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Phenotypic Stability for Grain Yield and Maturity in Sorghum

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ABSTRACT

Genotype × environment interactions for grain yield and days to maturity were studied by planting five promising cultures in five successive years (1972-73 to 1976-77). Varieties, environments, and varieties × environment interaction were highly significant for both the characters. Varieties × environment (linear) interaction was significant for grain yield and pooled deviation was significant for days to maturity. Sona-108 exhibiting the highest yield, unit regression and negligible pooled deviation from regression was found to be very promising and stable.

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INTRODUCTION

A knowledge of the nature and relative magnitude of the various types of genotype-environmental interactions is important in making decision concerning the stability of yield potentiality of a variety before recommending it for general cultivation. In recent years, the statistical approach of Yates and Cochran (1938) suitably modified by Finlay and Wilkinson (1963) and Eberhart and Russel (1966) provided for estimates of stability parameters. A second approach, based on generation means and variances was suggested by Mather and Jones (1958), Jinks and Stevens (1959) and Bucio Alanis and Hill (1966). Perkins and Jinks (1968) attempted to bridge the gap between approaches and extended the analysis to cover many inbred lines and the crosses among them. The present study is an effort to understand the genotype × environmental interactions of improved strains of grain sorghum developed at the Jowar Research Station, Surat.

MATERIALS AND METHODS

Five promising strains of grain sorghum (*Sorghum bicolor* L. Moench) viz. S-873, No. 2, HD-1, Sona-108 and Surat-1 were evaluated for stability of performance. The experiment was conducted for five years during *kharif* 1972-73 to 1976-77 using randomised block design with four replications at the Jowar Research Station, Surat. Each plot consisted of eight rows, 8 meter long spaced 75 cms apart. The within row distance of 25 cms was maintained. Data on grain yield and mean days to maturity were obtained from middle six rows of each plot.

Statistical analysis was according to the methods proposed by Finlay and

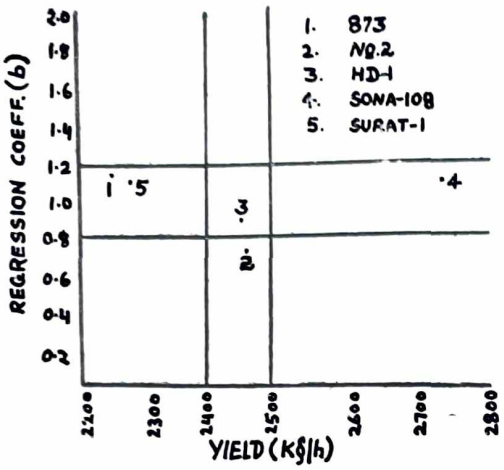

Fig. 1. Relative adaptability of sorghum varieties for yield.

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

RESULTS AND DISCUSSION

An analysis of variance for phenotypic stability for two characters is presented in Table-1. The differences among the means of the cultivars were significant for both the characters. The total environment, variety × environment and their component (environment-linear) were also significant for both the characters. However, variety × environment (linear) difference was significant for grain yield only and pooled deviation from regression was highly significant for days to maturity only.

Mean of grain yield and days to maturity with two stability parameters varietal regression on environmental indices (b) and deviation from regression (s^2d) are given in Table 2. Three varieties viz. No. 2, HD-1 and Sona-108 exhibited above average grain yield. However, only Sona-108 was significantly higher yielder (2752·07 kg/h) than the average grain yield (Fig. 1). Linear regression coefficients of varieties on environmental indices was near to unity for all except No. 2, suggesting that these varieties were suitable for all type of environments. Pooled deviation from regression (prediction of stability of varieties over environments) was not significant for any of them in respect of grain yield.

Days to maturity which is an important component of yield/day was below average for No. 2, HD-1 and Sona-108. Among these three varieties, Sona-108 was the earliest maturing (139·2 days). Linear regression coefficient for days to maturity was near to one and pooled deviation from regression was significant for all the varieties.

