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Research Article

Genotype x Environment interaction in Mungbean (*Vigna radiata* (L.) Wilczek) cultivars grown in different agro-climatic zones of Karnataka

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Abstract:
Fourteen genotypes were tested at five locations in North-Karnataka in the *kharif* season-2008 to study their yield stability. Pooled analysis of variance and stability analysis were performed. The genotypic (G) x environment (E) interaction and both variance due to genotypes and environment were significant. The partioning of G x E interaction into linear and non-linear components indicated that both predictable and unpredictable components shared the interaction. On the basis of stability parameters, the top yielding genotypes such as DGGV-2 (964 Kg/ha) DLGG-22 (945 Kg/ha) and DGGS-16 (933 Kg/ha) exhibit the stable performance across the environments. The genotypes BGS-9 (933 Kg/ha), BPMR-1 (903 Kg/ha) and KGS-83 (908 Kg/ha) gave higher yield across the locations but their performance was unstable due to significant deviation from regression. On the basis of results, DGGV-2, DLGG-22 and DGGS-16 were the most suitable and desirable genotypes which showed higher stable grain yields at different agro-climatic regions.

Key words: Green gram, G x E interaction, Stability analysis, Seed yield

Introduction

Pulses plays an important role in Indian agriculture besides being rich in protein and constitute the main source of essential amino acids for predominantly vegetarian population of India (Armugam, Anandhi & Selvi, 2010). In India greengram is grown in 2.84 m. ha with a production of 1.04 m. t during 2008-09. Mungbean (*Vigna radiata* (L.) Wilczek) is one of the important pulse crops grown in Karnataka. The development of varieties, which can be adapted to diverse environments, is the major goal of plant breeders in a crop improvement program. The adaptability of a variety over diverse environments is usually tested by the degree of its interaction with different environments under which it is tested. Crop growth is being affected by erratic nature of climate, hence there is a need to evaluate genotypes for their suitability and niche based stable performance. Grain yield, an economically important quantitative trait, exhibits Genotype x Environment interaction, which necessitates genotypes evaluation in multi-environment.

Genotype x Environment interaction is an important and essential component of plant breeding programs dedicated to cultivar development (Natarajan, 2001). Eberhart and Russell (1966) defined stability as the ability to show a minimum interaction with the environment. Hence, the stability of genotype performance is directly related to the effect of G x E (Campbell and Jones, 2005). The adaptability of a variety over diverse environments is usually tested by the degree of its interaction with different environments under which it is tested (Finlay, and Wilkinson, 1963). A variety or genotype is considered to be more adaptive / stable one, if it has high mean yield but a low degree of fluctuation in yielding ability when grown over diverse environments. The yield of mungbean fluctuates due to suitability of varieties to different growing environments. A specific genotype does not always exhibit the same phenotypic traits under all environments and different genotypes respond differently to specific location. Therefore knowledge of G x E interaction and yield stability are important for breeding new cultivars with improved adaptation to environmental constraints prevailing in the target environments. The present research studies were conducted to know genotype-environment interaction and to identify stable and high yielding mungbean genotypes under changing environments.

Material and methods

The materials for the present study comprised fourteen genotypes of greengram evaluated during *kharif* 2008-09, under five different locations viz. Dharwad, Bidar Gulbarga, Bailhongal and Annigeri, that represented different agro climatic zones of north Karnataka (Table 1). The trials were conducted in randomized block design replicated thrice in each environment with row to row distance of 30 cm and plant to plant distance of 10 cm. Recommended agronomic practices and plant protection measures were followed for raising good crop at each location. The crop was harvested at the time of 90% pod maturity and yield data were recorded in Kg/ha. Stability parameters for grain yield were worked out as suggested by Eberhart and Russell (1966), using computer software written in "INDOSTAT".

