

**INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS
(ICRISAT)**

CEREAL PATHOLOGY

REVIEW OF PEARL MILLET RUST RESISTANCE SCREENING

1974 - 1978

S.D. Singh & R.J. Williams



ICRISAT

1-11-256, Begpet, Hyderabad 500 016, A.P., India

INTRODUCTION

Pearl Millet rust, caused by *Puccinia penniseti*, has great destructive potential and is reported to occur in Africa and in Asia. There are several locations in India where rust is frequently severe, though the disease generally comes late in the season and thus is unlikely to cause significant yield reduction. However at some of these locations severe rust has been seen to develop at an early stage on many exotic introduction and on certain improved high yielding hybrids and varieties. If improved pearl millet cultivars are to be widely accepted in India they must possess an adequate level of rust resistance.

RESISTANCE SCREENING

Lines first selected in 1974

At ICRISAT the work on pearl millet rust has been restricted to identification of resistance sources under natural rust infection. During Kharif 1974 considerable rust occurred in the millet germplasm and 450 apparently low susceptible lines were selected. These lines were retested during Rabi 1974-75 when, under a heavy natural rust attack, 10 lines were rust free (p.5) and 183 lines developed less than 10 per cent rust (using Cobb's modified scale). These 193 lines were regrown at ICRISAT during Kharif 1975 and Rabi 1975-76 but due to poor rust development it was not possible to confirm the resistance. In Kharif 1976 all 193 lines were planted at Bhavanisagar in south India where rust

is known to be endemic. Severe rust developed in many entries and 12 remained rust free while 62 developed no more than 5 per cent rust (Table 1). Thus as a result of field screening at Hyderabad and Bhavanisagar 74 lines were selected which had developed little or no rust. In 1977 with the kind cooperation of scientists at six locations from Ludhiana in north India to Kovilpatti in the extreme south, the 74 low susceptible lines were tested for stability of resistance across environments and pathogen populations. The trial was called the Preliminary Pearl Millet Rust Nursery (PPMRN) and the detailed results are presented in Table 2. Eight entries developed no more than 10 per cent rust at any location of which four had no more than 5 per cent rust at any location. Distinct differential reactions occurred among locations with certain entries (see Report on the 1977 Preliminary Pearl Millet Rust Nursery).

Lines first selected in 1976

In December 1976 rust became severe in a large planting of new pearl millet germplasm at the ICRISAT farm, from which we identified 113 rust free plants. These were selfed and the resulting progeny (head-to-row) were tested at Bhavanisagar in the Kharif 1977 and at Hyderabad during Rabi 1977-78. One entry, IP 537-B was rust free at both locations; six entries had a maximum rust score of 5 per cent and 24 entries had a maximum rust score of 10 per cent (Table 3). The range of rust scores in the test entries was from 0 to 65 per cent at Bhavanisagar and from 0 to 100 per cent at Hyderabad. The mean rust incidence in the

susceptible checks was 92 per cent at Hyderabad and 54 per cent at Bhavanisagar.

The 1978 IPMRN

During 1978 we initiated the International Pearl Millet Rust Nursery (IPMRN) which consisted of the best 45 lines from both groups of materials referred to above. The 1978 IPMRN has been sent to cooperators at eight locations in India, and the results of this trial will be published in early 1979.

DISCUSSION

Considering the large number of germplasm lines screened we have identified a relatively small number of lines which appear to be consistently low rust susceptible in India. Although a large proportion of the least susceptible lines originate in West Africa a surprising number of African millets are highly rust susceptible at Hyderabad. In our travels in West Africa it has been difficult to find rust in land-race millets. It seems probable therefore that the Hyderabad rust pathotypes have not been encountered before by the majority of the African millets in our germplasm collection. Before we can make firm conclusions on this point we need to examine further the relationship between origin and rust susceptibility at various locations.

The marked differential reaction of some of the PPMRN entries probably indicates the occurrence of distinct pathotypes within *P. perniciosa*,

though the possibility of more than one rust pathogen also needs investigation.

FUTURE ACTIVITIES

We need a reliable field screening technique which will allow effective screening whenever we need it at Hyderabad. We will attempt to develop such a screening technique.

