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Short Communication

Variability and correlation studies for charcoal rot (stalk rot) and yield components in recombinant inbred lines of sorghum

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Sorghum is an important food crop for a large section of people in the sub-tropical part of Asia and Africa, and a good source of feed for cattle. Charcoal rot (stalk rot) of sorghum, caused by *Macrophomina phaseolina*, is a weak fungus, causes disintegration of the pith of roots and lower internodes during grain filling, leading to wide spread lodging and poor grain fill. The expression of the disease (lodging following pith degradation) is highly dependent on soil moisture status (low), sink strength (high), leaf nitrogen status (low) among other factors [1]. The disease has a great destructive potential on sorghum especially under post-flowering receding moisture stress conditions, in many parts of the world [2].

A set of 93 recombinant inbred lines (RILs) used in present study, derived from charcoal rot susceptible IS22380 × resistant E36-1 parents, was kindly provided by Seetharama, NRCS, Hyderabad, India. The entries (100); 93 RILs, parents (repeated 3 times) and a local check (RS-29) were raised in a simple 10 × 10 lattice with four replications in a charcoal rot sick-plot at the main research station of the University of Agricultural Sciences, Dharwad, during the post-monsoon season (*rabi*) of 2003-04. Individual entries were planted (45 × 15cm) in single rows, accommodating 15 plants per row. Three rows of SPV86, a charcoal rot sensitive genotype, were sown on all sides of the experimental plot and the recommended package of practices was followed. All observations were made on ten random plants, tagged at pre-flowering stage, as described in the sorghum descriptor [4]. Different yield parameters and three charcoal rot disease parameters *viz*., per cent lodging with infection, number of internodes crossed by the fungus and length of infection at 20 days after complete grain filling were recorded. The phenotypic (PCV) and genotypic (GCV) coefficients of variation were calculated following the method of Burton and Davane [5]. Heritability in broad sense and genetic advance as percent of mean were computed following the method of Johnson *et al.* [6]. Phenotypic and genotypic correlation coefficients were estimated as in Singh and Choudhary [7].

Analysis of variance revealed highly significant differences among RILs for all the traits studied. High values of PCV (23.09-46.04 %) and GCV (11.56-43.48 %) were observed for early seedling vigor, head exertion, number of grains per spike, threshability, stem thickness, seed yield per plant, length of infection, number of internodes crossed and per cent lodging with infection. Earhead related traits such as ear head length, number of spikelets per plant and 1000-seed weight, as expected, had moderate PCV (14.42-16.92 %) and GCV (9.27-11.68 %) values as reported previously in this RIL population [8] and in other germplasm of sorghum [9].

Among the charcoal rot parameters, a highly significant and positive correlation (Table 1) was found between plant height and per cent lodging with infection, as observed by Esahia *et al.* [3]. Negative and significant association was observed between length of infection and 1000-seed weight at both genotypic and phenotypic level. Incidentally, this trait also had negative and significant association with early seedling vigor and days to 50 per cent flowering at genotypic level, similar to the observations of Punnuri [8] in the same population and Gururajrao [10] in another set of genotypes. The negative association between one or the other disease parameter with head exertion, number of grains per spike, 1000-seed weight, days to 50 per cent flowering and early seedling vigor clearly shows possible difficulties in simultaneous improvement for higher yield, lodging and charcoal rot resistance in the present material. Among yield components, plant height showed negative and significant association with ear-head length and head exertion at genotypic level. Stem thickness showed negative and significant association with earhead length and it showed positive and significant association with head exertion and number of spikelets per plant at both phenotypic and genotypic level. Days to 50 per

Table 1. Phenotypic and genotypic correlation coefficients among 14 traits in RILs of IS22380 × E36-1

Traits	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
X_1	-	0.017	–0.094	–0.090	0.062	–0.100	0.033	0.088	–0.050	0.056	0.050	–0.058	–0.053	–0.007
X_2	0.015	-	–0.097	–0.231**	0.044	–0.055	0.016	–0.062	–0.104	–0.032	–0.057	0.133	–0.019	0.295**
X_3	–0.388**	–0.265**	-	0.034	–0.091	–0.032	0.025	–0.062	0.092	–0.222**	–0.035	–0.114	0.118	0.113
X_4	–0.198*	–0.377**	0.063	-	–0.007	0.480**	–0.155	0.127	0.178	0.220**	–0.070	–0.127	0.133	–0.192
X_5	0.269**	0.074	–0.180	–0.018	-	0.090	–0.051	–0.155	–0.061	0.245**	0.104	0.189	–0.120	–0.018
X_6	–0.243**	–0.083	–0.083	0.579**	0.117	-	–0.183	0.110	0.032	0.138	–0.117	–0.120	0.060	–0.154
X_7	0.120	0.045	0.087	–0.162	–0.084	–0.219*	-	–0.001	–0.112	–0.081	–0.032	–0.054	–0.203*	–0.112
X_8	0.183	–0.116	–0.045	0.187	–0.298**	0.150	–0.019	-	0.125	–0.161	0.015	–0.308**	0.085	0.150
X_9	–0.018	0.391**	0.396**	0.332**	–0.141	0.104	–0.194	0.273**	-	–0.067	0.040	–0.166	0.184	–0.065
X_{10}	0.054	–0.069	–0.350**	0.233*	0.338**	0.162	–0.090	–0.191	–0.087	-	–0.100	0.170	–0.004	–0.149
X_{11}	0.122	–0.076	–0.010	–0.101	0.140	–0.176	–0.035	–0.001	0.079	–0.132	-	0.102	–0.059	–0.043
X_{12}	–0.203*	0.215*	–0.186	–0.161	0.293**	–0.143	–0.059	–0.457**	–0.358**	0.212*	0.103	-	–0.298**	–0.125
X_{13}	–0.099	–0.117	0.120	0.242*	–0.193	0.063	–0.038	0.135	0.396**	0.013	–0.109	–0.515	-	0.034
X_{14}	–0.052	0.267**	0.149	–0.244*	0.035	–0.203*	–0.135	0.198*	–0.109	–0.198	–0.063	–0.137	–0.055	-

The values above and below the diagonal are phenotypic and genotypic correlation coefficients, respectively. *Significant at 5 % probability level; ** Significant at 1 % probability level; X_1: Early seeding vigor (1 to 5); X_2: Plant height (cm); X_3 Earhead length (cm); X_4: Head exertion (cm); X_5: No. of spikelets/plant; X_6: No. of grains/spike; X_7: X_8: 1000-seed weight (g); X_9: Days to 50 % flowering; Threshability (1 to 5); X_{10}: Stem thickness (cm); X_{11}: Seed yield/plant (g); X_{12}: Length of infection (cm); X13: No. of internodes crossed; X_{14}: Lodging per cent.

cent flowering showed positive and significant association with ear head length, number of spikelets per spike, head exertion, 1000-seed weight and plant height at genotypic level. Similar observations have been made earlier [11].

The RIL population recorded highly significant differences among themselves for most of the traits studied. High heritability coupled with high genetic advance observed for head exertion, number of grains per spike, stem thickness, seed yield per plant, length of infection, number of internodes crossed by the fungus and per cent lodging with infection indicate that simple selection scheme in sick-plot would be desirable for their improvement. Highly significant and positive association between plant height and per cent lodging with infection at both phenotypic and genotypic level was expected as the shorter plants are always resistant to lodging, irrespective of the disease. Occurrence of the disease at grain maturity in tall and productive plants will certainly promote lodging. A combination of medium height, thick stem, large earhead and resistance to charcoal rot disease are desirable in productive genotypes. The RILs in the present study did not reveal such a combination.

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