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ADDITIVE MAIN EFFECTS AND MULTIPLICATIVE INTERACTION (AMMI) STABILITY ANALYSIS FOR SEED YIELD IN BLACKGRAM (*VIGNA MUNGO* L. HEPPER) GENOTYPES

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Abstract

Twenty-one blackgram genotypes were evaluated for three seasons from Rabi 2017 to Rabi 2018 to assess the genotype x environmental interactions. Analysis of variance for the pooled data over seasons showed significant difference between genotypes, seasons and the interaction between genotypes and seasons for seed yield per plant. Genotypes recorded high yield during Rabi seasons as compared to that of Kharif season which showed that winter season was more favourable for blackgram cultivation. According to AMMI biplot 2, KGB-28 was comparatively non-sensitive to environmental interactive forces with significant high seed yield per plant. Hence this genotype (KGB-28) can be selected for seed yield per plant. Based on the present study, the genotype KGB-28 can be recommended as a stable genotype for blackgram cultivation.

Key words: Blackgram, Stability, AMMI, Biplot.

Introduction

Black gram (*Vigna mungo* L. Hepper), is an important pulse crop of India. Most suitable climate to cultivate blackgram is 27-30°C with heavy rainfall. This annual crop prefers loamy soil which has high water preservation capability. Blackgram grows normally in 90–120 days and it also enriches the soil with nitrogen. Lack of suitable varieties and genotypes with adaptation to local conditions are one of the important factors affecting the pulse production in India. Genotype × Environment interaction is an important and essential component of plant breeding programs dedicated to cultivar development (Natarajan, 2001). According to Shanthi *et al*., (2007), though several improved varieties in blackgram have been developed, most of them show inconsistent performance under varied environmental conditions due to genotype × environment interaction. As it is under the control of genes, the breeders are able to select suitable genotypes in advance generations by growing them under different environmental conditions. The yielding ability of a crop variety over a wide range of environments is as important as it's per se for yield especially so when the crop is grown under wide range of environmental conditions. Thus, Planning for preliminary evaluation to identify stable genotypes of wide adaptability or productive genotypes for a specific environment is imperative.

The AMMI model is a hybrid analysis that incorporates both additive and multiplicative components of the two-way data structure. AMMI biplot analysis is considered to be an effective tool to diagnose G × E patterns graphically. The principal component analysis (PCA), which provides a multiplicative model, is applied to analyse the interaction effect from the additive ANOVA model. The biplot display of PCA scores plotted against each other provides visual inspection and interpretation of G × E interaction components. The integration of biplot display and genotypic stability statistics enables genotypes to be grouped on the basis of similarity in performance across diverse environments (Mukherjee *et al.,* 2013). Present study was taken up to evaluate the genotype x environment interaction of twenty-one blackgram genotypes under different seasons and to identify the stable genotypes suitable for cultivation.

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Material and Methods

Twenty-one genotypes of blackgram were evaluated under three seasons (Rabi 2017, Kharif 2017 and Rabi 2018) at Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Tamilnadu. The experiment was laid out in randomized block design with two replications. Standard agronomic practices were followed throughout the growing season. The mean value of two replications over seasons were used for statistical analysis. The data for seed yield per plant was subjected to analysis of variance using statistical package STAR (Statistical Tool for Agricultural Research). Genotype x environment interaction of the genotypes over different seasons for seed yield per plant was done by AMMI model using PBTools statistical package.

Table 1: Combined analysis of variance.

Source	Df	MSS
Season	2	5.16**
Genotype	20	5.49***
Season:Genotype	40	1.39***

*, **, *** significant at the p<0.05, p<0.01, p<0.001.

Table 2: Seed yield per plant (g) of blackgram genotypes over seasons.