Results and discussion

Pooled analysis of variance showed highly significant differences among the genotypes and environments for grain yield (Table 2), indicating the presence of genetic variability among the genotypes as well as the environments under study. The genotype x environment (G x E) interaction was further partitioned into linear and non-linear (pooled deviation) components. It was found that both components were significant, indicating that both predictable and unpredictable components shared G x E interaction. The G x E (linear) interaction was highly significant when tested against pooled deviation, which revealed that there are genetic differences among genotypes for their regression on the environmental index. These results are in agreement with those reported by Natarajan (2001) in blackgram and Manivannan et al., (1998) and Patel et al., (2009) in greengram. Eberhart and Russel (1966) and Westerman (1971) emphasized that both linear (bi) and non-linear (S^2di) components of G x E interaction should be considered in judging the phenotypic stability of a particular genotype.

Based on the environmental indices, for grain yield indicated that Bailhongal (73.6) followed by Dharwad (58.3) and Bidar (34.9) were the most favourable environments for the better expression of traits as revealed by high and positive environmental indices, while, Gulbarga and Annigeri were the unfavourable environment due to high negative environmental indices (Table.3). At Dharwad (Northern-Transition Zone), DGGS-4(1086 kg/ha), DGGS-16 (1042 kg/ha), KGS-5 (1027 kg/ha) and KGS-83 (1004 kg/ha) are the promising entries, while, BGS-9 (1222 kg/ha), DLGG-21 (1114 kg/ha), KGS-83 (1102 kg/ha) and DGGV-2 (1036 kg/ha) are the high yielding genotypes at Bailhongal. The genotypes, SG-101 (1107), KGS-83 (912 kg/ha) , DGGS-16 (866 kg/ha) and TM-98-50 (828 kg/ha) are the top yielding entries at Annigeri (Northern dry zone). KGS-5 (1060 kg/ha) followed by DGGV-2 (1035 kg/ha) are the suitable cultivars for Gulbarga (North-Eastern Dry zone). The genotypes such as BGS-9 (1053 kg/ha), DLGG-22 (1035 kg/ha) and DGGV-2 (1017 kg/ha) are the promising entries at Bidar (North-Eastern-Transition Zone).

In the present study, stability parameters such as mean (X), regression coefficient (bi) and deviation from regression (S^2di) as suggested by Eberhart and Russel (1966) were considered to explain and discuss the stability of different genotypes for grain yield (Table.4).

The genotypes such as DGGV-2 (964 kg/ha) and DLGG-22 (945 kg/ha) and DGGS-16 (933 kg/ha) and TM-98-50 (924 kg/ha) exhibited high mean performance along with regression value nearer to unity (bi=1) and non significant deviation from regression (S^2di = 0) indicating their wider adaptability across the environments. The genotypes such as KGS-83 (908 kg/ha) and BPMR-1 (903 kg/ha) and SG-101 (915 kg/ha) are showed higher mean performance, low regression value (bi<1) and significant deviation from regression (S^2di>0), indicating their performance was unstable across the environments and they are suitable for poor environments. The genotype, Sedam local (933 kg/ha) was found suitable for rich environments (bi>1) and their performance was unpredictable due to significant deviation from regression.

The simultaneous consideration of these stability parameters for the individual genotype revealed that genotypes such as DGGV-2, DLGG-22, DGGS-16 (933 kg/ha) and TM-98-50 (924 kg/ha) are high yielders and showed stable performance across the environments. The stability of genotypes for seed yield and its components in greengram has also been reported by Manivannan et al. (1998) and Patel et al. (2009).

The present investigation revealed that the presence of G x E interaction among the genotypes of mungbean. High yielding genotypes with wider adaptation and genotypes with specific adaptation to target environment were identified. Further studies on G x E interaction for yield components at different growth stages and biochemical profiles are needed to be investigated.

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References:

Armugam, P.M. Anandhi, K., and Selvi, B. 2010. Stability analysis of yield in blackgram. *Legume Res.,* **33**: 70-71.

Campbell, B.T., and Jones, M.A. 2005. Assessment of genotype x environment interactions for yield and fibre quality in cotton performance trials. *Euphytica,* **144**: 69-78.

Eberhart, S.A. and Russell, W.A. 1966. Stability parameter for comparing varieties. *Crop Sci*., **6**: 36-40.