A study of the genotype × environment interactions can lead to successful evaluation of stable genotypes which could be used in future breeding programme. Finlay and Wilkinson (1963)

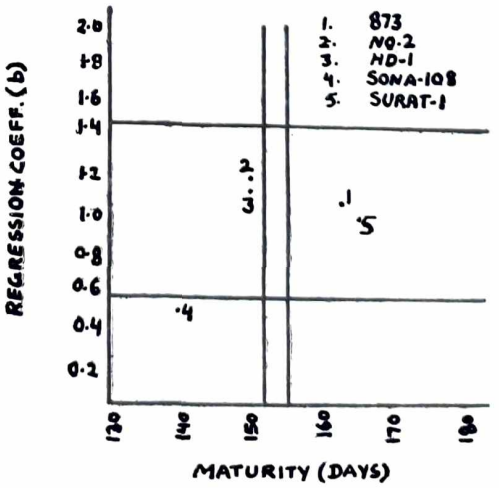

Fig. 2. Relative adaptability of sorghum varieties for maturity.

TABLE 1

Analysis of variance for stability parameters in sorghum.

Source	*DF*	*Mean square*	
		Grain yield	*Days to maturity*
Varieties	4	206152·71**	574·85**
Environments	4	3057753·59**	859·50**
Varieties × environments	16	40807·30**	46·07**
Environment (linear)	1	12231303·07**	3438·01**
Varieties × environment (linear)	4	79430·62*	56·57
Pooled deviation	15	22327·04	34·05**
Pooled error	60	13330·95	0·44

* and ** = Significant at 5% and 1% level of probability respectively.

gave statistical procedure to measure the adaptation reaction for yield of a cultivar in a series of environments by computing the regression of its yield upon the mean yield of all the cultivars tested in the same environment. Eberhart and Russell (1966) suggested that the sum of deviation of variety from its regression line would measure its stability, whereas the magnitude of its linear regression indicated the type of environment to which the cultivar was best adapted. They further suggested that breeder desires a variety with high mean, unit regression coefficient and the deviation from regression as small as possible. The deviation around regression line should be considered as a measure of stability was further suggested by Breese (1969), Samuel *et al.* (1970) and Paroda and Hays (1971).

In the present study, three varieties (No. 2, HD-1 and Sona-108) exhibited equal or above average yield, two varieties viz. HD-1 and Sona-108 had regression coefficient approaching unity and the deviation from regression near to zero. Hence these varieties exhibited similar magnitude of stability parameters as suggested by Eberhart and Russell (1966) for a promising type. These varieties were also early maturing. In respect of No. 2, which also exhibited average yield was suitable only in poor environment, since its regression value was less than unity.

TABLE 2

Stability parameters for five promising cultivars of sorghum.

Variety	*Grain yield*			*Days to maturity*		
	Mean (kg/h)	*bi ± S.E.*	*s^2d*	*Mean (days)*	*bi ± S.E.*	*s^2d*
S-873	2239·56	1·1311 ± 0·1088	15624·44	163·40	1·0860 ± 0·3180	69·10*
No. 2	2442·07	0·7246 ± 0·0878	5523·83	149·90	1·2364 ± 0·2368	38·11*
HD-1	2435·72	0·9074 ± 0·1121	17409·52	149·85	1·1686 ± 0·1542	15·92*
Sona-108	2752·07	1·1292 ± 0·0642	+	139·20	0·5127 ± 0·1981	26·54*
Surat-1	2272·65	1·1077 ± 0·0970	9680·43	164·95	0·9962 ± 0·1655	18·40*

+ M. S. value less than error M. S.
* Significant at 5% level of probability.

The environment index which represents the relation of the performance of grain yield of varieties and average yield with environments also suggested that Sona-108 was better in all the environments over average yield; whereas Surat-1 (Check) and S-873 were inferior in all the environments. However, No. 2 and HD-1 were superior in poor environments whereas in better environment, HD-1 approached the average yield and No. 2 yielded less than average yield. From this study, it is therefore concluded that Sona-108 is a promising and stable variety for South Gujarat.

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