.00	0.00	0.00	0.00	0.00
12	5972	0.00	0.00	0.00	0.00	0.00	0.00
13	1342	7.26	7.26	8.06	8.47	8.87	7.98
14	17840	0.00	0.00	0.00	0.00	0.00	0.00
15	18580	0.00	0.00	0.00	0.00	0.00	0.00
16	1225	0.00	0.00	0.00	0.00	0.00	0.00
17	22822	5.47	6.25	7.42	7.42	7.81	6.88
18	42182	0.00	0.00	0.00	0.00	0.00	0.00
19	42479	0.00	0.00	0.00	0.00	0.00	0.00
20	1202	0.00	0.00	0.00	0.00	0.00	0.00
21	1206	6.00	6.00	7.50	7.50	7.50	6.90
22	5969	0.00	0.00	0.00	0.00	0.00	0.00
23	15067	0.00	0.00	0.00	0.00	0.00	0.00
24	16010	0.00	2.88	2.88	3.37	3.37	2.50
25	20437	0.00	0.00	0.00	0.00	0.00	0.00
26	15695	0.00	0.00	0.00	0.00	0.00	0.00
27	16625	2.42	2.42	3.23	3.23	3.23	2.90
28	42299	4.63	5.09	6.02	6.02	6.48	5.65
29	15691	0.00	0.00	0.00	0.00	0.00	0.00
30	41530	0.00	0.00	0.00	0.00	0.00	0.00
31	15041	0.00	0.00	0.00	0.00	0.00	0.00
32	16745	3.70	3.70	4.17	4.63	4.63	4.17
33	16322	7.81	7.81	8.98	8.98	8.98	8.52
34	17130	0.00	0.00	0.00	0.00	0.00	0.00
35	17659	0.00	0.00	0.00	0.00	0.00	0.00
36	15924	10.71	10.71	11.61	11.61	12.05	11.34
37	15743	3.13	3.13	4.69	4.69	4.69	4.06
38	18839	11.84	11.84	15.13	15.13	15.13	13.82
39	15708	1.43	1.43	2.86	2.86	2.86	2.29
40	16101	0.00	0.00	0.00	0.00	0.00	0.00
41	42852	0.00	0.00	0.00	0.00	0.00	0.00
42	17734	11.25	11.25	12.92	12.92	12.92	12.25
43	21334	0.00	0.00	0.00	0.00	0.00	0.00
44	16317	0.00	0.00	0.00	0.00	0.00	0.00
45	42078	4.30	5.08	5.08	5.47	5.47	5.08
46	18023	0.00	0.00	0.00	0.00	0.00	0.00
47	22559	0.00	0.00	0.00	0.00	0.00	0.00
48	17479	4.84	4.84	5.24	5.24	5.24	5.08
49	15738	5.00	5.00	5.42	5.42	5.42	5.25
50	22726	1.56	1.56	1.56	1.56	1.56	1.56
51	41215	0.00	0.00	0.00	0.00	0.00	0.00
52	17928	1.67	1.67	1.67	1.67	1.67	1.67
53	17703	0.00	0.00	0.00	0.00	0.00	0.00
54	17933	0.00	0.00	0.00	0.00	0.00	0.00

