Crop Improv. 29 (1): 47-52 (2002)

CLASSIFICATION OF SORGHUM GENOTYPES FOR LEAF BLIGHT RESISTANCE

K. KANAKA DURGA[1], M. S. S. REDDY[2] AND BELUM V. S. REDDY[3]
ICRISAT Asia Center, Patancheru, 502 324, Andhra Pradesh

ABSTRACT

Sorghum hybrids of 20 cytoplasmic-male steriles and six restorers and the parents were evaluated in 1996 and 1997 for leaf blight disease resistance parameters. On the basis of disease damage score the cluster analysis identified four major clusters corresponding to the disease reaction exhibited by the parents and the hybrids. Of the four clusters, Cluster I is considered to be the most important cluster as the progeny was found to be resistant irrespective of the disease reaction of the parents involved. The hybrids viz., MS 11 x R 3 and MS 9.x R 3 involving resistant and moderately resistant parents exhibited hypersensitive reaction.

Index Words : *Exserohilum turcicum,* leaf blight, sorghum.

Exserohilum turcicum (Pass.) Leonard and Suggs (1974) is extensively distributed (Tarumoto *et al.,* 1997), and at times most damaging foliar pathogen of sorghum (Fredericksen, 1980). The safest and the most economical way of combating diseases was through the development of the resistant varieties. Although variation was measured in genotypes for various disease-related characters, overall disease damage score was used as a criterion in cluster analysis to identify the groups of related cultivars. The objective of our analysis was to categorize the genotypes into different groups on the basis of overall disease damage score.

MATERIAL AND METHODS

Materials and field evaluation

In the present study, 20 CMS (cytoplasmic male-sterile i.e., A) lines were crossed with six restorer (testers i.e., R) lines in a line x tester fashion during the rainy seasons of 1996 and 1997. The resultant 120 cross combinations (A x R hybrids),

---

[1]Scientist (Breeding), RARS, Lam, Guntur - 522 034

[2]Ex Director of Extension, ANGRAU, Rajendranagar, Hyderabad 500 030

[3]Principal Scientist (Sorghum Breeding), GREP, ICRISAT, Patancheru, Hyderabad - 402 324

along with their respective parents and checks, were sown in a randomized complete block design replicated three times during the post rainy seasons of 1996 and 1997, to evaluate for leaf blight disease related parameters and yield contributing characters under artificial disease epiphytotic conditions at ICRISAT Asia Center, Patancheru, Hyderabad, Andhra Pradesh, India. Plot size in both the seasons consisted of 2 rows each of 4m length with 75 cm between rows and 12 cm spacing within the row. Spraying with fungicides was avoided immediately after the inoculation to prevent its adverse effect on the spread of the inoculum. Plant protection measures were applied as required at the initial stages of the crop from the incidence of shoot fly. Genotypes highly susceptible to leaf blight such as *Kundi Jowar* and H 112 were planted in two rows as infestor, all round the field and after every 10 rows and 12 rows of the test material.

Inoculum preparation

The leaves affected with leaf blight (*Exserohilum turcicum* (Pass.)) were collected from the field and cut into small pieces and surface sterilized with 0.1% mercuric chloride for one minute followed by washing with sterile distilled water. Leaf pieces were aseptically transferred to sterilized petri plates containing 20 ml of sterilized Potato Dextrose Agar media (PDA) and incubated at 20°C for encouraging the fungal growth. The fungal growth was aseptically transferred to flasks containing sterilized sorghum grains and incubated at 20°C for 15 days. Sorghum grains covered with mycelia and the conidia of the fungus were removed from the flasks, allowed to air dry and separated as far as possible.

Inoculation

Sorghum plants were artificially inoculated following the shorl-drop method of inoculation (Frederiksen & Franklin, 1978). The inoculation was carried out 21 and 30 days after emergence of the coleoptile during the post rainy seasons of 1996 and 1997, respectively. The second inoculation was given one week after the first inoculation. All the plants in each entry were inoculated by placing two or three grains of seed inoculum in the whorl. High humidity conditions were created by providing overhead sprinklers on the day after inoculation until the disease has spread. It took 40 days for the disease to spread.

Observations

The observations were taken on disease damage score (DDR) (scored on a 1-9 scale on plot basis where 1 = highly resistant and 9 = highly susceptible), length of the lesion (cm), width of the lesion (cm), area of the lesion (cm^2), number of lesions, number of flecks, days to 50% flowering, plant height (cm), agronomic

desirability (scored on a 1-5 scale on plot basis where 1 = excellent and 5 = poor), grain yield plant^{-1} (g) and testweight (g 100 grain^{-1}). The genotypes were grouped into six disease reaction groups viz., highly resistant (HR) resistant (R), moderately resistant (MR), less susceptible (LS), susceptible (S), and highly susceptible (HS) reaction groups taking overall disease damage score as the basis for presentation of the data. Cluster analysis is carried out using Hierarchical, Euclidean, Average Link Method following SAS. One hundred and forty six genotypes included in the study are grouped into different clusters following the abovde method.

