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STABILITY OF YIELD COMPONENTS OF CHICKPEA GENOTYPES

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ABSTRACT

Pooled analysis of variance revealed the existence of high genotype-environment (GxE) interaction for all the characters. Inspite of the non-significance of linear component of GxE interaction, few genotypes exhibited b> 1 or b<1 for seed yield per plant, seeds per pod, and harvest index. The regression analysis of Eberhart and Russell (1966) has been useful in assessing the adaptation of various genotypes. Accordingly, the genotypes showing wide adaptability and specific adaptation were identified. K-4 was found suitable for better management conditions. Pant G-110 showed promise for moderate input management, and Kaka, NEC-240 and Pink-2 appeared worthwhile for poor environmental conditions.

Phenotypically stable varieties are usually sought for commercial production of crop plants. In any breeding programme it is necessary to screen and identify phenotypically stable genotypes which could perform more or less uniformly under different environmental conditions. Though the information on genotype-environment (G x E) interaction has been adequately worked out in cereal crops, the relative basic information on the important pulse crop like chickpea is limited. Therefore, the present investigation was carried out to collect this information in chickpea which may be of great use in launching a dynamic and efficient breeding programme.

MATERIALS AND METHODS

The material used in the present study consisted of 32 lines of chickpea which represented released and pre-release material from India and abroad. The material was planted during *rabi* 1976-77 and 1977-78 at three locations, namely Pantnagar, Bulandshahar and Nagina. The experimental material was planted in a randomized complete block design (RBD) with three replications. Each plot consisted of 5m long four rows. The rows were spaced 30cm apart and within row plant to plant distance was 10cm. Five competitive plants

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from each experimantal plot were randomly taken for recording the observations. The data were recorded in eight environments. Observations were recorded on pods/plant, seeds/pod yield/plant and harvest index (%). Stability parameters were calculated following Eberhart and Russell (1966).

RESULTS

The pooled analysis of variance indicated differences among genotypes (G), environmental variation (E), its linear component E (L), and genotype-environment (G x E) interactions as highly significant for all the characters (Table 1).

TABLE 1

Pooled analysis of variance for different characters

Source of variation	d.f.	Mean sum of squares			
		Pods/plant	Seeds/pod	Seed yield/ plant (gm)	Harvest index(%)
Genotype (G)	31	2043.09**	0.19**	38.69**	39.74**
Environments (E)	7	159023.90**	1.28**	238.61**	134.93**
G x E	217	874.36**	0.02	9.63**	13.00**
E (L)	1	1113167.00**	9.02**	1670.26**	944.31**
G x E (L)	31	4586.53**	0.02	11.46	15.68
Pooled deviation	192	248.05**	0.02	9.04**	12.17**
Pooled error	496	27.77	0.05	1.55	4.96

d.f. = Degree of freedom

** = Significant at 1 per cent level

Mean performance and stability parameters : The range of variation for mean performance (X_i), linear sensitivity coefficient (b_i) and non-linear sensitivity coefficient (S^2_{di}) for all the characters have been graphically presented in Fig 1 to 4.

NUMBER OF PODS PER PLANT

Sixteen genotypes possessed more pods per plant than the population mean, $\bar{X}$=74.9 pods. Of these, P-3552 (1), P-840 (8), USA-613 (12), P-1081-1 (13), NCE-1639 (14) and P-2974 (15), constituted top ranking group. Both linear and non-linear components of G x E interaction were significant. The b_i values ranged from 0.22 to 1.62. Seven genotypes recorded b_i value <1 and 5 had b_i >1. S^2_{di} was greater than zero for 24 genotypes. Joint consideration of mean

