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Research Article

Stability analysis for seed yield in cowpea genotypes (*Vigna unguiculata* (L.) Walp.)

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Abstract
A total of 14 genotypes including three checks of cowpea were evaluated over two seasons in two years to study the G x E interaction for seed yield. Variances due to genotype, genotype x environment, environment + (genotype x environment), environment (linear) and pooled deviation were significant for seed yield. Based on the stability analysis of Eberhart and Russell model, three genotypes *viz.,* VCP 12006, VCP 13001, VCP 15006 were found to be stable across the environments for seed yield. These genotypes had high seed yield with a unity regression coefficient and deviation from regression equal to zero.

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is a valuable warm season pulse crop grown for its seed, vegetable and also for fodder purpose in both tropical and subtropical regions. Phenotypically stable genotypes are of great importance because the environmental conditions vary from season to season and year to year. Stable performance of cowpea genotypes across contrasting environments is essential for the successful selection of stable and high yielding varieties (Yousaf and Sarwar, 2008). Combination of genotypes stability with high yield is an important criteria for selecting high yielding and stable genotypes. An understanding of the genotype and environmental interactions in cowpea is important both for crop improvement and to ascertain the performance of genotypes to variations in the environmental factors. An analysis of adaptability and stability is essential to identify varieties with predictable performance and that are responsive to environmental variations in specific or wide conditions, making more reliable the recommendation of cultivars (Cruz *et al.,* 2012). The main purpose of a breeding program is to identify superior genotypes than the existing varieties/hybrids. Thus, the genotypes are intensively evaluated for grain yield. However, the relative ranking of the genotypes, in most cases, is not consistent, since variations may occur because of the interactions between genotype and environment. Therefore, this interaction takes leading role in the process of cultivar recommendation. In this way, genotype with high yielding potential and good stability could be recommended for cultivation. There are few studies about the adaptability and stability of cowpea genotypes. Therefore, the aim of this study was to evaluate selected cowpea genotypes for the adaptability of seed yield using Eberhart and Russell model (1966) in order to recommend stable genotypes for cultivation and for their utilization in breeding programmes for improvement of grain yield in cowpea. In this technique, response of genotypes to a given environment is considered. G x E cannot be avoided, in fact, is an important limiting factor for testing the efficiency of any breeding programme. The occurrence of large genotypes x environment (G x E) interaction affects the recommendations of the breeders in selecting genotypes for specific environment. Genotype x environment analysis is used to provide unbiased estimated of yield and agronomic characteristics and to determine yield stability or the ability to withstand both predictable and unpredictable environmental variation.

Material and Methods

The experimental material for the present investigation consisted of 14 genotypes which included 11 test entries *viz.,* VCP 09024, VCP 12005, VCP 12006, VCP 12010, VCP 12016, VCP 12024, VCP 13001, VCP 14001, VCP 14005, VCP 14013, VCP 15006 along with three checks *viz.,*CO (CP) 7, Vamban 1 and VBN 3. They were evaluated in a Randomized Complete Block Design (RCBD) with two replications at NPRC, Vamban over four environments *viz., kharif* 2016, *Rabi* 2016-17 and *kharif* 2017 and *Rabi* 2017-18. All the entries were raised in the plot size of 12 m^2, adopting a spacing of 45 x 15 cm. All the recommended package of practices were provided for good crop growth and development. Data recorded on grain yield/plot (12 m^2) over environments was analyzed using TNAUSTAT package (Manivannan, 2014). The stability model proposed by Eberhart and Russell (1966) was used to estimate stability parameters for seed yield.

Eberhart and Russell (1966) model for stability analysis provides regression indices (b values) and mean square for deviation from regression minus pooled error (S^2d) as indices of a stable genotype. The stable genotypes will be those having mean yield higher than the average yield of all the genotypes under test, regression coefficient of unity and deviation from regression equal to zero. Pooled error was obtained by averaging the error mean squares from the analysis of variance of individual environments and dividing by the number of replications. The significance of mean squares was tested against the pooled error. For testing significance of mean values; Least Significant Difference (LSD) was computed by using the pooled error. The t-test based on the standard error of regression value was used to test significant deviation from 1.0. To determine whether deviation from regression were significantly different from zero, the F-test was employed *i.e*. comparing the mean square due to deviation from regression with pooled error.

