Electronic Journal of Plant Breeding,
ISSN 0975-928X

DOI: 10.5958/0975-928X.2016.00001.6

Stability analysis of high yielding varieties of black gram (*Vigna mungo* L. hepper)

N. Rita[1*], S. Kigwie[2], K. Noren[3], N. Brojen[3] and Kh. Pramesh[3]
[1]*ICAR Research Complex for NEH Region, Arunachal Pradesh- Centre, Basar - 791101, Arunachal Pradesh*
*mrsbengiarita@gmail.com, phone: 03795-226646, mobile no.: 9436255820
[2]*School of Agricultural Sciences and Rural Development, Medziphema-* 797106, *Nagaland University, Nagaland*
[3]*College of Agriculture, CAU, Imphal-795004, Manipur*

(Received: December 2014 ; Accepted: March 2016)

Abstract
Black gram is grown throughout India. Most of the varieties show great degree of genotype x environment interactions for most desirable characters. Field experiment was conducted using fourteen genotypes of black gram during *kharif* season, 2009 and 2010. The data were analyzed according to the stability model as suggested by Eberhart and Russell (1966). The pooled analysis of variance due to genotypes was found highly significant for all the characters indicating genetic variability among the genotypes. Highly significant pooled deviation for all the characters except 100 seed weight was observed in all the genotypes that fluctuated significantly from their respective linear path of response to environments. From the estimated parameters of stability in the present study, genotypes RBU1012 and Pant U-19 were considered to be the most stable genotypes. Environments E-6 was the best for yield and its components while Environment E-1was the lowest for yield and its components.
Key words: Black gram, stability, seed yield, component characters.

Introduction

Blackgram (*Vigna mungo*) which belongs to leguminace ae family is a very important pulse crop in India. It is commonly used in the form of fermented food such as idli, papad, dosa, and other regional foods in India. It is consumed in the form of split pulse as well as is whole pulse, which is an essential supplement of cereal based diet. It is also ground into flour and used to make cakes, bori, bread and porridge. Besides, it is used as a nutritive fodder especially for milch cattle. It is also used as green manuring crop. Urd bean contains about 24% protein, 60% carbohydrates, 1.3% fat, and is the richest among the various pulse in phosphoric acid, being 5 to 10 times richer than in others (Modern Techniques of raising field crop). In addition, being an important source of human food and animal feed**,** it also plays an important role in sustaining soil fertility by improving soil physical properties and fixing atmospheric nitrogen. Being a drought resistant crop, it is suitable for dry land farming and predominantly used as an intercrop with other crops.
Most of improved varieties show in consistent performance under varied environmental conditions due to genotype environment interaction. Stable genotypes of black gram are necessary to increase the productivity. In view of the lack of suitable and well adapted high yielding varieties to varied agro-ecological conditions, the present study entitled, "Stability analysis in black gram (*Vigna mungo L. Hepper)"* was carried out with the following objectives

1. To study the effects of different environments on yield and some yield attributes in black gram.
2. To find out high yielding stable varieties of black gram.

Materials and methods

Field experiments were conducted during *kharif* season, 2009 and 2010 at two locations where three different manural treatments were imposed to create six environments. The details of the environments under which the experiments were conducted are given Table 5,

Fourteen genotypes were used during the experiments. The source of these genotypes was AICRP - MULLaRP, CAU, Imphal, Manipur. The fourteen genotypes were RBU1012, NDU3-4, Uttara, PantU-19, KU323, PantU-35, PantU-31, KU-99-22, KOBG-653, SB 27-3, Type 9, IPU02-1, NDU5-3 and NDU99-2(Ch). The experiment was laid out in a RBD with three replications in each Environment. Each genotype was grown in a plot of 1.5 x 2 m^2 consisting of 5 rows of 2 m each with a spacing of 30 cm row to row and 10 cm plant to plant. Ten competitive plants at random were taken from each plot in each replication under each environment to record the data on six characters. *viz.*,Days to 80% maturity, Plant height at maturity (cm), Cluster per plant, Number of pods per plant, 100 seed weight (gm.) and Seed yield per plant (gm.) Days to 80% maturity were recorded on plot basis by visual observations.

Statistical analysis of the data:

The mean values for the different characters were used for statistical analysis, which was carried out using SPAR-2 Software.