RESULTS AND DISCUSSION

The present investigation have revealed, on the basis of the total leaf area damage, that all the genotypes could be clustered in to four groups (Table 1). Cluster I consists of 24 genotypes with a disease score ranging from 2.7 to 3.3. Parents with resistant reaction and the crosses involving R x R, R x MR, R x LS, MR x MR, LS x MR, and S x MR parents fall in the category of cluster I. It is evident that all the crosses involving either resistant female parent or moderately resistant male parent with disease score ranging from 2.7 to 3.3 fall in cluster I indicating that resistance has exhibited no dominance in R x R, dominance in R x MR, R x LS and overdominance in MR x MR, LS x MR and S x MR combinations.

Thirty-six genotypes with overall disease damage score ranging from 3.7 to 4.7 fall in cluster II. The moderately resistant parents and the crosses involving R x R, R x LS, R x S, MR x R, MR x MR, MR x LS, MR x S, LS x R, LS x MR, LS x LS, S x R parents fall in second category. Though the hybrids involving resistant parents and the crosses involving R x LS, MR x MR, LS x MR were also reported in cluster I, the disease reaction of these hybrids is found to be moderately resistant while the disease reaction of the hybrids falling in cluster I is resistant. In this group, moderate resistance is found to be partially dominant in R x R, R x LS, R x S, LS x R and S x R combinations, dominant in MR x MR combination and overdominant in LS x MR combinations. The exception to this clustering pattern is resistant hybrids involving susceptible and less susceptible female parents and resistant male parents (S x R and LS x R) because one parent in these two hybrids is from cluster I.

Cluster III consists of 21 genotypes with overall disease damage score ranging from 6.7 to 8.0. The susceptible parents and the hybrids involving R x LS, MR x LS, MR x S, LS x LS, LS x S, S x LS, S x S parents occurred in this category. Though an overlapping of the hybrids viz., R x LS, MR x LS, MR x S, and LS x LS with the hybrids falling in category II is noticed, the progeny exhibited susceptible reaction in this cluster unlike moderately resistant reaction in cluster II. The disease reaction i.e., susceptibility is found to be resistant in MR x S, LS x S and S x LS,

Table 1. Cluster, genotype, disease damage score and the disease reaction of different genotypes of sorghum for leaf blight (Exserohilum turcicum).