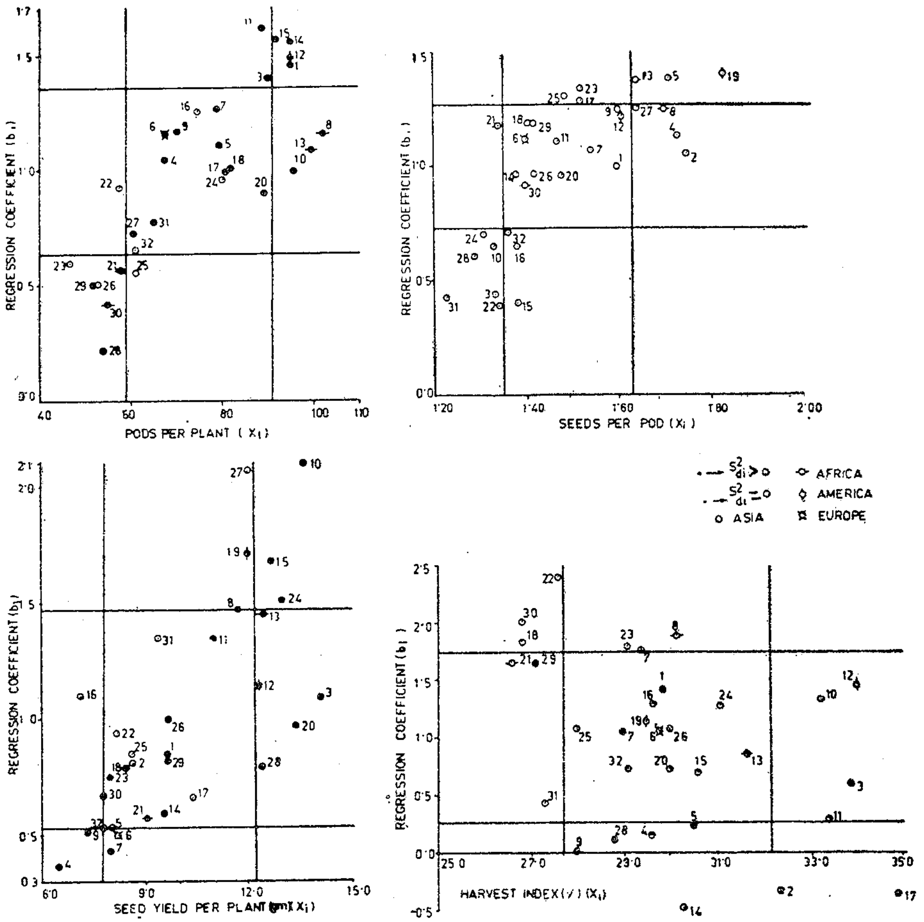

Fig. 1-4 show variation for mean, bi and S²di values for pods per plant, seeds per pod, yield and harvest index, respectively. Dot (.) indicates non-significance of S² di while (+) indicates that S²di is significantly greater than zero.

and stability parameters graphically depicted in Fig. 1 revealed that none of the genotypes had higher pod number than mean combined with $b_i=1$ and $S^2_{di}=0$.

NUMBER OF SEEDS PER POD

From the mean performance of genotypes computed over eight environments, it can be observed that 13 genotypes had more seeds per pod than the population mean, $\bar{X}=1.49$. Seven genotypes secured their positions in top ranking group. The components of G x E interaction were not significant for this character. The b_1 values ranged from 0.43 to 1.41. Four genotypes, viz. K-468

(2), Kaka (4), P-840 (8) and K-4 (24), had more number of seeds per pod, b=1 and $S^2_{di}=0$ (Fig. 2). Accordingly, these genotypes appeared promising for hybridization in order to combine all the three aspects of adaptation.

SEED YIELD PER PLANT

Thirteen genotypes yielded more than population mean, $\bar{x}=10.02$ gm. Eight genotypes yielded significantly higher than the population mean. Out of these, four were in the highest yielding group. Nonlinear component of G x E interaction was signifiant for this character. The b_i values ranged from 0.37 to 2.10. Five genotypes possessed linear regression cofficients statistically greater than one. Three genotypes recorded $b<1$. Twenty-one genotypes showed $S^2_{di}>0$. Simultaneous consideration of mean and stability parameters (Fig. 3) revealed that only Pant G-110 (17) with average yield had b=1 and $S^2_{di}=0$. Accordingly, this genotype appeared promising from adaptation point of view.

HARVEST INDEX (%)

Fourteen genotypes had higher harvest index than the population mean, $\bar{x}=29.95$. Only four genotypes were the best. Although nonlinear component of G x E interaction was important for this character, six genotypes had $b>1$ and another six genotypes had b_i values less than 1. Three genotypes possessed negative b_i values. Seven genotypes recorded $S^2_{di}>0$ which further confirmed the preponderance of non-linear sensitivity for harvest index. A joint consideration of mean and stability parameters (Fig. 4) revealed that three genotypes, namely, Annigeri-1 (10), B-110 (11) and USA-163 (12), had higher harvest index, b=1 and $S^2_{di}=0$. These genotypes appeared promising from adaptation point of view and these genotypes could be utilized in breeding programmes.

DISCUSSION

The results of the present study clearly indicated that the linear component of G x E interaction played an important role in the expression of pod number per plant. The non-linear component of G x E interaction was improtant for many genotypes in case of pods per plant, seed yield per plant and harvest index. Hence, for these characters the underlying regression model was not adequate to predict the linear sensitivities of genotypes to varying environments. For pods per plant both the components of G x E interaction were significant. Under these circumstances the practical usefulness of any predictions depends on their relative magnitude. For pods per plant, seed yield per plant and harvest index the linear component was more important than that of non-linear. Therefore, the prediction of G x E interactions based on the regression still has considerable practical significance. It is quite evident that major portion of G x E interaction was contributed by the non-linear component. It suggests that there was considerable genetic diversity in the material. It is also likely that the environments used in this study differed in several physical parameters resulting in the differential responses of genotypes to different environmental conditions as pointed out by Witcomb and Whittington (1971). Singnificant deviations from linearity may also arise due to specific cultivar-environment interaction as argued by Joppa *et al.* (1971).

In the present study for characters like seeds per pod, seed yield per plant, and harvest index, the linear component of G x E interaction was not significant in the pooled analysis. Yet a few genotypes with $b>1$ or $b<1$ were indentified. Kaltsikes and Larter (1970) and Gautam and Jain (1977) found that for days to maturity in *durum* wheats, although the regression M.S. was not significant against error M.S., even then some of the varieties exhibited significant regression coefficients.

In plant breeding programme it is usually desired to identify promising genotypes for high, medium and low yielding environments. In this investigation only one line, K-4, was found suitable for high yielding environments. This genotype combined high mean, $b>1$ and $S^2{}_{di}=0$. Similarly, Pant G-110 appeared promising. This genotype has average yield, $b=1$ and $S^2{}_{di}=0$. Three genotypes, namely, Kaka, NEC-240 and Pink-2, retained and manifested their inherent potentialities fully well under low yielding environments. These were characterized with average yield, $b<1$ and $S^2{}_{di}=0$.

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