The basis of the differential reactions among Indian locations will be investigated.

Now germplasm will be screened at Hyderabad and Bhavanisagar and low rust susceptible lines will be tested further in the IPMRN program.

**Pearl Millet lines free from rust during Rabi 1974-75 at
Hyderabad**

Sc-1 (S) 4-1-1

SC-1 (S) 4-4-4

SC-1 (S) 4-4-5

SC-1 (S) 4-4-6

SC-1 (S) 4-4-14

13 (m) 25-1

Ser. 17-10-6

700481-3-4

700481-34-6

500526-3-8

**Table 1. Rust incidence in 193 Pearl Millet lines at
Bhavaniagar during Kharif 1976**

No.	Pedigree	Grade (Cobb's scale)
1.	SC-1 (S) 4-4-5	0.0
2.	700481-7-5	0.0
3.	700481-18-9	0.0
4.	700481-23-1	0.0
5.	700481-23-2	0.0
6.	700481-23-14	0.0
7.	700481-27-2	0.0
8.	700481-27-5	0.0
9.	700481-34-5	0.0
10.	700481-34-8	0.0
11.	700481-35-5	0.0
12.	700557-10-1	0.0
13.	SC-1 (S) 4-2-9	5
14.	SC-1 (S) 4-4-4	5
15.	SC-1 (S) 4-4-6	5
16.	14 CM 21-2	5
17.	Ser 2 (A) 1-5	5
18.	Ser 2 (A) 2-6	5
19.	Ser 3 (A) 1-1	5
20.	Ser 30-1-2	5
21.	700481-1-5	5

No.	Pedigree	Grade (Cobb's scale)
22.	700481-2-1	5
23.	700481-7-4	5
24.	700481-7-7	5
25.	700481-10-2	5
26.	700481-10-5	5
27.	700481-18-3	5
28.	700481-18-10	5
29.	700481-19-2	5
30.	700481-19-3	5
31.	700481-21-3	5
32.	700481-21-4	5
33.	700481-21-6	5
34.	700481-21-8	5
35.	700481-21-9	5
36.	700481-22-7	5
37.	700481-22-8	5
38.	700481-27-6	5
39.	700481-27-9	5
40.	700481-30-1	5
41.	700481-30-2	5
42.	700481-30-3	5
43.	700481-30-4	5
44.	700481-30-5	5
45.	700481-32-1	5
46.	700481-32-1	5

No.	Pedigree	Grade (Cobb's scale)
47.	700481-33-4	5
48.	700481-33-5	5
49.	700481-35-4	5
50.	700481-35-4	5
51.	700481-35-6	5
52.	700481-35-7	5
53.	700526-3-8	5
54.	700526-6-1	5
55.	700557-2-8	5
56.	700557-2-9	5
57.	700557-6-5	5
58.	700557-10-2	5
59.	700557-10-3	5
60.	700557-10-5	5
61.	700623-4-1	5
62.	700623-4-3	5
63.	700623-4-4	5
64.	700623-4-5	5
65.	J 240	5
66.	J 781-5B	5
67.	B 537	5
68.	B 731	5
69.	B 730	5
70	B 1 0	5

: 9 :

No.	Pedigree	Grade (Cobb's scale)
71.	IP 2699	5
72.	Kano-1	5
73.	Kano-3	5
74.	Kano-10	5
75.	SC-1 (S) 4-4-7	10
76.	13 (M) 25-1	10
77.	13 (M) 25-5	10
78.	14 (M) 25-4	10
79.	Ser. 17-4-1	10
80.	Ser. 17-10-6	
81.	700481-16-2	10
82.	700481-18-5	10
83.	700481-18-6	10
84.	700481-18-7	
85.	700481-19-6	10
86.	700481-21-5	10
87.	700481-22-1	10
88.	700481-22-3	10
89.	700481-22-4	10
90.	700481-22-5	10
91.	700481-22-6	10
92.	700481-23-6	10
93.	700481-23-8	10
94.	700481-23-9	10
95.	700481-23-10	10