S. No.	Cluster	Genotype	Disease Damage Score	Disease Reaction Hybrid	Disease Reaction Parents	S. No.	Cluster	Genotype	Disease Damage	Disease Reaction Hybrid	Disease Reaction Parents
1	I	MS 11	2.7	R	R	27	II	MS 12 x R 3	4.7	MR	LS x MR
2		MS 7 x R 3	2.7	R	R x MR	38		MS 6 x R 4	4.7	MR	MR x LS
3		MS 9 x R 5	2.7	R	R x LS	39		MS 19 x R 4	4.7	MR	MR x LS
4		MS 16 x R 3	2.7	R	MR x MR	40		MS 3 x R 5	4.7	MR	MR x LS
5		MS 11 x R 3	2.3	HR	R x MR	41		MS 6 x R5	4.7	MR	MR x LS
6		MS 9 x R 3	2.3	HR	R x MR	42		MS 16 x R 5	4.7	MR	MR x LS
7		MS 4	3.3	R	R	43		MS 24 x R 5	4.7	MR	LS x LS
8		MS 7	3.3	R	R	44		MS 16 x R 6	4.7	MR	MR x S
9		MS 9	3.3	R	R	45		MS 16	4.3	MR	MR
10		MS 15	3.3	R	R	46		MS 11 x R 4	4.3	MR	R x LS
11		MS 7 x R 1	3.3	R	R x R	47		MS 11 x R 2	4.3	MR	R x S
12		MS 10 x R 1	3.3	R	R x R	48		MS 7 x R 4	4.3	MR	R x LS
13		MS 4 x R 3	3.3	R	R x MR	49		MS 14 x R 1	4.3	MR	LS x R
14		MS 1 x R 5	3.3	R	R x LS	50		MS 16 x R 11	4.3	MR	MR x R
15		MS 1 x Rv3	3.3	R	S x MR	51		MS 6 x R 3	4.3	MR	MR x MR
16		MS 13 x R 3	3.3	R	S x MR	52		MS 17 x R 4	4.3	MR	LS x LS
17		MS x 17 x R 3	3.3	R	LS x MR	53		MS 22 x R 4	4.3	MR	MR x LS
18		MS 22 x R 3	3.3	R	MR x MR	54		MS 22 x R 2	4.3	MR	MR x LS
19		MS 10 x R 1	3.0	R	R	55		MS 4 x R 1	4.0	MR	R x R
20		R 1	3.0	R	R	56		MS 9 x R 1	4.0	MR	R x R
21		MS 11 x R 1	3.0	R	R x R	57		MS 24 x R 3	4.0	MR	LS x MR
22		MS 10 x R 3	3.0	R	R x MR	58		MS 16 x R 4	4.0	MR	MR x LS
23		MS 19 x R 3	3.0	R	MR x MR	59		MS 1 x R 1	3.7	R	S x R
24		MS 21 x R 3	3.0	R	MR x MR	60		MS 17 x R 1	3.7	R	LS x R
						61	III	MS 1	6.7	S	S
25	II	MS 6	4.7	MR	MR	62		MS 10 x R 4	6.7	S	R x LS
26		MS 21	4.7	MR	MR	63		MS 25 x R 2	6.7	S	LS x S
27		R 3	4.7	MR	MR	64		MS 14 x R 5	6.7	S	LS x LS
28		MS 11 x R 5	4.7	MR	R x LS	65		MS 13 x R 6	6.7	S	S x S
29		MS 15 x R 1	4.7	MR	R x R	66		MS 22 x R 6	6.7	S	MR x S
30		MS 9 x R 4	4.7	MR	R x LS	67		MS 13	7.3	S	S
31		MS 4 x R 2	4.7	MR	R x S	68		R 2	7.3	S	S
32		MS 7 x R 6	4.7	MR	R x S	69		MS 296 x R 6	7.3	S	S x S
33		MS 12 x R 1	4.7	MR	LS x R	70		MS 1 x R 4	7.0	S	S x LS
34		MS 19 x R 1	4.7	MR	MR x R	71		MS 3 x R 4	7.0	S	MR x LS
35		MS 25 x R 1	4.7	MR	MR x MR	72	III	MS 14 x R 2	7.0	S	LS x S
36		MS 3 x R 3	4.7	MR	MR x MR	73		MS 25 x R 5	7.0	S	LS x LS