Genotype	Mean (g)			
	Rabi 2017	Kharif 2017	Rabi 2018	Pooled
IC-343943	3.13	1.84	3.19	2.72
IC-343947	3.71**	2.23	3.59	3.18
IC-343962	2.75	2.61	2.61	2.66
ABG-11013	4.51**	3.00	3.34	3.62**
KU-11680	5.28**	2.72	4.60**	4.20**
TBG-104	1.96	1.79	2.74	2.16
VBG-10010	7.18**	2.57	6.63**	5.46**
VBG-11011	5.70**	3.43*	4.38**	4.50**
VBG-12005	2.55	2.88	2.70	2.71
VBG-12062	5.38**	2.56	4.78**	4.24**
VBG-13017	1.90	2.01	2.60	2.17
ADT-5	4.83**	2.79	4.87**	4.16**
RU-16-9	2.23	3.30*	2.53	2.69
RU-16-13	1.91	2.45	2.06	2.14
RU-16-14	2.38	3.30*	2.28	2.65
KGB-28	3.43	3.18	3.68	3.43**
T-9	1.89	2.84	2.37	2.37
VBN(Bg)-4	1.94	2.20	2.30	2.15
VBN(Bg)-6	1.89	2.47	2.11	2.16
VBN(Bg)-7	1.78	2.74	2.28	2.27
MDU Local	2.91	2.53	2.51	2.65
General mean	3.30	2.64	3.25	3.06
SE	0.08	0.22	0.21	0.11
CD (p = 0.05)	0.24	0.64	0.62	0.32
CD (p = 0.01)	0.33	0.87	0.84	0.43

*, ** significant at the p<0.05, p<0.01

Table 3: Percent of GEI and cumulative percentage for seed yield per plant.

Character	Source	Df	MSS	Percent of GEI sum of squares	Cumulative percentage
Seed yield	IPCA 1	21	1.84	92.40	92.40
per plant	IPCA 2	19	0.16	7.60	100.00

Results and Discussion

The combined analysis of variance revealed that, there were significant differences (p<0.01) among genotypes in respect to seed yield per plant, which demonstrates high genetic variance among the genotypes where the screening would be effective. Similarly, seasons differed significantly (p<0.001) for seed yield. Moreover, genotype x environment interaction was also significant which suggested that performance of genotypes was inconsistent across different seasonal conditions.

Comparison of mean yield of black gram genotypes Table 2 over seasons revealed that high grain yield was

Table 4: Mean and IPCA scores of blackgram genotypes and environments for seed yield per plant.

Genotype	Seed yield per plant		
	Mean	IPCA 1	IPCA 2
IC-343943	2.72	-0.24	0.16
IC-343947	3.18	-0.28	0.07
IC-343962	2.66	0.19	-0.14
ABG-11013	3.62**	-0.18	-0.60
KU-11680	4.20**	-0.60	-0.13
TBG-104	2.16	0.08	0.46
VBG-10010	5.46**	-1.34	0.25
VBG-11011	4.50**	-0.43	-0.58
VBG-12005	2.71	0.33	-0.01
VBG-12062	4.24**	-0.70	-0.05
VBG-13017	2.17	0.19	0.37
ADT-5	4.16**	-0.50	0.26
RU-16-9	2.69	0.57	-0.02
RU-16-13	2.14	0.40	-0.04
RU-16-14	2.65	0.57	-0.26
KGB-28	3.43**	0.11	0.14
T-9	2.37	0.51	0.11
VBN(Bg)-4	2.15	0.28	0.14
VBN(Bg)-6	2.16	0.41	-0.002
VBN(Bg)-7	2.27	0.51	0.13
MDU Local	2.65	0.14	-0.26
Season 1	3.30	-1.23	-0.73
Season 2	2.64	1.80	-0.21
Season 3	3.25	-0.56	0.94

*, ** significant at the p<0.05, p<0.01.