DOI: 10.5958/0975-928X.2016.00001.6

Stability analysis:
After testing homogeneity of the error variances by using Barlett's test (Gomez and Gomez, 1984) and having satisfied the homogeneity of variance for all the environments were performed. The data were analyzed according to the stability model as suggested by Eberhart and Russell (1966). According to this model, the regression of each variety on an environmental index and a function of the acquired deviations from this regression would provide an estimate of the desired stability parameters.

Results and discussion

Analysis of variance
The environment wise analysis of variance for different characters was presented in Table 2. It was evident from the environment wise analysis of variance that the variance ratios due to genotypes for all the characters were found to be significant in three environments and non-significant in other three environments. Bartlett's test of homogeneity of variances of all environments for all the characters revealed the homogeneity of error variances. The character days to 80% maturity variance ratio due to genotype were significant in all the environments except E-2.

Pooled analysis of variance
Character wise pooled analysis of variance was presented in Table 3. The character wise pooled analysis of variance revealed that variance ratios due to genotypes were found to be significant for all the characters studied.

Analysis of variance for phenotypic stability
Analysis of variance (mean squares) for phenotypic stability for all the characters were studied. The genotypic differences were significant for all the characters (Table 1). Similarly, environment (linear) component was also significant for all the traits. The variance ratio due to G x E (linear) when tested against the mean sum of square due to pooled deviation was significant for all the characters under study.
The mean sum of square due to pooled deviation when tested against pooled error was significant for 100 seed weight and the rest of the characters were found to be non-significant (Table1)
In the present study stability parameters such as mean (x), regression coefficient (bi) and deviation from regression (S^2di), as suggested by Eberhart and Russell (1966) were considered to explain the stability of different genotypes for various characters under consideration.

Days to 80% maturity
The genotypes which require minimum number (low mean value) of days to mature were more desirable for this character. The genotypes PantU-31 (75.72days) followed by NDU3-4 (78.78 days) had less number of days to maturity while PantU-19 had higher number of days to maturity than the general mean with significant values of bi and significant S^2di value. Therefore, both the genotypes were considered unpredictable for stability for this character (Table 4). The genotypes PantU-19 had higher mean value greater than the general mean, bi greater than unity and non-significant S^2di, was predictable for stability under favourable environments whereas, KU323, PantU-35 and NDU5-3 were suitable for unfavourable environment. The most favourable environment for this character was E-6 and E-2 for unfavourable environment.

There were no significant differences between the genotypes for this character since, the value of C.D. (G) at 5% was more than the difference between the two earliest maturing genotypes. However, significant differences were observed between the environments as the value of C.D. (E) at 5% was less than the difference between the highest and lowest mean value over the environments.

Plant height at maturity (cm)
Out of fourteen genotypes Pant U-35, SB27-3 and Type 9 exhibited significant regression below unity revealing that plant height was closely associated with both favourable and unfavourable environmental conditions (Table 4). The genotype Type-9 had the lowest mean plant height with regression value significantly lower than unity and non-significant S^2di value indicating its suitability for unfavourable environments, while Pant U-19 had the highest mean plant height with regression value significantly above unity and non-significant S^2di value indicating its suitability for favourable environments (Table 4). The most stable genotype for this character was found to be NDU3-4 having mean value greater than the general mean, bi equal to zero with non-significant S^2di value. Among the environments, the favourable environment was recorded from E6 and the unfavourable environment was recorded from E-1(Table 4).

The value of C.D. (G) at 5% was more than the difference between the two genotypes with lowest plant height so, there were no significant differences in plant height between the genotypes for this character. However, significant differences were observed between the environments as the value of C.D. (E) at 5% was less than the difference between the highest and lowest mean value over the environments.

Number of cluster per plant
The genotypes COBG-653, PantU-19 and RBU1012 for this character had the mean values over the environments greater than the general mean, and their regression value greater than unity and S^2di value were found to be non-significant so, these genotypes were the most stable genotypes for favourable environment (Table 4). The genotype Pant U-35 could be regarded as

better adapted genotype over specific environment. Similar results were also obtained by Revanappa *et al*. (2012).

Among the environments E6 was found to have the highest value and hence was favourable for all the genotypes. Environment E1 was found to have the lower value and was unfavourable for all the genotypes (Table 4).

The value of C.D. (G) at 5% was greater than the difference between the two genotypes with highest number of cluster per plant, so there were no significant differences for this character. However, significant differences were observed between the environments as the value of C.D. (E) at 5% was less than the difference between the highest and lowest mean value over the environments.