S. No.	Cluster	Genotype	Disease Damage Score	Disease Reaction Hybrid	Disease Reaction Parents
74	III	MS 12 x R 6	7.0	S	LS x S
75		MS 21 x R 6	7.0	S	MR x S
76		MS 24 x R 6	7.0	S	LS x S
77		MS 296 x R 5	7.0	S	S x LS
78		MS 296	7.7	S	S
79		MS 12 x R 2	7.7	HS	LS x S
80		MS 25 x R 6	7.7	HS	LS x S
81		R 6	8.0	S	S
82		MS 3	5.0	MR	MR
83		MS 19	5.0	MR	MR
84		MS 22	5.0	MR	MR
85		MS 4 x R 4	5.0	MR	R x LS
86		MS 7 x R 2	5.0	MR	R x S
87		MS 110 x R 5	5.0	MR	R x LS
88		MS 15 x R 5	5.0	MR	R x LS
89		MS 10 x R 6	5.0	MR	R x S
90		MS 15 x R 6	5.0	MR	R x S
91		MS 3 x R 1	5.0	MR	MR x R
92		MS 22 x R 1	5.0	MR	MR x R
93		MS 14 x R 3	5.0	MR	LS x MR
94		MS 16 x R 2	5.0	MR	MR x S
95		MS 1 x R 5	5.0	MR	S x LS
96		MS 1 x R 6	5.0	MR	S x S
97		MS 19 x R 6	5.0	MR	MR x S
98		MS 11 x R 6	5.3	LS	R x S
99		MS 9 x R 2	5.3	LS	R x S
100		MS 15 x R 2	5.3	LS	R x S
101		MS 6 x R 1	5.3	LS	MR x R
102		MS 13 x R 1	5.3	LS	S x R
103		MS 24 x R 1	5.3	LS	LS x R
104		MS 24 x R 4	5.3	LS	LS x LS
105		MS 13 x R 2	5.3	LS	S x S
106		MS 17 x R 2	5.3	LS	LS x S
107		MS 19 x R 5	5.3	LS	MR x LS
108		MS 22 x R 5	5.3	LS	MR x LS
109		MS 12	5.7	LS	LS
110	IV	MS 15 x R 3	5.7	LS	R x MR
111		MS 10 x R 2	5.7	LS	R x S
112		MS 9 x R 66	5.7	LS	R x S
113		MS 21 x R 1	5.7	LS	MR x R
114		MS 12 x R 4	5.7	LS	LS x LS
115		MS 3 x R 2	5.7	LS	MR x S
116		MS 19 x R 2	5.7	LS	MR x S
117		MS 12 x R 5	5.7	LS	LS x LS
118		MS 13 x R 5	5.7	LS	S x LS
119		MS 17 x R 5	5.7	LS	LS x LS
120		MS 3 x R 6	5.7	LS	MR x S
121		MS 14	6.3	LS	LS
122		R 4	6.3	LS	LS
123		MS 15 x R 4	6.3	LS	R x LS
124		MS 4 x R 6	6.3	LS	R x S
125		MS 25 x R 3	6.3	LS	LS x MR
126		MS 13 x R 4	6.3	LS	S x LS
127		MS 14 x R 6	6.3	LS	LS x S
128		MS 296 x R 4	6.3	LS	S x LS
129		MS 296 x R 2	6.3	LS	S x S
130		MS 17	6.0	LS	LS
131		MS 24	6.0	LS	LS
132		MS 25	6.0	LS	LS
133		R 5	6.0	LS	LS
134		MS 4 x R 5	6.0	LS	R x LS
135		MS 14 x R 4	6.0	LS	LS x LS
136		MS 21 x R 4	6.0	LS	MR x LS
137		MS 25 x R 4	6.0	LS	LS x LS
138		MS 1 x R 2	6.0	LS	S x S
139		MS 6 x R 2	6.0	LS	MR x S
140		MS 21 x R 2	6.0	LS	MR x S
141		MS 24 x R 2	6.0	LS	LS x S
142		MS 21 x R 5	6.0	LS	MR x LS
143		MS 6 x R 6	6.0	LS	MR x S
144		MS 17 x R 6	6.0	LS	LS x S
145		MS 296 x R 1	6.0	LS	S x R
146		MS 296 x R 3	6.0	LS	S x MR

no dominance in S x S comibination and over dominance in R x LS, MR x LS and LS x LS combinations. The exceptional case to this cluster is highly susceptible hybrids involving less susceptible and susceptible (LS x S) parents. The less susceptible parents fall in cluster IV and susceptible parent in cluster III.

Cluster IV consists of moderately resistant parents and less susceptible parents. The hybrids viz., R x MR, R x LS, R x S, MR x R, MR x LS, MR x S, LS x R, LS x MR, LS x LS, LS x S, S x R, S x MR, S x LS, S x S fall in this category. Varied disease reaction i.e., moderate resistance and less susceptible reaction is exhibited by the above combinations.

Thus, the cluster analysis identified four major clusters corresponding to the disease reaction exhibited by the parents and the hybrids. Of the four clusters, cluster I is considered to be the most important cluster as the progeny was found to be resistant irrespective of the disease reaction of the parents involved. The hybrids viz., MS 11 x R 3 and MS 9 x R 3 involving resistant and moderately resistant parents and falling in cluster I and exhibiting hypersensitive reaction can be utilised further.

ACKNOWLEDGEMENT

The senior author is thankful to the Council of Scientific and Industrial Research, New Delhi, India for the award of Senior Research Fellowship during the period of study. She is also thankful to Sorghum Breeding Unit, ICRISAT Asia Center, Patancheru, Andhra Pradesh, India for providing field facilities for carrying out the research.

REFERENCES

Leonard, K. J. and Suggs, E. G. (1974). *Setosphaeria prolatum. Mycologia* 66, 265-68.

Frederiksen, R. A. and Franklin Denis (1978). Sources of resistance to foliar diseases of sorghum in the International Disease and Insect Nursery. *Proceedings of the International Workshop on Sorghum Diseases* - A World Review, 11-15 December 1992, pp. 265-268. ICRISAT Center, Patancheru, Andhra Pradesh, India.

Frederiksen, R. A. (1980). Sorghum leaf blight. In *Sorghum Diseases : A World Review,* pp. 243-248. Eds. R J Williams, R A Frederiksen, L K Mughogho and G D Bengston. ICRISAT, Patancheru, Andhra Pradesh, India

Tarumoto, J., Isawa, K. and Watanabe, K. (1997). The inheritance of leaf blight resistance in sorghum-sudan grass and sorghum sudan hybrids. *Japanese Journal of Plant Breeding* 27: 216-222.