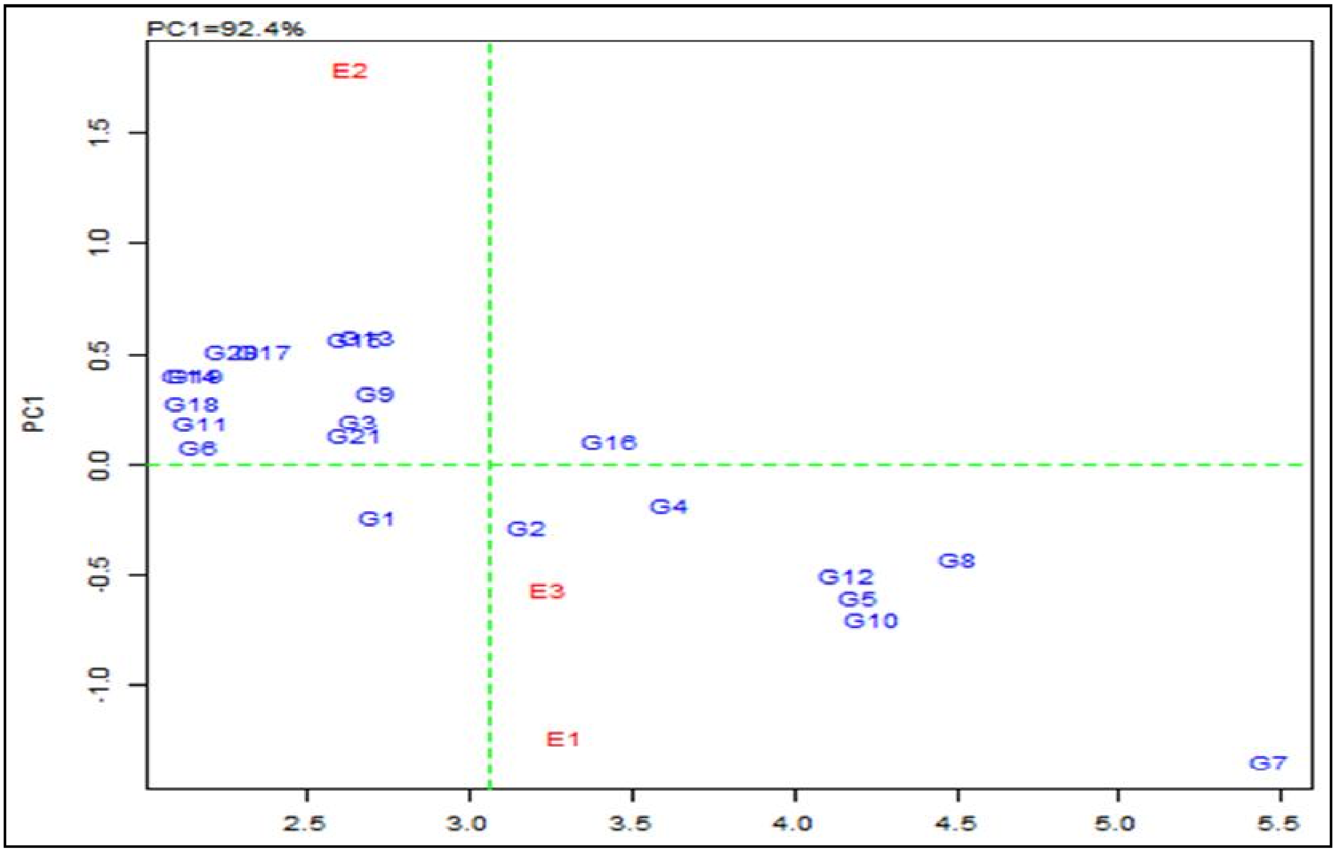

Fig. 1: Biplot (AMMI 1) for seed yield per plant.

