GAU Res. J. 1992, 18 (1) : 35-39

Phenotypic Stability for Grain Yield and Yield-Contributing Characters in Rabi Sorghum

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ABSTRACT

Phenotypic stability of fifteen diverse parents and their thirty-six hybrid combinations in a 3 x 12 line x tester mating system was studied under three environments. The hybrid 296A x CSV-8R was found to be the most adaptable combination as it showed high mean unit regression and low deviation from regression for grain yield. Only two hybrid combinations viz. 296A x PVR-281 and SPL-46A x M-209 exhibited significant deviation from unity. The hybrids 296A x CSV-8R and 3660A x PVR-251 were found highly adaptable against diverse environments.

(Received on 3rd Dec., 1990)

MATERIALS AND METHODS

The experimental material consisted of three male sterile lines viz. 296A, 3660A, SPL-46A and twelve restorers viz. SPV-492, PVR-160, SPV-901, M-202, M-209, CVS-8R, CMS-12R, PVR-251, PVR-268, Jeur, PVR-275 and PVR-281 and their 36 hybrids. Each treatment was accomodated in single row plot, having three m long rows spaced 45 cm apart with the inter-plant distance of 15 cm. The experiments were conducted in three environments at Sorghum Research Station, M.A.U., Parbhani in rabi, 1989.

The data were analysed for stability parmeters using Eberhart and Russell model, 1966.

RESULTS AND DISCUSSION

The analysis of variance (Table 1) indicated that the environmental effects and genotypic differences were highly significant among themselves for all the characters. Mean squares for pooled deviation and g x e interaction were found to be significant for all the characters except penicle length and grain size. Similarly the mean sum of squares for environment (linear) was highly significant for all the characters except no. of secondaries. Whereas, panicle length and weight exhibited significant test for g x e (linear) interaction.

Estimates of Stability Parameters

The mean performance of stability parameters for promising experimental hybrids and parents are presented in Table 2.

Among the fifteen parents only two parents viz. M-202 (Mean-22.73, bi=0.92, S^2di=0.25) and M-209 (Mean = 22.40, bi = 0.89, S^2 di = -0.17) were found highly stable against different environments for panicle length. Five hybrids showed average stability with least S^2di values and had high mean. Parental line CSV-8 R was found to be highly stable one.

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TABLE 1

Analysis of variance for stability in sorghum.

Source of variation	d.f.	Mean sum of squares									
		Plant height (cm)	Days to 50% flowering	Days to maturity	Panicle length (cm)	Panicle weight (g)	No. of primaries	No. of secondaries	Test seed wt.	Fodder yield (g)	Grain yield (g)
Genotypes (M_1)	50	1582.65**	6.19**	7.58**	25.06**	224.30**	58.56**	105.03**	0.65**	631.04**	186.06**
Environments	2	4751.18**	494.55**	761.79**	222.10**	3392.71**	118.39**	1199.36**	0.45**	17.27	2349.45**
Genotype X environments	100	135.15**	2.40**	4.74**	1.33	60.92**	14.27**	568.85**	0.01	13.63	59.41**
Environment (linear)	1	9142.37**	989.11**	1523.58**	444.20**	6785.43**	236.79**	2398.72	0.91**	34.55**	4698.90**
G x E (Linear) (M_2)	50	203.31**	3.18**	7.21**	1.79**	76.90**	6.13	432.31	0.01	27.14**	57.01
Pooled deviation (M_3)	51	65.68**	1.60**	2.23**	0.84	44.05**	21.98**	691.56**	0.01	0.13	60.60**
Pooled error	306	40.51	0.75	1.30	1.34	15.33	8.49	104.37	0.03	23.22	6.72

* Indicate significant at 5%.
** Indicate significant at 1%.

TABLE 2

Estimates of stability parameters for promising hybrids and parents for yield and yield contributing characters.

