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EVALUATION OF GENOTYPES X ENVIRONMENTAL INTERACTION IN GRASS PEA (*Lathyrus sativus* L.)

S. R. Kamdi[1], Shanti Patil[2], Shubhangi Bhasme[3], P. R. Kadu[4], R. D. Deotale[5] and V.S. Jayade[6]

ABSTRACT

For assessment of Genotypes x Environmental interaction, six grass pea local collections (CAGL- 19, CAGL-93, CAGL-86, CAGL-43, CAGL-94 and CAGL-63) along with three checks viz., Ratan, Prateek and Mahateora were evaluated in randomised block design with three replications at three locations namely College of Agriculture, Gadchiroli, Agricultural Research Station, Sakoli and Zonal Agricultural Research Station, Sindewahi during *rabi* 2015 for yield (kg ha^{-1}) using Eberhart and Russell Model (1966). Significant differences were observed among the genotypes under all the locations. Mean sum of squares due to environment (linear) and genotype – environment interaction were highly significant. Based on high mean, b_i=1 and minimum S^2di value, genotype CAGL-86 was identified as stable genotype for yield (kg ha^{-1}). Therefore, this genotype could be suitable for cultivation in Vidarbha (Maharashtra).

(Key words: Grass pea, *Lathyrus sativus* (L.), stability analysis, G x E interaction)

INTRODUCTION

Grass pea is valued for its high protein content, high degree of adaptability under extreme conditions, disease resistance and low input requirement for its cultivation. In India the crop is largely grown in Madhya Pradesh, Maharashtra, West Bengal and Bihar and many instances of a crippling disorder have been reported in these states.

In the state of Himachal Pradesh, grass pea is a minor crop grown by marginal farmers as a rainfed crop in mid hill region conditions of the northwestern Himalayas. The climate of this region is sub humid and temperate wet, characterized by dry conditions at the time of sowing and terminal drought. Cultivation of grasspea has not been completely abandoned and the marginal farmers continue to grow it on a small scale for domestic consumption and as a forage crop. Grass pea (*Lathyrus sativus* L.) is mainly grown as *utera* crop after paddy in *rabi* season on residual moisture in Eastern Vidarbha region on approximately 60,000 ha area. But, the yield potential of Vidarbha is nearly half as compared to India. Because most farmers use local varieties for cultivation which have low yield potential, poor plant type and high neurotoxin content, this is unstable over environment. So, there is urgent need to develop varieties having high yield potential, tolerance to drought, low neurotoxin content and stable over environment. The genotype which can precisely maintain consistent yield performance over a wide range of climate and fluctuating environment is said to be stable genotype. The stability of genotype has always been a matter of great concern to plant breeders. Keeping these things in view, present study was conducted to identify potential genotypes having stable performance over environment in lathyrus.

MATERIALS AND METHODS

Six grass pea local collections (CAGL- 19, CAGL-93, CAGL-86, CAGL-43, CAGL-94 and CAGL-63) and three checks viz., Ratan, Prateek and Mahateora were evaluated in randomised block design with three replications at three locations namely College of Agriculture, Gadchiroli, Agricultural Research Station, Sakoli and Zonal Agricultural Research Station, Sindewahi during *rabi* 2015 for yield. Every genotype was sown with 4 rows of 5 m length with a plot size of 5 x 1.20 m^2. The row to row and plant to plant spacing was maintained as 30 cm and 10 cm respectively. Recommended package of practices were followed to raise a healthy and disease free crop. Observation on five randomly selected plants for yield plant^{-1}, yield plot^{-1} and used for calculating yield (kg ha^{-1}). The data were analysed for stability using Eberhart and Russell (1966) model.

RESULTS AND DISCUSSION

Environment-wise analysis of variance revealed significant differences among the genotypes under each environment for all the characters (Table 1). The pooled analysis of variance also revealed significant differences among genotypes for all the characters (Table 2) indicating

1., 2. & 6. Asst. Professors, Agril. Botany Section, College of Agriculture, Nagpur
3. Agril. Officer. Panchayat Samiti, Kamptee.
4. Assoc. Professor, Soil Science & Agril. Chemistry Section, College of Agriculture, Nagpur
5. Professor, Agril. Botany Section, College of Agriculture, Nagpur

that environments were differently exerted influence on different genotypes in their expression of characters. The Genotype x Environment interaction was also significant indicating all the genotypes were effectively interacted against environments. The existence of G x E interaction for yield has also been reported by Kamaluddin and Ahmad (2012) in soybean and Kumari (2001) in lathyrus.