Number of pods per plant

The character under study was found to be predictable for the genotypes Uttara, and KU-99-22 and NDU99-2 as the bi and S^2di were non-significantly deviated from unity and zero (Table 4.1). The genotypes RBU1012 and NDU5-3 had higher mean value and bi values greater than the general mean and unity respectively therefore, it could be predicted for favourable conditions while Uttara, KU-99-22, and NDU99-2 had lower mean values than the general mean with bi less than unity and S^2di non-significant therefore, these genotypes could be recommended for unfavourable environments. This result was further supported by Raffi *et al*. (2004). The contradictory results of the present study with that of earlier findings of Patil and Narkhede (1995) in mung bean, might be attributed to the differences in the magnitude and range of environments affecting physiological developmental path as a response to the environmental change. Among the environments, E6 was found to be favourable environment and E1 for unfavourable environment (Table 4.1).

The value of C.D. (G) at 5% was greater than the difference between the two genotypes with highest number of pods per plant, so there were no significant differences in number of pods per plant between the genotypes. However, significant differences were observed between the environments as the value of C.D. (E) at 5% was less than the difference between the highest and lowest mean value over the environments.

100 seed weight (gm.)

The genotype RBU-1012 had non-significant bi and S^2di value with the mean value highest and greater than the general mean, this genotype could be considered as the most stable genotype followed by IPU02-1 for 100 seed weight (Table 4.1). The genotype Uttara and Pant U-35 had mean value lesser than the general mean, bi value greater than unity with non-significant S^2di; therefore this genotype could be performed best in favourable environments. The genotypes SB27-3 had mean value less than the general mean, bi value less than unity with non-significant S^2di; therefore, this genotype could be performed best in unfavourable environments. IPU02-1 having mean value greater than general mean with non-significant bi and S^2di could be performed best in favourable environments.

The favourable and unfavourable environments for 100 seed weight were found to be E6 and E1 respectively (Table 4.1).

Since, the value of C.D. (G) at 5% was less than the difference between the two genotypes with highest seed weight, there were significant differences in seed weight between the genotypes and also significant differences were observed between the environments as the value of C.D. (E) at 5% was less than the difference between the highest and lowest mean value over the environments.

Seed yield per plant (gm.)

The character was found to be predictable for most of the genotypes except Type 9, SB 27-3 and KU-99-22 genotypes. The genotypes NDU5-3, COBG-653, RBU1012, PantU-19, PantU-35 and PantU-31 had mean values higher than the general mean with bi values greater than unity and S^2di values were found to be non-significant (Table 4.1). Therefore, these genotypes were stable for favourable environments. NDU3-4, Uttara, KU323, IPU02-1 and NDU99-2 had mean values less than the general mean with bi values lesser than unity and S^2di values were found to be non-significant. Therefore, these genotypes were stable for unfavourable environments. Similar results were also observed by Senthil Kumar *et al.* (2012).

Among the environments, E4 and E6 were favourable environments and E1 was the unfavourable environment for the character under study. The value of C.D. (G) at 5% was less than the difference between the two genotypes with highest number of seed yield per plant, there were significant differences in seed yield between the genotypes and also significant differences were observed between the environments as the value of C.D. (E) at 5% was less than the difference between the highest and lowest mean value over the environments.

On the basis of stability parameters, for days to 80% maturity Pant U-19 was the most stable genotype under favourable environment. Most stable genotype in case of plant height at maturity was Type-9. Pant U-35 was the most stable genotype under favourable environment for cluster per plant. RBU1012 and NDU5-3 were the most stable genotypes against all the environments for pods per plant, RBU1012 and KU323 were stable for 100 seed weight For seed yield per plant RBU1012, Pant U-19 and Pant U-35 were found to be the most stable.Therefore, in view of the above estimated parameters of stability in the present study, genotypes RBU1012 and Pant U-19 was considered to be the most stable genotypes under the present created environments.

DOI: 10.5958/0975-928X.2016.00001.6

Among the genotypes studied, earliest stable genotypes over the environments were KU-99-22 for days to 80% maturity. For plant height at maturity KU-99-22 was the most stable and shortest while Pant U-19 recorded to be the tallest and most stable. Pant U-19 and COBG-653 for cluster per plant, RBU1012 and NDU5-3 for pods per plant under favourable environment and KU323, RBU1012 were stable genotypes for 100 seed weight (gm.). Pant U-35, Pant U-19, RBU1012 and Pant U-31 in descending order could be predicted for favourable environment in case of seed yield per plant. In view of yield and its components for which they were better performing under favourable environment, the genotype Pant U-35 for seed yield per plant, RBU1012 for pods per plant and KU323 for 100 seed weight. And could be considered as better performing genotypes over all the environments. The genotypes that performed best under unfavourable environment were KU-99-22 for pods per plant, SB27-3 for 100 seed weight and NDU-99-2 for seed yield per plant. Thus, these genotypes could be considered as better performing genotypes under unfavourable environment.