Genotype	Panicle length			Panicle weight			No.of primaries			Test seed weight			Grain yield		
	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
296 B	23.58	1.75	0.812	83.89	-0.77**	29.160	29.44	1.09	35.260	2.73	0.60	-0.007	51.55	-0.55	0.774
3660 B	22.16	1.44	1.209	80.89	0.90	101.200	44.33	1.13	-2.546	2.75	0.77	-0.006	53.44	0.36	294.400
SPL-46 B	24.44	1.37	1.140	75.89	0.82	87.520	41.33	1.60	5.441	2.52	0.67**	0.016	49.67	1.11	5.341
SPV-492	17.18	1.11	-0.233	87.11	1.70	26.260	41.00	0.73	4.214	3.47	2.63*	0.015	57.11	2.33	23.670
PVR-160	22.47	0.85	-0.446	84.33	0.18	6.447	40.00	0.17	5.720	2.91	-0.07	0.065	62.77	-0.25	99.502
SPV-901	22.47	1.45	-0.054	78.66	0.98	-0.447	37.89	1.37	6.720	2.00	0.65	-0.007	50.11	0.89	3.694
M-202	22.73	0.92	-0.259	90.11	1.61	3.733	40.00	0.91	-0.682	2.02	1.18	0.003	37.44	0.93	72.970
M-209	22.40	0.89	-0.171	78.11	0.73	9.847	39.66	3.00	3.531	2.84	-1.50**	0.002	48.22	0.84	0.933
CSV-8R	22.23	0.71	-0.392	93.11	0.95	-2.996	43.78	0.22	12.340	3.08	0.01	-0.004	61.33	0.95	1.700
CMS-12R	21.47	0.76	-0.303	85.89	0.46	0.590	47.33	0.44	13.160	3.31	0.62	-0.007	57.88	1.31	1.469
PVR-251	22.46	0.86	-0.442	96.67	1.80	-4.627	42.33	1.35	18.220	3.33	1.40	-0.009	68.11	1.19	7.970
PVR-268	19.23	0.65	-0.436	89.44	0:51	-1.283	43.55	0.03	3.905	3.53	0.93	0.011	64.00	0.53	-1.365
JEUR	17.55	0.83	0.156	93.22	1.23	-5.090	37.44	2.80	5.281	3.40	1.42	0.008	62.44	1.63	15.250
PVR-275	12.57	0.66	0.640	102.55	1.52	21.530	48.11	0.74	16.870	3.28	0.73	-0.006	68.11	1.31	-2.006
PVR-281	13.38	0.82	-0.260	116.88	1.27	-5.066	42.44	-0.51	25.790	3.04	0.50	-0.006	82.33	1.21	-221.000
296A x CSV-8R	27.14	1.00	-0.436	-	-	-	-	-	-	-	-	-	76.00	0.97	3.124
296A x PVR-251	24.55	0.96	-0.327	94.66	0.95	-5.107	-	-	-	-	-	-	-	-	-
296A x JEUR	21.51	1.03	-0.411	80.00	1.04	-4.572	-	-	-	-	-	-	-	-	-
296A x M-202	26.33	1.23	0.018	105.88	1.58	424.700	48.22	2.15	21.520	-	-	-	75.00	2.29	567.500
3660A x CMS-12R	20.96	0.96	-0.447	92.77	0.87	57.590	-	-	-	-	-	-	-	-	-
SPL 46A x JEUR	-	-	-	94.11	1.11	3.714	-	-	-	-	-	-	-	-	-
296A x SPV-492	-	-	-	-	-	-	54.78	1.05	5.421	3.41	1.12	-0008	-	-	-
3660A x PVR-160	-	-	-	-	-	-	56.00	1.17	8.723	-	-	-	-	-	-
3660A x CSV-8R	-	-	-	-	-	-	47.78	0.88	1.194	3.49	1.19	-0.006	65.56	0.89	26.030
3660A x PVR-275	-	-	-	-	-	-	-	-	-	3.74	1.02	-0.007	-	-	-
3660A x PVR-251	-	-	-	-	-	-	-	-	-	-	-	-	65.89	0.94	-0.915
SPL 46 A x PVR-268	-	-	-	-	-	-	-	-	-	-	-	-	59.89	0.90	-0.888

* Significant at 0.05 per cent level.