Results and Discussion

The pooled analysis of variance (Table 1) revealed significant differences among the genotypes for the grain yield. The environment + (genotype x environment) was significant for grain yield indicating distinct nature of environments and genotype x environment interactions in phenotypic expression. The environment (linear) was found significant for grain yield, indicating differences between environments and their influence on genotypes for expression of the character. The genotype x environment (linear) interaction component showed significance for grain yield. This indicated significant differences among the genotypes for linear response to environments (b_i) behavior of the genotypes could be predicted over environments. The mean square due to pooled deviation from regression was significant showing that the performances of some of the genotypes were not stable over environments. Similar results were obtained by Thiyagarajan and Rajasekaran (1989), Sarvamangala *et al.* (2010), Nunes *et al.* (2014) and EI-Shaieny *et al.* (2015). Grain yield is the most important trait in the development of cowpea varieties/hybrids and for identifying a genotype with high grain yield, stability and average response is of immense value. The stability parameters (mean, b_i and s^2d) of the individual genotypes are illustrated in Table 2. The grain yield (kg/ha) of 11 cowpea genotypes which included for testing ranged from 1160 to 1645 kg/ha with an average of 1276 kg/ha including three check entries across years, locations and genotypes.

Mean performance: Among three checks, VBN 3 recorded highest seed yield of 1359 kg/ha and among the test genotypes, VCP 14001 recorded highest grain yield of 1359 kg/ha. The check VBN 3 and nine test genotype *viz.*, VCP 09024, VCP 12005, VCP 12006 VCP 12016, VCP 12024, VCP 13001, VCP 14001, VCP 14005 and VCP 15006 had statistically on par seed yield with VCP 14001. Hence these genotypes may be considered for evaluation in large plot based on *per se* performance.

Deviation for regression (s^2d): The genotypes VCP 12006, VCP 13001 and VCP 15006 deviated non-significantly from zero (s^2d=0). Therefore, these genotypes were stable for seed yield over all the environments. Similar findings were reported by Gouri Shankar *et al.* (2008). High yielding check VBN 3 and many other genotypes recorded significant deviation from zero (s^2d=0). Therefore, these genotypes could not be recommended over all the seasons. High yielding genotypes are not to be expected to stable as reported by Manivannan *et al.* (1999a). These results are in agreement with those obtained by Santos *et al.* (2015) and Sarvamangala *et al.* (2010).

The regression coefficient of the genotypes VCP 12006, VCP 13001 and VCP 15006 recorded non-significant deviation from unity (b=1). Hence, these genotypes have average response to environments and recommended for all environments. Similar results were observed by Bhakta and Das (2008) and Panwar *et al.* (2008).

It is concluded from the present study that the three genotypes VCP 12006, VCP 13001, VCP 15006 were found stable with high mean yield and had average responses to the environmental conditions and recorded statistically on par yield with yield levels of check variety VBN 3. Hence these genotypes can be recommended for cultivation in both *kharif* and *rabi* season.

References

Bhakta, N. and Das, S.R. 2008. Phenotypic stability for grain yield in rice. *Oryza*, **45** (1): 105-119.

Cruz CD, Regazzi AJ, Carneiro PCS 2012. Modelos biométricos aplicados ao melhoramento genético. UFV, Viçosa.

Eberhart SA, WA Russell (1966). Stability parameters for comparing varieties. Crop Science. **6**:36-40.

EI-Shaieny, A. A. H., Y.Y. Abdel-Ati, A. M. El-Damarany and A. M. Rashwan. 2015. Stability analysis of components characters in cowpea (*Vigna unguiculata* (L.) Walp). Journal of Horticulture and Forestry**, 7** (2): 24 - 35.