Pollution and Effects on Community Health

55	17633	0.00	0.00	0.00	0.00	0.00	0.00
56	5984	3.33	3.33	5.83	5.83	5.83	4.83
57	6067	0.00	0.00	0.00	0.00	0.00	0.00
58	17179	6.25	6.25	7.03	7.03	7.03	6.72
59	22827	6.90	6.90	6.90	6.90	6.90	6.90
60	16128	3.85	3.85	3.85	4.33	4.33	4.04
61	15001	10.16	10.16	11.33	12.50	12.50	11.33
62	42063	5.36	6.25	7.59	7.59	7.59	6.88
63	16060	4.17	4.17	4.17	4.17	4.17	4.17
64	15325	9.00	9.50	10.00	11.00	11.00	10.10
65	17604	0.00	0.00	0.00	0.00	0.00	0.00
66	6055	0.00	0.00	0.00	0.00	0.00	0.00
67	15208	0.00	0.00	0.00	0.00	0.00	0.00
68	6034	0.00	0.00	0.00	0.00	0.00	0.00
69	16108	6.67	6.67	8.33	8.75	8.75	7.83
70	6000	0.00	0.00	0.00	0.00	0.00	0.00
71	15277	0.00	0.00	0.00	0.00	0.00	0.00
72	17328	3.13	3.13	5.47	5.47	5.47	4.53
73	17805	2.94	2.94	3.31	3.31	3.31	3.16
74	22847	0.00	0.00	0.00	0.00	0.00	0.00
75	16194	0.00	0.00	0.00	0.00	0.00	0.00
76	15388	0.00	0.00	0.00	0.00	0.00	0.00
77	1105	0.00	0.00	0.00	0.00	0.00	0.00
78	16659	10.71	10.71	16.07	16.07	16.07	13.93
79	15494	0.00	0.00	0.00	0.00	0.00	0.00
80	16161	0.00	0.00	0.00	0.00	0.00	0.00
81	17126	1.85	1.85	2.78	2.78	3.24	2.50
82	41767	0.00	0.00	0.00	0.00	0.00	0.00
83	1586	2.27	2.27	2.84	2.84	2.84	2.61
84	15764	1.56	1.56	1.56	1.56	1.56	1.56
85	16482	3.23	3.23	5.24	5.24	5.24	4.44
86	17406	3.45	3.45	4.31	5.60	6.03	4.57
87	40946	0.00	0.00	0.00	0.00	0.00	0.00
88	17094	3.45	4.74	4.74	6.03	6.03	5.00
89	16088	5.00	5.00	5.00	5.00	5.00	5.00
90	15439	11.67	12.50	13.33	13.33	13.33	12.83
91	15220	0.00	0.00	0.00	0.00	0.00	0.00
92	15611	6.67	6.67	7.08	7.92	7.92	7.25
93	15729	0.00	0.00	0.00	0.00	0.00	0.00
94	15211	0.00	0.00	0.46	0.46	0.46	0.28
95	16168	7.50	7.50	8.75	8.75	8.75	8.25
96	Susceptible check – 67.32 (7042S)						

The pearl millet germplasms were evaluated in downy mildew sick field under infector rows systems to identify the downy mildew resistant lines. The susceptible downy mildew cultivar 7042S was utilized as infector row as well as indicator row to measure the progress and disease pressure in the screening trial. The observations were recorded at 30 days after sowing and then after 15 days interval up to harvesting. Among 95 germplasms, 61 germplasms found highly resistant (16976, 16110, 42246, 18037, 16625, 15691, 41530, 15041, 17130, 17659, 15708, 15695, 20229, 22923, 15787, 1421, 5972, 17840, 5969, 15067, 16010, 20437, 18580, 1225, 42182, 42479, 1202, 16101, 42852, 21334, 16317, 18023, 22559, 22726, 41215, 17928, 17703, 17933, 17633, 6067, 16128, 17604, 6055, 15208, 6034, 6000, 15277, 22847, 16194, 15388, 1105, 15494, 16161, 17126, 41767, 1586, 15764, 40946, 15220, 15729

and 1521), 22 germplasms found resistant (15078, 1220, 1206, 42299, 16745, 16322, 15743, 42078, 17479, 5984, 17179, 22827, 42063, 16060, 16108, 17328, 17805, 16482, 17406, 17094, 16088 and 15611), 12 germplasms found susceptible (15805, 1342, 22822, 15924, 18839, 17734, 15738, 15001, 15325, 16659, 15439 and 16168) and none of the germplasm was found highly susceptible (Table 1, 2 and 3).

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