**. Significant at 0.01 per cent level.

Among the females, parent SPL-46B (Mean = 49.6, bi=1.11 S^2di=5.341) and male parents SPV-901 (Mean=50.11, bi-0.89, S^2di=3.64), M-202 (Mean = 37.49, bi=0.93, S^2 di=72.97) and CSV-8R (Mean = 61.33, bi=0.95; S^2di=1.70) showed average stability for grain yield. However, CSV-8R was found to be most stable one as it exhibited high mean grain yield and least S^2di value.

Phenotype is a function of genotype (G), environment (E) and G x E interaction. Degree of main and interaction effects may vary from genotype to genotype and with the environment. Characterization of these effects is, thus, of great significance to a plant breeder. The G x E interaction effects can further be partitioned into linear and nonlinear components. Preponderance of linear G x E interaction is of great practical importance. The significant G x E (linear) interaction (Table 1) indicated that the differences among regression co-effecients pertaining to various genotypes on environmental means were real. However, variances due to pooled deviation were significant for all the characters (except test weight) indicating role of non-additive gene action.

Study of genotype x environment interaction leads to successful evaluation of stable genotypes which could be used in further breeding programme. The linear regression slope is considered as a measure of stability. Eberhart and Russel (2) emphasized the need of considering both linear (b) and non-linear (S^2di) components of genotype-environment interaction in judging the stabillity of a genotype.

For grain yield and panicle weight male parent CSV-8R, for panicle length \M-202, for No. of primaries female parent 296B and 3660B and for test weight PVR-268 showed average stability. For grain yield crosses of female parent like 296 A with the male parents CSV-8R, PV-251 and PVR-281; SPL-46A with male parents CMS-12R and PVR-268 exhibited average stability. For test weight crosses of female parent 3660A with male parents PVR-275 and CSV-8R exhibited average stability.

In sorghum, the length and weight of panicle are important characters from yield point of view. For these two characters, the hybrid 296A x M-202 proved stable one only under favourable environmental condition for these two characters. The results of Patel *et al.* (1984) in which the hybrids like 2077A x M-1 and 2077A x M-28 were found as average stable for panicle length are similar with the present findings.

The hybrids involving female 296A for No. of primaries were found having differential stability, which indicated that it contributed favourable genes of above characters for stability.

Grain yield is the final economic return in sorghum. The hybrid combinations although exhibited regression co-efficient close to unity and the deviation from regression approaching to zero, only two hybrid combinations 296A x CSV-8R (bi=0.97, S^2di=8.124) and 3660A x PVR-251 (bi=0.94, S^2di=-0.91) with higher means for grain yield were found highly adaptable against diverse environments. In support of this Nayeem (1980) has also reported that hybrids 2219A x PD-3-1-11 and CSH-8R showed average stability for grain yield, whereas Patel *et al.* (1984) found that hybrid CSH-1 was the most stable for Gujarat State. The hybrid 296A x M-202 could be considered as potential one provided there is availability of rich environments. Shivanne *et al.* (1989) also noticed that hybrids like 2219A x BS-1085, 2219A x SB 5204 and CSH-1 were having below average stability and were adaptable to favourable environments only. The graphic representation of grain yield for parents and hybrids showed that hybrids 296A x SPV-492 and 296A x CSV-8R and PVR-281 were highly resistant to the environmental fluctuations and were within the limit of deviation from regression co-efficient with higher mean.

Test weight is an important yield contributing character and is said to be highly heritable one. For this character, the hybrid 3660A x PVR-275 and male parent PVR-268 were observed to be stable ones. The potentiality for high seed weight could be explored in advance generation of the said cross or by using a male parent PVR-268 with good female.

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