Gouri Shankar, V., Ansari, N.A. and Ilias Ahmed, M. 2008. Stability analysis using thermo-sensitive genic male syerility (TGMS) system in rice (*Oryza sativa* L.). *Res. on Crops* **9** (1): 141-146.

Nunes, HF, Freire Filho FR, Ribeiro VQ, Gomes RLF. 2014. Grain yield adaptability and stability of blackeyed cowpea genotypes under rainfed agriculture in Brazil. Afr. J. Agric. Res**. 9**:255-261.

Panwar, L.L., Joshi, V.N. and Mashiat Ali. 2008. Genotype x environment interaction in scented rice. *Oryza* **45** (1): 103-109.

Santos, A., G. Ceccon, E. V. Rodrigues1, P. E. Teodoro, P. A. Makimo, V. B. Alves, J. F. Silva , A. M. Corrêa , R. C. F. Alvares and F. E. Torres. 2015. Adaptability and stability of cowpea genotypes to Brazilian Midwest. African Journal of Agricultural Research, **10** (41): 3901 - 3908.

Sarvamangala C, Uma MS, Biradar S, Salimath PM. 2010.. Stability analysis for yield and yield components over seasons in cowpea [*Vigna unguiculata* (L.) Walp.]. Electronic. J. Plant Breed. **1**:1392- 1395.

Thiyagarajan, K. and Rajasekaran, S., 1989, Stability analysis for seed yield and its components in cowpea (Vigna unguiculata (L.) Walp). Legume Res., **12** (2): 53-60.

Yousaf, A. and G. Sarwar (2008). Genotypic x environmental interactions of cowpea genotypes. Int. J. Environ. Res., **2**: 125-132.

Manivannan, N., K. Sethuraman, N. Nadarajan. 1999a. Phenotypic stability for seed yield in mungbean. Indian J. Pulses Res., **12** (1): 105-106

Manivannan, N. (2014). TNAUSTAT-Statistical package. Retrived from https://sites.google.com/site/tnaustat.

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Table 1. Pooled analysis of variance for stability for grain yield in cowpa genotypes

Source of variation	df	MSS for grain yield
Genotypes	13	202943.39**
Environments + (G × E)	42	672451.25**
Environment (linear)	1	19768554.00*
Genotype × Environments (linear)	13	245325.08**
Pooled deviation	28	188756.61**
Pooled error	52	73203.32

*Significant at P = 0.05 ** Significant at P = 0.01

Table 2. Mean and stability parameters for grain yield in cowpea

S. No.	Genotype	Grain yield g/plot (12 m^2)	Grain yield kg/ha	S^2d	b
1	VCP 09024	1657 [a]	1381	64246.65*	1.20 @ ns
2	VCP 12005	1522 [a]	1268	80.03*	0.83 @ ns
3	VCP 12006	1585 [a]	1320	-3894.04	1.27 @ ns
4	VCP 12010	1404	1170	77339.94*	0.70
5	VCP 12016	1453 [a]	1211	317811.84*	0.70
6	VCP 12024	1633 [a]	1361	6364.18*	1.33 @ ns
7	VCP 13001	1577 [a]	1314	-11136.32	0.73 @ ns
8	VCP 14001	1975 [a]	1645	363866.59*	1.74
9	VCP 14005	1718 [a]	1432	27426.96*	1.51 @ ns
10	VCP 14013	1392	1160	1141374.75*	0.71
11	VCP 15006	1578 [a]	1315	-21586.07	1.26 @ ns
12	CO CP 7 (Check 1)	1323	1102	119283.56*	0.85
13	VBN 1 (Check 2)	984	820	-13456.63	0.12
14	VBN 3 (Check 3)	1631	1359	62448.96*	1.06
	Mean	**1531**	**1276**		
	CD (P=0.05)	**541**	**451**		

[a] Statistically on par with best check (VBN 3)
*Significant at P = 0.05
@ Significantly different from b=0 at P=0.05
ns Non significantly different from b=1 at P=0.05