No.	Pedigree	Grade (Cobb'
96.	700481-23-11	0
97.	700481-23-12	10
98.	700481-23-13	10
99.	700481-23-16	10
100.	700481-27-1	10
101.	700481-33-8	10
102.	700481-34-2	10
103.	700481-34-4	10
104.	700481-35-1	10
105.	700481-35-2	10
106.	700481-35-3	10
107.	700557-10-4	10
108.	700557-11-1	10
109.	700623-3-2	10
110.	700623-4-6	10
111.	700623-4-7	10
112.	700623-6-5	10
113.	J 81-1	10
114.	J 235	10
115.	J 405	10
116.	J 781-SB	10
117.	B 537	10
118.	8C-1 (S) 4-1-1	25
119.	8C-1 (S) 4-1-2	25
120.	8C-1 (S) 4-4-14	25

No.	Pedigree	Grade (Cobb's scale)
121.	8C-1 (8) 4-12-5	25
122.	13 (M) 15-2	25
123.	Ser. 2 (A) 3-1	25
124.	Ser. 2 (A) 4-1	25
125.	700481-1-2	25
126.	700481-1-4	25
127.	700481-1-7	25
128.	700481-7-6	25
129.	700481-7-8	25
130.	700481-10-3	25
131.	700481-15-4	25
132.	700481-15-8	25
133.	700481-16-3	25
134.	700481-18-3	25
135.	700481-19-4	25
136.	700481-19-5	25
137.	700481-20-2	25
138.	700481-21-1	25
139.	700481-21-7	25
140.	700481-22-9	25
141.	700481-23-3	25
142.	700481-23-4	25
143.	700481-23-15	25
144.	700481-24-1	25
145.	700481-24-2	25
146.	700481-34-1	25

No.	Pedigree	Grade (Cobb's scal
147.	700481-34-7	25
148.	700557-12-1	25
149.	700557-12-3	25
150.	700623-3-1	25
151.	700623-3-4	25
152.	700623-4-10	25
153.	700623-6-4	25
154.	700638-3-2	25
155.	700638-4-5	25
156.	700638-4-7	25
157.	700646-2-2	25
158.	J 70-1 (N. Br.)	25
159.	J 558	25
160.	J 742-1	25
161.	J 779-1	25
162.	J 637-1	25
163.	J 645-1	25
164.	B 281	25
165.	B 333	25
166.	B 389	25
167.	B 406	25
168.	B 604	25
169.	B 724	25
170.	B 900	25
171.	B 925	25
172.	IP 2704	25

No.	<u>Pedigree</u>	Grade (Cobb's scale)
173.	IP 2708	25
174.	Ser. 39-1-6	40
175.	Ser. 39-2-2	40
176.	700481-8-2	40
177.	700481-15-1	40
178.	700481-16-1	40
179.	700481-19-1	40
180.	700481-20-3	40
181.	700481-23-5	40
182.	700588-2-3	40
183.	700623-3-3	40
184.	700638-4-4	40
185.	J 759	40
186.	J 373-1	40
187.	J 1139	40
188.	J 2111	40
189.	B 332	40
190.	B 338	40
191.	700481-3-6	60
192.	700481-23-7	60
193.	J 648-1	60
	HB-3 (Susceptible check)	40-100

Table 9. Maximum Rust incidence (%) in 74 PP:RN Pearl Millet entries at six locations in India during 1977