The mean sum of squares due to environment (linear) was found significant (Table 3). Therefore, it is concluded that the environments were random and different variation could have arisen due to the linear response of regression. The significance of linear component of variance due to environment has also been reported by Verma *et al.* (2011), Solanki *et al.* (2014) and Idhole *et al.* (2016) in soybean and Kumari (2001) in lathyrus, The mean sum of squares due to G x E (linear) was found to be non significant for yield (kg ha^{-1}) indicating possible absence of genetic difference among the genotypes for their regression on the environmental index making difficult the prediction for the performance of these traits. Similar to this findings non-significant G x E (linear) was reported by Solanki *et al.*(2014) and Idhole *et al.* (2016) in soybean . The non-linear component (pooled deviation) arising due to heterogeneity measured as mean squares due to pooled deviation was significant which revealed the presence of non-linear response of the genotypes to changing environments. The significance of pooled deviation confirmed contribution of non-linear component to total G x E interaction. The genotypes differed with respect to stability of these traits making its prediction more difficult. However, the magnitude of linear component i.e. Environment (linear) and Environment + (G x E) was many times higher than the non-linear component (pooled deviation) indicating the prediction of stability could be reliable though it may get affected to some extent. In accordance to this result, Verma *et al.* (2011) and Idhole *et al.* (2016) also reported higher magnitude of linear component over the non-linear component in soybean. Significance of the deviation of each genotype from its regression when tested by 'F' test revealed that genotype CAGL-86 and Prateek(ch) was only non significant and all other genotypes recorded significant deviation.

Estimates of S^2di for yield (kg ha^{-1}) was non-significant and regression co-efficient b_i closer to unity for three genotypes *viz.,* CAGL-93, CAGL-86 and CAGL-94 (Table 4) for yield (kg ha^{-1})which revealed that these genotype had better stability for yield. Out of three genotypes only CAGL-86 showed non significant deviation from regression as observed from table 3. This genotype (CAGL-86) also recorded high yield and was observed to be significantly superior over Ratan (Ch) for yield (kg ha^{-1}). Solanki *et al.* (2014), Verma *et al.*,(2011) and Idhole *et al.* (2016) in soybean and Kumari (2001) in lathyrus also identified stable genotypes for seed yield $plant^{-1}$.

It is inferred from this study that genotypes CAGL-86 was found to be stable and suitable for cultivation in Vidarbha (Maharashtra).

Table 1. Analysis of variance location wise for yield (kg ha^{-1})

Sources of variation	df	Mean squares		
		Location 1	Location 2	Location 3
Replication	2	9934.62	1384.42	938.29
Varieties	8	42047.34**	47340.65**	52664.21**
Error	16	5463.55	13829.86	2221.70

Note: ** Significant at 1 % level

Table 2. Pooled analysis of variance over three locations for yield (kg ha^{-1})

Sources of variation	df	Mean squares
Environments (E)	2	163975.100 **
Varieties (V)	8	29167.590 **
Varieties x Environments	16	9091.57**
Pooled error	48	2390.56

Note: ** Significant at 1 % level

Table 3. Analysis of variance for stability for yield (kg ha^{-1})

Source of variation	df	Mean squares
Environment + (G x E)	18	26300.850
Environments (Linear)	1	327950.100 **
Genotype X Environments (Linear)	8	7916.771
Pooled Deviation	9	9125.669 **
CAGL- 19	1	3253.1*
CAGL-93	1	6189.8**
CAGL-86	1	129.3
CAGL-43	1	11037.1**
CAGL-94	1	5372.3*
CAGL-63	1	19230.3**
Ratan (Ch)	1	16539.5**
Prateek (Ch)	1	261.8
Mahateora (Ch)	1	20117.8**
Pooled Error	48	796.85

TABLE CHECK

Table 4. Stability parameters for yield (kg ha^{-1}) in local collections of Grass Pea (*Lathyrus sativus* L.)

Genotypes	Yield / kg ha^{-1}		
	Mean	b^i	s^2di
CAGL- 19	657.762	0.15	976.81
CAGL-93	758.568	1.33	3913.5
CAGL-86	847.011	1.3	-2147.02
CAGL-43	717.812	0.48	8760.85*
CAGL-94	775.686	1.32	3096.06
CAGL-63	582.246	1.3	16954.04**
Ratan (Ch)	757.026	1.15	14263.24**
Prateek (Ch)	814.922	0.59	-2014.51
Mahateora (Ch)	912.113	1.39	17841.57**
Mean	758.127	-	-
$SE_m \pm$	28.17		
CD	80.07		

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