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Research Article

Genetic analysis on genotype x environment interaction for seed yield in greengram (*Vigna radiata* (L.) Wilczek)

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Abstract

Nineteen cultures of greengram including two check varieties *viz*. CO 8 and VBN (Gg) 3 were evaluated for four seasons at NPRC, Vamban. The data on seed yield were subjected to genotype x environment interaction analysis to identify high yielding stable greengram culture. Significant G x E interaction depicted differential performance of the cultures over environments. Based on stability analysis, it was concluded that the genotype VGG 15-030 was found to be a high yielder, stable performer with no response to environments. It can be recommended for both *kharif* and *rabi* seasons. The genotype, VGG 15-035 was found to be high yielder, stable performer with above average response to environments. Hence this culture can be recommended to favourable environments.

Key words

Greengram, stability analysis, G x E interaction, seed yield

Introduction

Greengram (*Vigna radiata* L. Wilczek), an important short duration grain legume, widely grown in South and South east Asia.It is considered as an economically important legume crop in Asia. Over 80% of greengram is produced in South Asia. It is grown in crop rotation and relayed cropping with cereals using residual moisture in soil. The changes in climate may cause unpredictable drought and heat stress.

Genotype × environment is the main bottleneck which can vitiate entire efforts of a plant breeder for boosting higher yield. Thus, breeding for climate or environment resilient varieties is crucial (Allard and Bradshaw, 1964). Several methods of simultaneous selection for yield as well as stability and relations among them were discussed by Kang and Pham (1991) and Kang (1998).

The phenotype has been confidently defined as a linear function of genotype, environment and interaction between genotype and environment (Lu *et al*., 1986 and Scheiner, 1993). The results of various scientists *viz*. Immer and Power (1934), Salmon (1951), Horner and Frey (1957) and Sandison and Barlett (1958) reflected that variety × season interactions were basic estimates of adaptability. Yates and Cochran (1938) subdivided genotype × environment interactions into linear and nonlinear components. Eberhart and Russell (1966) developed a model based on the regression technique for measuring the stability of populations grown from single and three way crosses of maize. In order to identify such adaptable genotypes, it is essential to perform stability analysis. G x E interaction is one of the main bottlenecks which interfere with performance of genotypes. Therefore, identification of suitable genotypes with minimum G x E interaction is essential for crop improvement. Hence an attempt was made to identify stable and high yielding genotype among genotypes of greengram.

Material and Methods

Nineteen cultures of greengram including two check varieties *viz*. CO 8 and VBN(Gg) 3 were evaluated in Randomized complete block design with two replications during *kharif* 2015, *rabi* 2015-16, *kharif* 2016 and *rabi* 2016-17 at National Pulses Research Centre, Tamil Nadu Agricultural University, Vamban, Tamil Nadu. Each entry was evaluated in a plot size of 12 m^2. The data on each season was analysed. Further, the data on seed yield kg/ha was subjected to pooled analysis and found significant G x E interaction. Hence, this data was subjected to stability analysis as proposed by Eberhart and Russell (1966).

Results and Discussion

G × E interactions have major importance to plant breeders in developing improved varieties. Low levels of interactions are useful for some characters so as to maximize stable performance over a number of environments. The interactions of genetic and non genetic factors on phenotypic expression is called G × E interaction which is widely present and substantially contributes to the non realization of expected gain from selection (Comstock and Moll,1963). Stable genotypes are particularly of great importance in India, where greengram is grown as a risk under varied environmental conditions. G × E interaction certainly plays an important role in the evaluation and execution of breeding programmes. Allard and Bradshaw (1964) have critically reviewed this phenomenon and brought out its implications in applied plant breeding. Thus, G × E interaction is important in the expression of quantitative characters, which are controlled by polygenic systems and largely influenced by environmental fluctuations.