Finlay, K.W. and Wilkinson, G.N. 1963. The analysis of adaptation in a plant breeding programme. *Australian J. Agric. Res.,* **14**:742-754.

Manivannan, N. Ramasamy, A and Natarajan, N. 1998. Phenotypic stability analysis in greengram. *Indian J. Agric. Sci*. **68**: 31-32.

Natarajan, C. 2001. Stability of yield and its components in blackgram. *Madras Agric. J.* **88:** 409-413,

Patel, J.D. Naika, M.R. Chaudhari, S.B. Vaghelaa, K.O. and Kodappully, V.C. 2009. Stability analysis for seed yield in greengram (*Vigna radiate* L. Wilczek). *Agric. Sci. Digest*, **29**: 24-27.

Westerman, J. M. 1971. Genotype x Environment interaction and developmental regulation in *Arabidopsis thaliana* II. Inbred lines analysis. *Heredity*, **26**: 93-106.

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Table 1. Various locations of the experiments conducted for stability study

Research Institutes/Stations	Agro-climatic zones of North-Karnataka	Soil type
MARS, Dharwad	Northern-Transition Zone (Z-8)	Medium black clay and red sandy loam in equal proportion
ARS, Bidar	North-Eastern Transition Zone (Z-1)	Medium black clay-laterite type
ARS, Gulbarga	North-Eastern Dry Zone (Z-2)	Deep black clay
ARS, Bailhongal	Northern-Transition Zone (Z-8)	Medium black clay and red sandy loam in equal proportion
ARS, Annigeri	Northern-Dry Zone (Z-3)	Shallow to deep black soil

Table 2. Pooled analysis of variance for grain yield in green gram

Source of variation	df	MSS
Genotypes	13	28367.160 *
Environments	4	93076.110 ***
Genotypes x Environment	52	150687.530 *
Env.+ (Genotypes x Environment.)	56	21215.290*
Environments (Lin.)	1	372304.400 ***
Genotypes x Environment.(Lin.)	13	15289.820*
Pooled Deviation	42	14690.090 ***
Pooled Error	130	286.624

*Significance at 5% level ** Significance at 1% level

Table 3. Performance of Mungbean cultivars over the locations

Genotype	Dharwad	Bailhongal	Annigeri	Gulbarga	Bidar	Mean (kg/ha)
KGS-83	1004	1102	912	806	713	908
KGS-5	1027	909	607	1060	692	860
BGS-9	922	1222	581	888	1053	933
DGGV-04	1086	796	603	489	841	763
DGS-052	937	641	654	657	911	760
TM-98-50	953	919	828	917	1006	924
DGGV-02	968	1036	808	991	1017	964
BPMR-1	900	898	810	953	953	903
DLGG-22	968	1114	682	933	1035	946
DGGS-16	1042	964	866	883	906	932
SG-101	810	1061	1107	744	849	915
China mung	818	893	729	735	965	828
Selection-4		731	638	729	866	753
Pusa Baisakhi	765	934	689	740	872	800
Mean	929	944	751	823	905	870
Environmental indices	58.310	73.643	-119.643	-47.262	34.952	

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Table 4. Mean performance and stability parameters for grain yield in green gram.

Name of the genotype	Mean (kg/ha)	bi	S²Di
KGS-83	908	0.66	26160.133**
KGS-5	860	1.16	42302.18**
BGS-9	933	2.59	12886.05**
DGGV-04	763	2.11	29411.98**
DGS-052	760	0.92	20685.63**
TM-98-50	924	0.93	539.50
DGGV-02	964	0.97	1452.7
BPMR-1	903	0.35	1434.98
DLGG-22	946	1.04	1551.9
DGGS-16	932	0.94	902.42
SG-101	915	0.47	30419.72**
China mung	828	0.95	2982.09
Sel-4	753	0.76	2830.68
Pusa Baisakhi	800	0.99	2809.22
Overall mean (kg/ha)	870		

*Significance at 5% level   ** Significance at 1% level