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Short Communication

Genotype x Environment Interaction for Grain Yield in Pigeonpea

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Study of genotype x environment (GxE) interactions assume special significance in pigeonpea [*Cajanus cajan* (L.) Millsp.] as 90% of the crop is grown in India. Various climatic conditions and seasonal variations have a large impact on pigeonpea production. The GxE interaction underlies the very success of a breeding programme related to stability of varieties. The statistical technique to measure GxE interactions developed by Finlay and Wilkinson (1963), Eberhart and Russell (1966) and Perkins and Jinks (1968) have been very useful in plant breeding programme. In the present study, the technique of Eberhart and Russell (1966) has been employed to understand the differential GxE interaction of 64 diverse pigeonpea genotypes and to assess the stability in performance of these genotypes for grain yield per plant.

The 64 diverse pigeonpea genotypes, comprising of 28 maintainer (B) lines, 31 restorer (R) lines and 5 released varieties, were evaluated for their stability performance in Randomized Block Design with three replications over three diverse locations viz., Sardarkrushinagar, Jagudan and Khedbrahma during kharif 2007. Each genotype was sown in single 4 m long row with inter and intra row spacing of 60 cm and 20 cm, respectively. All recommended agronomical practices and plant protection measures were adopted for raising the good crop. The observations were recorded on grain yield. The GxE interactions and stability parameters were statistically analyzed following Eberhart and Russell (1966).

The pooled analysis of variance for genotypes was found to be significant for grain yield. This revealed significant variation among genotypes and environments. Significance of variance due to genotypes + genotypes x environments for grain yield per plant exhibited variable response of genotypes to different environments. This also suggests presence of genetic variability and its inconsistency in performance over different environments. Similar results for grain yield were reported by Manivel *et al.* (1988) and Muthiah and Kalaimagal (2005). On further portioning of the GxE interaction, it was found that GxE (linear) interaction was non-significant indicating that phenotypic performance of the genotype was not predictable. The pooled deviation that depicted non-linear component of GxE interaction was highly significant indicating predominant role of non-linear components of GxE interactions for the differences in the stability of performance for grain yield per plant (Table 1).

The ultimate goal of any breeding programme is to increase the productivity by developing stable varieties capable of producing high yield though the ways and means to achieve this goal are widely different. The stability is the consistency in performance of a variety over varying environments (Singh and Chaudhary, 1979). Recently, interest has been focused on the regression analysis. The regression approach was first proposed by Yates and Cochran (1938) and later modified by Finlay and Wilkinson (1963) to interpret the varietal adaptation to varying environments. Regression technique was slightly improved by Eberhart and Russell (1966) by adding one more parameter *i.e.*, deviation from regression. According to them, both linear (b_i) and non-linear (S^2d_i) functions should be considered while judging the phenotypic stability of genotype. Eberhart and Russell (1966) defined a stable genotype, as one which produces high mean yield, depicts regression coefficient (b_i) around unity and deviations from regression (S^2d_i) near

Table 1. Mean squares from analysis of variance for phenotypic stability for grain yield in pigeonpea

Source	DF	Grain yield (kg ha^{-1})
Environments	2	12081811**
Genotypes	63	333252
G x E	126	284113**
E (Linear)	1	24163730**
G x E (Linear)	63	212530
Pooled Deviation	64	350137**
Pooled Error	378	20645

*** Indicates significance against pooled error M.S. at 1% levels of significance.*

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zero. Later on, Breese (1969) and Paroda and Hayes (1971) suggested that linear regression (b_i) should simply be regarded as a measure of response of particular genotype, whereas the deviation from regression (S^2d_i) as a measure of stability.

Stability of yield may be dependent upon stability of different yield components. Hence, information on the relative stability of different yield components is also essential to understand diverse mechanisms contributing to yield stability. It is always justified to breed for genotypes with only high potential because most of the times, the yield potential cannot be expressed. Therefore, a much higher priority should be given to improve yield stability (Caccarelli, 1989). Stability is genetically controlled character (Bradshaw, 1965). Therefore, one can breed for stability also.