In the present investigation, 19 genotypes of greengram comprising of 17 cultures and two local checks were subjected to pooled analysis of variance (**Table 1**). The analysis of variance depicts significant differences present among genotypes which indicate the presence of substantial amount of variability in mean performance of genotypes over four environments. Further these data were subjected to pooled analysis. The results indicated the presence of significant G x E interaction. Significant G x E interaction indicates differential performance of genotypes under different environments. Similar results of existence of G x E interaction was also reported by Imrie and Butler (1982), Singh and Nanda (1997). Anamika *et al.* (2013) and Manivannan *et al.* (1998) in greengram. The linear component of G x E interaction was significant for seed yield indicating genotypes differed for their linear response to the changing environments. Similar results were also reported by Patel *et al*. (2009) and Abbas *et al*. (2008). The magnitude of variation due to environment (linear) was higher than G x E (linear) for seed yield which revealed that most of the total variation was contributed by environment only. These results were in accordance with Gomashe *et al*. (2008). Significant pooled deviation indicated that genotypic performance varies in response to environment. The predominance of linear component would help in predicting the performance of the genotypes across the environments.

Mean seed yield and stability parameters are presented in **Table 2**. According to Eberhart and Russell (1966), a stable genotype should be with high yield, non-significant squared deviation from regression and average response to the environment. Among the two check varieties, non-significant S^2d_i and b_i was observed in check variety, VBN (Gg) 3. It indicates the stability of VBN (Gg) 3 over environments with average response to environment. Hence, VBN (Gg) 3 can be recommended to all seasons so as to obtain stable yield. With regard to cultures, two genotypes *viz*. VGG 15-030 and VGG 15-035 recorded non-significant S^2d_i and hence considered as stable genotypes. Among these two genotypes, VGG 15-030 had regression coefficient (b_i) equal to b=0. Thus, this genotype was considered as non responsive and suitable to all environments. The genotype, VGG 15-035 recorded non-significant S^2d_i and b_i>1 and hence considered as above average responsive genotype and suitable for favourable environments only. With regard to the mean performance for seed yield, both genotypes VGG 15-030 (1127 kg/ha) and VGG 15-035 (1110 kg/ha) recorded higher seed yield than the best and stable check variety VBN (Gg) 3 (943 kg/ha).

Based on the foregoing discussion, it can be concluded that the genotype, VGG 15-030 was found to be a high yielder, stable performer with no response to environments. It can be recommended for both *kharif* and *rabi* seasons. The genotype, VGG 15-035 was found to be high yielder, stable performer with above average response to environments. Hence, this genotype can be recommended to highly favourable environments only.

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Table 1. ANOVA for stability analysis of seed yield in greengram

Source of variation	**Df**	**Mean sum of square**
Genotype	18	87467.10 *
Environment	3	261400.14 *
G X E	54	29291.99 *
E + G x E	57	41508.21 *
Environment(linear)	1	784200.43 *
G x E (linear)	18	15739.20 *
Pooled deviation	38	34170.38 *
Pooled error	72	5419.64

* Significant at P = 0.05

Table 2. Estimates of stability parameters for seed yield in green gram

S. No.	**Genotype**	**Seed yield**	**b_i**	**S^2d_i**
1.	CO 8	832	0.59	-0.68
2.	**VBN (Gg)3**	943	**#1.00**	0.01**ns**
3.	VGG 15-007	1154	0.64	-0.58
4.	VGG 15-008	805	0.24	-0.73
5.	VGG 15-009	751	1.59	0.73
6.	VGG 15-011	749	2.49	0.92
7.	VGG 15-012	909	0.53	-0.24
8.	VGG 15-013	1056	0.49	-0.74
9.	VGG 15-015	938	0.91	-0.13
10.	VGG 15-016	919	0.23	-1.00
11.	VGG 15-029	1271	0.97	-0.04
12.	**VGG 15-030**	1127	1.27	0.9**ns**
13.	VGG 15-031	970	1.60	1.05
14.	VGG 15-032	1068	1.11	0.10
15.	VGG 15-033	957	1.25	0.30
16.	**VGG 15-035**	1110	**#@1.67**	8.04**ns**
17.	VGG 15-036	883	0.96	-0.07
18.	VGG 15-038	1124	1.47	0.50
19.	VGG 15-040	811	-0.07	-1.00

Significantly different from b=0
@ Significantly different from b=1
*Significantly at 5% probability