Entry	Locations						\bar{x} Max- imum	Abso- lute Maxi- mum
	Ludhi- ana	My- sore	Punc	Kovil- patti	Bhavani- sagar	Hyder- abad		
700481-7-5	0	0	5	0	0	0	0.8	5
700431-34-8	0	5	0	0	0	0	0.8	5
700401-27-2	5	0	0	0	0	5	1.7	5
700557-10-1	0	5	5	0	5	0	2.5	5
700481-23-14	10	0	0	0	0	5	2.5	10
700481-34-5	0	0	10	0	0	5	2.5	10
SC-1(5)4-4-5	10	0	10	10	0	0	5.0	10
700431-27-5	10	0	5	5	5	5	5.0	10
700481-18-9	25	0	5	0	5	0	5.8	25
700481-33-1	0	0	25	0	5	5	5.8	25
700401-10-5	0	0	25	0	5	5	5.8	25
700481-21-8	10	0	25	0	0	5	6.7	25
700481-35-5	10	0	25	0	0	5	6.7	25
700557-2-8	0	0	25	0	10	5	6.7	25
700481-23-2	25	-	5	0	0	5	7.0	25
700481-23-1	25	5	5	0	5	5	7.5	25
700481-22-8	10	0	25	0	5	5	7.5	25
700481-33-4	5	0	25	5	5	5	7.5	25
700481-30-5	-	0	25	0	10	5	8.0	25
700481-18-3	25	0	25	0	0	5	9.2	25
700481-21-4	25	0	25	0	5	5	10.0	25

Contd..

Table 2 Continued

Entry	Locations						X Max- imum	Absc lute Maxi mum
	Ludhi- ana	Hy- sore	Punc	Kovil- patti	Chavani- sagar	Hyder- abad		
700481-21-6	25	0	25	0	5	5	10.0	25
700481-35-7	25	0	25	0	5	5	10.0	25
700481-18-10	25	0	25	0	5	10	10.8	25
700481-32-1	10	10	25	10	5	10	11.7	25
700481-35-6	25	5	25	0	5	10	11.7	25
700481-30-3	25	5	25	10	25	5	15.8	25
700481-7-7	-	0	40	0	0	5	9.0	40
700481-10-2	10	0	40	10	0	5	10.8	40
700481-1-5	25	0	40	5	5	5	13.3	40
700481-21-3	5	5	40	5	5	25	14.2	40
700481-22-7	25	0	40	5	5	10	14.2	40
700481-27-6	40	0	25	10	5	5	14.2	40
J 781-S8	40	10	25	5	5	5	15.0	40
700481-7-4	40	0	40	10	10	5	17.5	40
700557-2-9	25	5	40	0	10	25	17.5	40
Ser. 39-1-2	40	10	40	10	10	5	19.2	40
700481-33-5	25	0	25	5	40	25	20.0	40
700481-34-6	40	5	25	0	40	10	20.0	40
700557-6-5	40	5	25	5	25	25	20.8	40
700557-10-2	40	0	25	10	25	25	20.8	40
KANO-3	25	5	25	40	25	25	24.2	40
KANO-1	40	5	25	40	25	25	26.6	40

Contd

Table 2 Continued

Entry	Locations						X Max- imum	Abso- lute Maxi- mum
	Lychi- ana	Hy- sore	Pune	Kovil- patti	Bhavani- sagar	Hydor- abad		
700481-19-2	55	0	25	0	0	5	15.8	65
700481-27-9	65	0	25	5	0	5	16.7	65
700557-10-5	65	0	25	5	0	5	16.7	65
700623-4-5	65	0	25	0	5	5	16.7	65
700481-30-1	65	0	25	5	5	5	17.5	65
700481-19-3	65	5	25	0	5	5	17.5	65
700431-21-9	65	-	25	0	5	5	20.0	65
700557-10-3	65	0	25	25	5	5	20.5	65
700481-2-1	65	0	40	5	10	5	20.8	65
700623-4-4	65	-	25	5	5	5	21.0	65
700481-30-4	65	5	25	5	10	25	22.5	65
SC-1(S) 4-4-4	65	5	25	25	10	10	23.3	65
700481-30-2	65	5	25	10	10	25	23.3	65
SC-1(S) 4-2-9	65	5	25	40	5	5	24.2	65
B 537	65	10	40	25	10	10	26.7	65
KANO-10	65	5	25	25	25	25	28.3	65
700526-3-8	65	10	25	25	25	25	29.2	65
Ser.2 (A) 2-6	65	5	40	10	40	25	30.8	65
Ser.3 (A) 1-1	65	0	40	25	40	25	32.5	65
B-731	65	10	40	40	40	10	34.2	65
B 899	65	10	40	40	40	10	34.2	65

Contd .