In the present study, it was observed that the genotypes, GT 403B (1710 kg ha^{-1}), GT 401B (1508 kg ha^{-1}) and GT 301B (1254 kg ha^{-1}) among B lines, GTR 26 (1618 kg ha^{-1}), GTR 23 (1586 kg ha^{-1}), GTR 18 (1463 kg ha^{-1}), GTR 3 (1400 kg ha^{-1}) and GTR 54 (1350 kg ha^{-1}) among R lines and GT 101 (1521 kg ha^{-1}) and UPAS 120 (1137 kg ha^{-1}) among released varieties, evinces stability of performance over environments as indicated high mean values and non-significant regression coefficient (bi) approaching unity with non-significant deviation from regression (Table 2). The results are in accordance with the findings of Manivel *et al.* (1998), Muthiah and Kalaimagal (2005) and Kuchanur *et al*. (2008). Use of these stable R lines and counterpart A lines of stable B lines in heterosis breeding could be expected to yield stable high yielding hybrid combinations.

Table 2. Stability parameters of different genotypes for grain yield (kg ha^{-1}) in pigeonpea

Genotype	Mean	b_i	S^2d_i	Genotype	Mean	b_i	S^2d_i
GT 288B	684.33	0.60	177732.16**	GTR 1	664.89	0.06	45755.72
GT 33B	1283.89	2.25	1749915.12**	GTR 29	1617.22	1.62	377245.00**
GT 87B	904.22	1.31	534205.25**	GTR 21	932.56	0.22	151497.98**
GT 100B	499.22	0.03	6809.45	GTR 22	1124.56	1.93	1187997.00**
GT 289B	389.00	0.17	1833.67	GTR 30	1616.67	1.20	1210744.50**
GT 290B	580.00	0.21	53488.93	GTR 31	993.44	0.78	152513.42**
GT 301B	1254.11	1.57	16719.43	GTR 33	890.78	0.25	10323.52
GT 302B	1039.56	1.46	262516.09**	GTR 34	963.89	0.23	211142.64**
GT 303B	1411.56	1.39	238352.27**	GTR 23	1585.67	0.08	4437.30
GT 304B	1067.67	0.08	45664.93	GTR 24	863.44	0.80	97139.55*
GT 305B	764.89	0.10	128110.56*	GTR 25	526.89	0.20	50373.84
GT 306B	1276.89	2.36	256887.05**	GTR 26	1617.78	1.38	4413.69
GT 307B	1281.56	1.80	180143.91**	GTR 27	1197.67	0.42	889131.94**
GT 308B	1066.89	0.53	713418.88**	GTR 28	1027.78	0.96	35351.03
GT 309B	795.33	0.51	1988.50	GTR 39	1018.22	1.20	351143.19**
GT 310B	1275.44	0.38	186060.47**	GTR 44	1019.00	1.19	170553.23**
GT 311B	1231.44	1.14	456593.56**	GTR 45	1349.89	1.60	6260.18
GT 401B	1507.89	1.83	10317.90	GTR 5	1565.33	1.65	555667.69**
GT 402B	1512.56	1.51	259155.95**	GTR 37	1218.89	1.97	772076.69**
GT 403B	1709.56	1.71	58223.27	GTR 10	732.00	0.86	242428.95**
GT 404B	1257.44	1.42	509217.53**	GTR 42	1443.11	2.17	329282.16**
GT 405B	883.44	0.66	8860.84	GTR 52	1103.22	1.65	12780.21
GT 406B	816.11	0.61	6009.18	GTR 51	741.22	0.43	62117.08
GT 501B	1016.22	0.99	82153.16*	GTR 8	950.00	0.82	1138.10
GT 502B	1522.67	1.48	115417.77*	GTR 6	994.44	1.07	11783.02
GT 503B	1231.89	1.68	190862.17**	GTR 3	1400.00	1.79	61170.49
GT 504B	1429.11	1.86	734190.44**	GT 101 (C)	1521.44	1.03	3984034.00**
GT 505B	1363.44	1.09	373931.16**	ICPL 87 (C)	652.89	0.80	9441.08
GTR 20	1626.11	2.04	1155965.88**	GT 100 (C)	960.67	0.61	3279.43
GTR 17	1863.33	1.87	1910310.88**	BDN 2 (C)	990.78	0.79	1338.88
GTR 15	875.33	0.97	481538.75**	UPAS 120 (C)	1136.67	0.24	31166.58
GTR 18	1463.33	1.52	46361.41	Mean	1131.15	1.00	
GTR 13	1068.00	0.45	273752.69**	SE$\pm$	418.41	0.96	

**, ** Indicates significance against pooled error M.S. at 5% and 1% levels of significance, respectively.*

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