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Phenotypic Stability in Certain Varieties of Fox-Tail Millet (*Setaria italica* Beauv.)

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Twelve genotypes of fox-tail millet were tested in six different environments in five years. The linear regression of the genotypes on the environments was not significant in six of the genotypes. These include the highest yielding genotype Si 76/4. Of the other six in which the regression was significant, only two genotypes viz., CO3 and Ise. 701 met all the requirements of a stable variety., viz., high yield, unit regression coefficient and non-significant deviation from regression.

Fox-tail millet (*Setaria italica* Beauv.) is largely a dryland cereal with lower productivity compared to other dryland cereals like sorghum and pearl millet. However, there is scope for increasing the yielding ability of this crop, since a number of potentially high yielding genotypes are available. However, it is worthwhile to study the comparative stability and adaptability of such genotypes over a number of environments so as to identify superior genotypes. The present paper reports the results of such an investigation involving genotypes of fox-tail millet in advanced stages of testing.

MATERIAL AND METHODS

Twelve genotypes of fox-tail millet were tested in six different environments in five years. Excepting environment 5 which was irrigated, the other environments were rainfed. The genotypes were tested in each environment in a randomised block design with four replications. Mean hectare yields were subjected to regression analysis of the model

$$Y_{ij} = \mu_i + \beta_i I_j + \delta_{ij}$$

suggested by Eberhart and Russel (1966) where,

Y_{ij} = Mean of the i^{th} genotype in j^{th} environment ($i = 1,2 \ldots 12$, $j = 1,2 \ldots 6$)

μ_i = Mean of the i^{th} variety over all environments

β_i = Regression coefficient of the i^{th} genotype on environmental index

I_j = Environmental Index $[(\Sigma_i Y_{ij}/g) - \Sigma_i \Sigma_j Y_{ij}/ge)]$

where,

g = Number of genotypes

e = Number of environments and

δ_{ij} = Deviation from regression of the i^{th} genotype at j th environment

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TABLE I. Specification of environmental conditions

Environment	Year	Cropping season	Meteorological data						
			Rainfall mm.	Raindays	Temperature °C		Relative humidity %	Soil type
					Maximum	Minimum		
E_1	1972	Monsoon	704.0	26	32.2	20.2	76.0	Black loam
E_2	1973	Monsoon	170.2	9	31.7	18.3	73.6	Black loam
E_3	1974	Monsoon	86.3	8	31.1	17.6	70.6	Black loam
E_4	1975	Monsoon	252.5	15	30.1	17.4	73.0	Black loam
E_5	1975	Monsoon	252.5	15	30.1	17.4	73.0	Black clay
E_6	1976	Monsoon	328.8	28	31.9	18.9	71.6	Black loam

The deviation mean square was calculated as per the formula

$$S^2_d = (\Sigma \delta^2_{ij} / n\text{-}2) - S^2_e$$

where,

$$S^2_e = \frac{\text{Pooled error MSS}}{r}$$

The different stability parameters were tested for their significance by useing appropriate tests suggested by Eberhart and Russel, (1966).

RESULTS AND DISCUSSION

The meteorological factors observed during the crop growth period in various environments season are presented in Table I. The precipitation received during 1974 (E3) was very low. In the E.4, there was timely and adequate rainfall distributed over the entire crop period. This season was also characterised by early sowings as against late sowings of the other seasons. The land under (E5) was irrigated and was raised with three crops while that under E-4, rainfed, was cropped only once a year. The mean yields of the genotypes over different environments are given in Table II. The analysis of variance is shown in Table III. The stability parameters 'b' and S^2_d and their significance are given in Table IV.

The differences among genotypic means were found to be significant as evidenced by the F test (MS_1/MS_3). The genetic differences among the genotypes for their regression on environmental index were also found to be significant (MS_2/MS_3). This indicates that the degree of response of individual genotypes for the environmental changes was not similar.