Table 2 Continued

Entry	Locations						X Max- imum	Abso- lute Maxi- mum
	Ludhi- ana	Hy- sore	Pune	Kovil- patti	Dhavani- sagar	Hydera- bad		
IP 2699	65	10	25	40	40	25	34.2	65
700526-6-1	65	5	25	40	40	40	35.0	65
SC-1(5) 4-4-6	55	10	25	40	40	40	36.7	65
14 C: 21-2	65	10	40	40	40	25	36.7	65
700481-35-4	65	0	40	25	65	25	36.7	65
B-739	65	10	40	65	40	10	38.3	65
700623-4-3	100	0	25	5	5	10	24.2	100
700623-4-1	100	0	25	10	10	5	25.0	100
J 240	100	10	25	5	25	25	31.7	100
Ser.2 (A)	100	5	40	25	10	10	31.7	100
Location mean	40.9	3.1	25.6	11.0	13.0	11.0		
Local check mean	75.6	10.0	39.3	45.6	37.0	100.0	51.3	100

Table 3. Rust incidence in 113 pearl millet lines at Chavanisagar during Kharif 1977 and at Hyderabad during Rabi 1977-78

Entries	Hyderabad		Chavanisagar		Mean	Overall maximum
	R-1	R-2	R-1	R-2		
IP 537-B	0	0	0	0	0	0
IP 2041-Lu	0	5	0	0	1.3	5
IP 70-L	0	5	0	0	1.3	5
IP 1662-L	0	0	5	5	2.5	5
IP 360 B	5	5	5	5	5.0	5
IP 2106 Lu	5	5	5	5	5.0	5
IP 2185-L	5	5	5	5	5.0	5
IP 2105-Lu	0	10	0	0	2.5	10
IP 152C	10	0	5	5	5.0	10
IP 319-L	5	10	5	0	5.0	10
IP 1971-L	10	10	0	5	6.3	10
IP 1623-L	10	10	0	5	6.3	10
IP 1461-L	5	10	5	5	6.3	10
IP 2117-L	5	5	5	10	6.3	10
IP 2073-L	10	10	5	5	7.5	10
IP 2021-L	10	10	5	5	7.5	10
IP 2758-L	5	10	10	5	7.5	10
IP 572-Lu	10	5	10	5	7.5	10
IP 1974-L	5	10	5	10	7.5	10

Continued

Table 3 Continued

Entries	Hyderabad		Dhavanisagar			Overall maximum
	R-1	R-2	R-1	R-2	can	
IP 1975-L	5	10	10	5	7.5	10
IP 69-Lu	5	10	10	5	7.5	10
IP 1743-L	10	10	10	5	8.0	10
IP 1834-L	10	10	10	5	8.0	10
IP 1905-L	10	10	10	5	8.8	10
IP 565-L	10	10	10	10	10.0	10
IP 1528-L	0	5	25	5	8.0	25
IP 1894-Lu	5	5	25	5	10.0	25
IP 1997-L	0	25	10	10	11.3	25
IP 1972-L	5	5	10	25	11.3	25
IP 1189-L	10	5	25	5	11.3	25
IP 67-Lu	25	10	10	0	11.3	25
IP 1039-L-11	5	5	10	25	11.3	25
IP 829-L	5	25	10	5	11.3	25
IP 727-E	5	10	25	5	11.3	25
IP 900 E	5	5	10	25	11.3	25
IP 2761-L	10	25	10	5	12.5	25
IP 1429-L	10	10	5	25	12.5	25
IP 387-Lu	10	10	25	5	12.5	25
IP 1323-L	10	25	10	5	12.5	25
IP 2006-L	5	10	10	25	12.5	25

Continued

Table 3 Continued:

