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Phenotypic Stability for Grain Yield in Certain Varieties of Sorghum

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Genotype - environment interactions for grain yield in sorghum were studied by growing eleven genotypes in four different environments (2 years x 2 managements). Genotype-environment interactions were observed and significantly large portion of these interactions was accounted for the linear regression of the individual phenotypes on the environmental means. The non-linear component was not significant and its magnitude was considerably smaller than that of the linear component. Genotypes Swarna, 604, SC. 411, 168 and 269 were found to be more stable with the least deviation around the regression line (Sb). CS.3541 was found to be a promising variety under very favourable conditions.

Genotype-environment interactions are of considerable importance in a breeding programme. Plant breeders in recent years have realised the significance of these interactions and have developed methods which could be used to provide reliable estimates of these interactions (Finlay and Wilkinson, 1963; Eberhart and Russel, 1966; Perkins and Jinks, 1968; and Paroda *at al.*, 1973). These analytical techniques have recently been utilised to study the phenotypic stability of different genotypes in various crop plants (Allard, 1961; Finlay, 1963; Russel and Eberhart, 1969; Solanki, 1970). In this paper, an attempt has been made to analyse the phenotypic stability of certain grain sorghum varieties grown under four different environments.

MATERIAL AND METHODS

Eleven genotypes of grain sorghum including the local variety K.3 were tested under two different environmental conditions over two years at the Millet Breeding Station, Coimbatore. In each year the experiment was conducted during the Kharif season under rainfed conditions. Two different management levels were adopted in each season: (i) with 100:80:60 kg NPK/ha+Plant protection measures and (ii) without fertilizers or plant protection measures. Thus, there were four different environments in two years.

Data on grain yield were obtained from each plot of 6 m x 2.7 m. The statistical analysis was done according to the methods proposed by Finlay

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TABLE I. Mean performance of some promising sorghum varieties in Kg/ha

Genotype	Environment (Year)				Mean	b	Sb
	1974		1975				
	High fertility	Low fertility	High fertility	Low fertility			
370	3382	2164	4844	2339	3182	1.35	0.51
303	780	195	3090	926	1243	0.99	0.87
Swarna	4220	1784	4610	1491	3026	1.99	0.17
296	2778	2018	3382	877	2264	1.28	1.06
168	3821	2856	2407	1560	2661	0.70	0.37
CS 3541	5380	3236	3187	2992	3693	0.75	0.83
604	3723	2241	3246	2018	2807	0.95	0.23
329	3343	1676	1335	877	1808	0.74	0.78
Sb 411	3265	3480	2992	2602	3085	0.13	0.32
269	2758	1969	3733	975	2359	1.38	0.33
K 3	1754	1530	4094	2368	2437	0.67	0.89
Mean	3200	2104	3356	1727	2597		

and Wilkinson (1963) and Eberhart and Russel (1966).

RESULTS AND DISCUSSION

Mean grain yield in kg/ha for the four different environments and the linear (b) and non-linear (Sb) components of genotype x environment interactions for the eleven genotypes are given in Table I. On the basis of the environmental mean values, significant differences were observed in different environments. The highest yields were obtained under high management during both the years whereas comparatively poor yields were obtained under the low level of fertility conditions.

Pooled analysis of variance is presented in Table II. The mean differences between the environments and those between genotypes were highly significant (P=0.01). The genotype x environment component was observed to be also highly significant. A major portion of this was accounted for by the linear component, which was also found to be highly significant and the remainder which is the variation around the regression slope was not significant. The linear regression component was tested against both the error mean square and the remainder mean square and found to be highly significant in both the cases.

Since the phenotype is the sum product of the genotype and its environment, a study of genotype x environment interactions will be much use for the evaluation of stable genotype. Stable genotypes may directly be introduced

TABLE II. Pooled ANOVA

Source	d.f	M.S
Replications (R)	2	0.2859
Environments (E)	3	25.2705**
Genotypes (G)	10	6.7692**
Replications x Environments	6	2.5133*
Replications x Genotypes	20	0.4739
Genotypes x Environments	30	2.1936**
Linear	10	2.7330**
Remainder	20	1.9238
Pooled Error (G x E x R)	60	0.8884

** Significant at 1% level.
* Significant at 5% level.

into a wide range of environments or they can be made use of in future breeding programmes. The linear regressions of individual genotypic values on the mean value of all genotypes for each of a number of environments will provide measures of response which can be used to predict relative performance over a range of environmental conditions. Earlier, Finlay and Wilkinson (1963) considered linear regression slopes as a measure of stability. Eberhart and Russel (1966) emphasised the need of considering both linear (b) and non-linear (Sb) components of genotype x environment interactions in judging the phenotypic stability of a genotype. Later, Breese (1969), Paroda and Hays (1971) and Paroda *et al.*,(1973) emphasised that the linear regression should simply be regarded as a measure of the response of a particular genotype, whereas the deviation around the regression line (Sb) should be considered as a measure of stability; genotypes with the lowest deviation being most stable and vice-versa.

The estimates of 'b' showed that there were distinct differences among the eleven varieties studied in the linear regressions of the individual genotypes. Varieties like 303,329,604 and CS.3541 are distributed around the unit value of 'b' and may be considered more stable. However, since CS.3541 showed a high (Sb) value it could not be considered as stable as the other three though it has recorded high mean yield over all the environments. Since the mean yield of the varieties 303 and 329 are less than the overall mean yield and their(Sb) value is also high, they may not be suitable for a range of environments. Varieties like Swarna, 604, SH.410, 262, 168 and 370 showed low 'Sb' values and could be considered phenotypically more stable. Of these six varieties, the varieties Swarna, 604 and SB 411 showed the least 'Sb' value and high mean yield and could be considered as very stable genotypes, which would give linear response to the improvement in environmental conditions. Eventhough CS.3541 is the most promising variety with the highest mean performance, it could not be considered as stable since its 'Sb' value was high.

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