The analysis of individual genotypes for phenotypic stability revealed that only six genotypes out of 12 viz., Si 80/2, CO3, ISe 701, Si 5307, ISe 358 and Arjuna showed significance for their regression coefficient(Table IV). Although Si 76/4 recorded the highest mean yield, the performance of the genotype did not show linearity with the environmental index. Such instances of non-linearity between the performance of some geno-

TABLE II. Mean grain yield of the genotypes in different environments

Genotypes	Grain yield kg/ha Env. 1 (1972)	Env. 2 (1973)	Env. 3 (1974)	Env. 4 (1975)	Env. 5 (1975)	Env. 6 (1976)	Mean
Si. 76/4	1348	1073	845	2740	3487	771	1711
Si. 80/2	1058	1083	687	2667	3020	403	1620
CO. 3	1111	1838	762	2340	2107	892	1508
Ise. 701	862	1449	1178	1927	1683	1382	1414
Si. 5307	629	1757	966	1931	1911	1274	1411
Ise. 703	565	1920	1268	1677	1272	1313	1336
Ise. 702	435	1223	1125	1597	1352	1576	1218
Ise. 704	218	1250	1200	1042	980	1382	1012
Ise. 709	329	1051	906	1219	822	674	834
Ise. 358	447	1096	559	1250	891	500	791
Ise. 700	194	797	634	962	778	1222	765
Arjuna	400	842	468	979	691	771	692
SE	98	171	168	178	120	224	165
CD at 5%	281	490	482	510	344	634	474
Environmental index ($X = I_j$)	−559.1	155.8	−309.3	501.8	390.3	−179.1	

TABLE III. Analysis of variance for stability parameters

Source	df		SS	MS	
Genotypes	11		8553353	777578**	(MS_1)
Environments	5	60	21322513	355375	
Genotypes × Environments	55				
Genotypes × Environments linear	11		3597494	327045**	(MS_2)
Environment linear	1		10430394	10430394	
Pooled deviation	48		7294625	151971	(MS_3)
Pooled error	198		21671100	109450	

** Significant at P = 0.01

TABLE IV. Stability parameters and their significance

Variety	Mean yield kg/ha	Regression coefficient£ (b ± SE)	Regression mean square	Deviation mean square (Sd^2)
Si 76/4	1711	2.0127 ± 0.7411 NS	3521080 NS	716076**
Si 80/2	1620	2.2248 ± 0.5346 NS**	4302172*	372667*
CO.3	1508	1.4564 ± 0.2803 NS	1843724**	102470
Ise 701	1414	0.8691 ± 0.0893 NS**	656565**	10403
Si 5307	1411	1.2769 ± 0.0995*	1416750**	12921
Ise 703	1336	0.7980 ± 0.3119 NS	553558 NS	126827
Ise 702	1218	0.7432 ± 0.2876 NS	480111 NS	107851
Ise 704	1012	0.4136 ± 0.3696 NS	148667 NS	178145
Ise 709	834	0.5882 ± 0.1861 NS	300713 NS	45135
Ise 358	781	0.7285 ± 0.1447 NS*	461307 NS	27310
Ise 700	765	0.4453 ± 0.2837 NS	182361 NS	104923
Arjuna	692	0.4435 ± 0.1204**	170979*	18893

£ NS* & NS** Not significant from unity but significantly different from zero at 1% and 5% respectively
* & ** Significantly different from unity at 1% and 5%

types and environmental index have also been reported by Ehdaie *et al.*, (1977) in safflower.

Among the six genotypes which showed linearity in performance in the present investigation, two genotypes viz. ISe 358 and Arjuna registered poor yields and are not worth considering. Among the other four genotypes, Si 80/2 gave the highest grain yield followed by CO3, Ise 701 and Si 5307 (Table II). The yield differences among these four genotypes were not significant. The regression coefficient in the case of Si 5307 was greater than unity. Therefore, this genetype is highly sensitive to environmental changes. In the other three genotypes the regression coefficient was equivalent to unity. However, in one of these genotypes viz. Si 80/2, the deviation mean square was significant indicating its unpredictable nature.

Thus, it may be observed that of the twelve genotypes studied, CO3 and Ise 701 are the most desirable ones because they meet all the three requirements of a superior genotype namely high mean yield, unit regression coefficient and deviation mean square equivalent to zero (Eberhart and Russel, 1966). The variety Si 5307 is, on the other hand, unfit for adverse environmental conditions. Its performance under superior most environment was also medium inspite of its 'b' value being greater than unity. (Table IV). The performance of Si 80/2 in a given environment is unpredictable because of the significant deviation from regression. Although Si 76/4 did not show linear performance with environments, it registered the highest mean grain yield over all the environments. However, its mean yield level is not significantly different from those exhibiting stable performance. In the most favourable environments (Env. 4 and 5), Si 76/4 recorded the highest yields (Table II) indicating that the genotype may be better suited for high yielding environments.

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