Entries	Hyderabad		Chavanisagar		Mean	Overall maximum
	R-1	R-2	R-1	R-2		
IP 1929-L	10	5	10	25	12.5	25
IP 1422-Lu	25	10	10	10	13.8	25
IP 21-L	10	10	2	10	13.8	25
IP 2665-L	10	10	10	25	13.8	25
IP 2677-L	5	10	25	25	16.3	25
IP 2116-L	5	10	25	25	16.3	25
IP 1181-L	25	25	10	5	16.3	25
IP 1006-L	25	25	5	10	16.3	25
IP 2040-L	5	10	25	25	16.3	25
IP 2041-L	5	25	10	25	16.3	25
IP 2124-L	5	10	25	25	16.3	25
IP 1752-L	25	25	0	-	16.7	25
IP 1953-1	10	10	25	25	17.5	25
IP 2008-L	10	25	10	25	17.5	25
IP 1131-L	10	25	25	10	17.5	25
IP 12-L	10	10	25	25	17.5	25
IP 1497-L	10	10	25	25	17.5	25
IP 2273-L	10	10	25	25	17.5	25
IP 1513-L	25	10	25	25	21.3	25
L-93	25	25	10	25	21.3	25
IP 2013-L	5	5	40	5	13.8	40

Continued

Table 3 Continue.

Entries	Hyderabad		Shavanisagar		Mean	Overall maximum
	R-1	R-2	R-1	R-2		
IP 2023-L	5	5	40	5	13.8	40
IP 57-L	5	5	16	40	15	40
IP 1955-L	5	5	40	10	15	40
IP 1959-L	5	10	10	40	16.3	40
IP 1920-L	10	10	40	10	17.5	40
IP 1129-L	10	10	10	40	17.5	40
IP 2756-L	10	10	40	10	17.5	40
IP 2023 Lu	5	5	40	25	18.8	40
IP 418-Lu	5	5	40	25	18.8	40
IP 685-B	5	25	40	10	20.0	40
IP 2345-L	5	40	25	10	20.0	40
IP 2092-L	5	10	40	25	20.0	40
IP 33-L	10	10	40	25	21.3	40
IP 934-B	25	40	10	25	21.3	40
IP 2002-L	0	5	40	40	21.3	40
IP 89-1-11	5	5	40	40	22.5	40
IP 2009-L	10	5	40	40	23.8	40
IP 1982-L	10	25	40	25	25.0	40
IP 328-B	10	40	25	25	25.0	40
IP 240-L	10	25	40	25	25.0	40
IP 1580-L	10	10	40	40	25.0	40

Continued

Table 3 Continued

Entries	Hyderabad		Bhavanisagar		Mean	Overall maximum
			R-1	R-2		
IP 393-L	10	25	40	25	25.0	40
IP 27-L	10	25	40	25	25.0	40
IP 342-Lu	10	10	40	40	25	40
IP 559-E	25	25	25	40	28.8	40
IP 929-L	25	25	25	40	28.8	40
IP 1811-L	40	40	10	25	28.8	40
IP 1327-L	25	10	40	40	28.8	40
IP 1931-Lu	40	25	25	40	32.5	40
IP 314-B	25	40	25	40	32.5	40
IP 1820-L	40	40	40	25	36.3	40
IP 2105-L	5	10	65	25	26.3	65
IP 1610-L	10	65	25	10	27.5	65
IP 1611-L	10	10	25	65	27.5	65
IP 1608-L	65	25	40	10	35.0	65
IP 77-L	10	25	65	40	35.0	65
IP 1992-L	40	25	65	25	38.8	65
IP 855-E	25	25	65	40	38.8	65
IP 1277-L	65	25	40	25	38.8	65
IP 1909-L	25	65	25	5	40	65
IP 2071-L	25	65	65	25	40	65

Continued

Table 3 Continued

Entries	Hyderabad		Dhavanisagar		Mean	Overall maximum
	R-1	R-2	R-1	R-2		
IP 1933-L	40	25	40	65	42.5	65
IF 411-Lu	65	5	65	65	50.0	65
IP 924-L	65	25	65	40	48.8	65
IP 899-B	65	65	40	40	52.3	65
IP 1935-L	40	65	40	65	52.5	65
IP 1311-L	65	65	65	25	55.0	65
IP 1363-L	25	100	40	40	31.3	100
104-5051-2	65	100	10	40	53.8	100
IP 666 B	25	100	40	65	57.5	100
IP 2295-L	65	100	40	40	61.3	100
IP 386-L	65	100	65	65	73.8	100
Check (Susceptible)	65-100	65-100	40-65	25-65	71.9	100