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COMBINING ABILITY ANALYSIS OF DOWNY MILDEW RESISTANT AND SUSCEPTIBLE LINES OF PEARL MILLET, *PENNISETUM AMERICANUM* (L.) LEEKE

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ABSTRACT

The results of diallel cross between 10 inbred lines showed that additive genes played predominant role in the control of days to flowering, plant height, head length, and downy mildew resistance. Early plant vigour and grain yield were mostly controlled by nonadditive gene effects. Inbred lines with high gca have been identified.

Key words: Pearl millet, downy mildew resistance, combining ability.

Downy mildew (DM) of pearl millet caused by *Sclerospora graminicola* (Sacc.) Schroet is the most important disease in major pearl millet growing countries of the world [1]. A strategy of identification and utilization of resistant sources has been adopted to control the disease by the Indian national programme and also at ICRISAT. Screening of pearl millet breeding material and lines obtained from Nigeria and other West African countries, where this crop and the pathogen have coevolved, through reliable field screening technique developed at ICRISAT, and testing these resistant lines multilocationally through the International Pearl Millet Downy Mildew Nursery (IPMDMN) [2], resulted in the identification of lines with high degree of stable resistance [3, 4]. The results for the combining ability of DM resistant and susceptible lines for DM, grain yield, and four other characters are summarised in this paper.

MATERIALS AND METHODS

A diallel set of crosses among ten inbred lines, 700250, 700516, 700560, 700651, 18 D_2B, L 111B, PIB 228, K 560, J 104 and 23B, was made at ICRISAT centre, Patancheru, India, during the 1976–77 post-rainy season. The first five of these lines were selected from the 1976 IPMDMN and the last five were the parental lines of

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the released commercial hybrids in India. Ten parental lines and their 45 F_1 were planted in randomised block design with three replications during the 1978 rainy season at Maradi, Republic of Niger, West Africa. The crop was sown in June after the first effective rain. Each entry was planted in two-row plots of 5 m length. The rows were 80 cm apart and hills within the rows were spaced at 40 cm. The crop was thinned to 2 plants/hill 18 days after planting (DAP).

A basal dose of 25 kg/ha P_2O_5 was applied at the time of field preparation. The crop was top dressed with two split doses of urea at 15 kg/ha N, 21 and 36 days after planting.

In each plot, observations were recorded on: (i) early vigour, scored 10 DAP on 1–5 visual scale, lower scores showed poor early vigour and higher scores indicated good early vigour, (ii) days to 50% flowering, (iii) plant height, measured on five representative plants/plot and averaged, (iv) head length, measured on five representative heads/plot, (v) downy mildew incidence count at grain filling stage, percentage of plants/plot showing DM incidence, (vi) grain yield/plot.

The diallel cross data were analysed for general combining ability (gca) and specific combining ability (sca) following Griffing's [5] Method 2, Model 1 (fixed model). As no effect of transformation of data on early vigour score and downy mildew was noticed on results, original data were utilised for the complete analysis of the diallel crosses.

RESULTS AND DISCUSSION

The combining ability analysis for various characters is presented in Table 1. The higher magnitude of estimates of variance for gca for days to flowering, plant height, head length, and resistance to downy mildew indicated the presence of predominantly additive genes controlling these characters. The presence of high gca variances and additive genes indicated that these characters can be further improved in the parental lines by selection. The sca variance was more than gca for early vigour and grain yield, indicating non-additive genes also involved in controlling these characters. A greater improvement for these characters may be brought about by developing hybrids and exploitation of hybrid vigour by other breeding methods.

Table 1. ANOVA for combining ability

Source	d.f.	Mean sum of square					
		early vigour×10	days to 50% bloom×10	plant height	head length	downy mildew	grain yield $\times 10^{-1}$
gca	9	30.5*	26.3*	637.6*	82.2*	356.5*	938.9*
sca	45	38.4*	10.9*	256.8*	14.3*	73.7*	1468.9*
Error	108	0.1	0.02	0.5	0.08	0.3	9.5

*Significant at P = 0.05.

A list of three best gca parents and best sca crosses is presented in Table 2. All the resistant lines, such as, 700250, 700516, 700560, 700651, 18D_2B, L 111B and PIB 228 having high to moderate DM resistance showed negative gca effects for this character. The highest negative gca effect was for 700516, followed by 700651. This was expected, as both these parents showed highest degree of DM resistance in the 1976 IPMDMN and in the present experiment. Positive and high gca effects for early vigour and grain yield was observed in these parents. These two lines also exhibited highest positive gca effect for height, indicating that the lines with tallest plants showed highest early vigour and downy mildew resistance. J 104 and 23B, the lines susceptible to DM, showed highest positive gca effects for this character. These lines also showed negative gca effects for early seedling vigour, ear length and grain yield. The shorter plant height, as indicated by the means and negative gca effects for 23b, J104 and BK560, confirmed the value of these parents in breeding for high harvest index and shorter plant height.

Table 2. Best gca parents and sca crosses for different characters

Parent/cross	Early vigour	Plant height	Downy mildew	Grain yield
Best 3 gca parents	L 111B	700516	700516	700516
	700651	700651	700651	18 D_2B
	700516	L 111B	L 111B	700651
Best 3 sca crosses	700560×PIB 228	700250×J104	700516×23B	700516×PIB 228
	700560×L 111B	18 D_2B×238	700651×23B	700516×23B
	700516×700560	700516×700560	700516×J 104	700560×700651

Resistance to DM appeared to be a dominant character, as the crosses involving one highly resistant and one highly susceptible parent generally showed low DM incidence and negative sca effects for this trait. The parents 700516 and 700651, which showed high resistance to DM with negative gca effects, were involved in 17 crosses as one parent, 13 of which showed negative sca effects for DM resistance. The parental lines 18 D_2B, L 111B and PIB228, which were relatively less resistant to DM than 700516 and 700651, could not produce as many DM resistant hybrids as 700516 and 700651. There were 29 out of 45 crosses which exhibited negative sca effects for days to flowering and 17 crosses with negative sca effects for plant height. This indicated the possibility of improving pearl millet for these traits through selective crossing programme. The present study clearly shows the value of combining ability analysis in identifying potential parents for crossing programme to combine desirable characters such as downy mildew resistance and high harvest index.

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