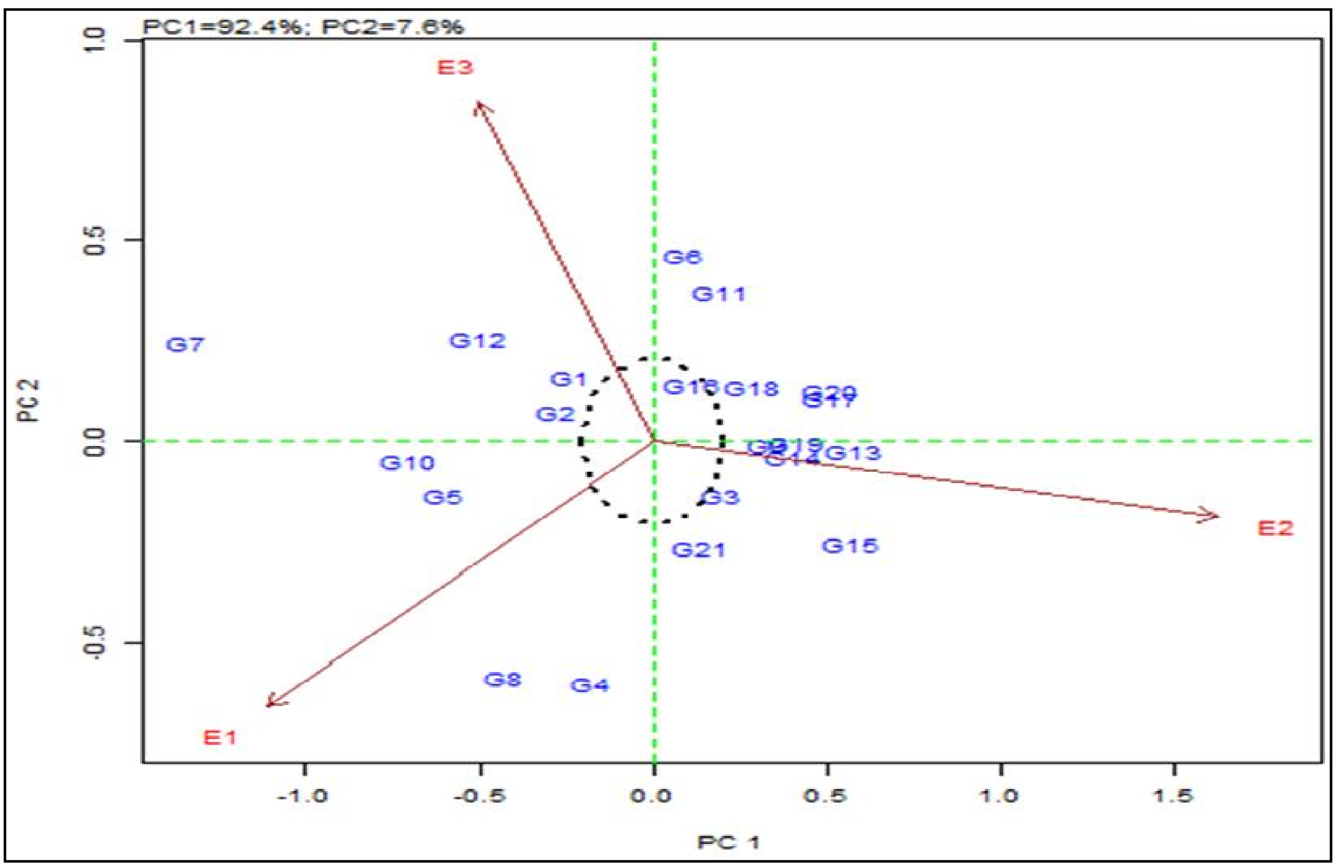

Fig. 2: Interaction biplot (AMMI 2) for seed yield per plant.

obtained during the season Rabi (2017) followed by Rabi (2018). Genotypes recorded high yield during the Rabi seasons as compared to Kharif season which shows that winter season were more favourable for blackgram cultivation. Genotype VBG-10010 showed highest seed yield per plant over seasons (5.46g). The genotypes ABG-11013, KU-11680, VBG-11011, VBG-12062, ADT-5 and KGB-28 exhibited significant high seed yield per plant.

Genotype × environment interaction is of universal occurrence for any quantitative character. A specific genotype does not exhibit the same phenotypic value under all environments (Joseph *et al.*, 2015). The different genotypes respond differently to a specified environment (Vidyarani, 2005).

Analysis of variance revealed that there was significant G × E interaction. Partitioning of the G × E into different scores principle components indicate that all the interaction was explained by three scores. Of these the first one accounted for 92.40 percent and first two scores accounted for 7.60 percent of the variation Table 3. Thus, the first two scores explained most of the variation.

Mean values of genotypes for seed yield per plant, ranged between 2.14 (RU-16-13) and 5.46 (VBG-10010). Range for seasonal mean for seed yield per plant varied from 2.64 to 3.30. Positive values for IPCA 1 were showed by IC-343962, TBG-104, VBG-12005, VBG-13017, RU-16-9, RU-16-13, RU-16-14, KGB-28, T-9, VBN(Bg)-4, VBN(Bg)-6, VBN(Bg)-7, MDU Local and season II. IPCA 2 values were positive in IC-343943, IC-343947, TBG-104, VBG-10010, VBG-13017, ADT-5, KGB-28, T-9, VBN(Bg)-4, VBN(Bg)-7 and season III (Table 4).

For seed yield per plant, based on the biplot 1 Fig. 1, KGB-28 is classified under the high mean and positive IPCA. According to biplot 2 Fig. 2, KGB-28 was comparatively non-sensitive to environmental interactive forces with significant high seed yield per plant. Hence this genotype (KGB-28) can be selected for seed yield per plant. Babu *et al.*, (2009) studied the phenotypic stability in blackgram using AMMI model and identified three genotypes as stable for seed yield per plant. Stability studies using AMMI model by Pratap *et al.*, (2009), in green gram indicated that seven genotypes out of 12 were stable for seed yield per plant. Based on the present study, the genotype KGB-28 can be recommended as a stable genotype for blackgram cultivation.

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