From the above findings, it could be concluded that the better genotypes for phenotypic stability of grain yield and its components were found to be RBU1012 and NDU5-3, both having higher mean yield could be considered for its stable performance, so it could be recommended for cultivation over wide environmental conditions. Among the environments, the E-6 (Pasighat, organic manure treated) was the best for yield and its components while the E-1(Medziphema, without any treated) was the lowest for yield and its components.

References

Allard, R.W and Bradsaw, A.D. (1964). Implications of genotypes x environment interactions in applied plant breeding. Crop Sci.. 4: 503-508.

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

Gomez, K.A. and Gomez, A.A. (1984). Statistical procedure for Agricultural Research.*360* IRRI Los Banos, Philippines.

Patil, H.S. and Narkhede, B.N.(1995). Phenotypic stability of plant height, days to flower and days to maturity in Urdbean (*Vigna mungo* L. Hepper). Legume research, 18(2): 71-74.

Revanappa, S.B., Kamannavar, P.Y., Vijaykuma, A.G., Ganajaxi, M., Gajanan, D.K., Arunkumar, B. and Salimath, P.M. (2012). Genotype x Environment Interaction and Stability analysis for grain yield in black gram (*Vigna mungo* L.). Legume Research: An International Journal, 35(1):56-58.

Senthil Kumar, N. and Chinna Ghouse Peera, S.K. (2012). Stability for seed yield in black gram (*Vigna mungo* L. Hepper). International Journal of Recent Scientific Research, 3(5): 336 – 339.

Singh, S.V. and Singh, R.B. (1980).Stability of component characters in relation with the stability of yield. Indian J. Genet., 40:93-98.

Electronic Journal of Plant Breeding,
ISSN 0975-928X

DOI: 10.5958/0975-928X.2016.00001.6

Table 1. Analysis of variance (mean squares) for different characters in black gram (Eberhart and Russell, 1966)

Source of variation	d.f.	Days to 80% maturity	Plant height	Cluster per plant	Pods per plant	100 seed weight	Seed yield per plant
Genotypes	13	92.24**	244.10**	22.27**	44.97**	0.16**	11.83**
Env. +(G x E)	70	223.83**	463.64**	25.46**	67.25**	0.19**	7.94**
Env. (linear)	1	14520.21**	26515.81**	1386.88**	2979.42**	7.50**	340.12**
G x E (linear)	13	40.73**	295.31**	10.76**	49.22**	0.11*	11.23**
Pooled deviation	56	11.04 NS	37.49 NS	4.56 NS	19.42 NS	0.08*	1.24 NS
RBU1012	4	2.95 NS	86.91*	3.66 NS	1.07 NS	0.07 NS	0.4 NS
NDU3-4	4	20.26 **	14.09 NS	8.48**	25.61*	0.11*	3.57*
Uttara	4	4.21 NS	11.35 NS	0.19 NS	17.39 NS	0.02 NS	1.08 NS
Pant U-19	4	5.08 NS	19.12 NS	2.54 NS	24.34*	0.10*	2.25 NS
KU323	4	10.89 NS	30.84 NS	5.27 NS	24.52*	0.03 NS	1.18 NS
Pant U-35	4	6.97 NS	96.05*	11.60**	49.95**	0.08 NS	1.83 NS
Pant U-31	4	34.48**	7.58 NS	8.72**	28.63*	0.19**	1.83 NS
KU-99-22	4	6.15 NS	22.64 NS	1.73 NS	11.95 NS	0.02 NS	0.11 NS
COBG-653	4	1.22 NS	33.92 NS	5.21 NS	33.96**	0.21**	1.54 NS
SB 27-3	4	2.79 NS	20.43 NS	4.19 NS	27.09*	0.04 NS	0.82 NS
Type 9	4	54.57**	76.75 NS	1.96 NS	3.63 NS	0.13**	0.33 NS
IPU02-1	4	2.78 NS	13.54 NS	1.07 NS	3.08 NS	0.03 NS	0.19 NS
NDU5-3	4	0.69 NS	64.81 NS	0.21 NS	1.26 NS	0.18**	0.20 NS
NDU 99-2	4	1.59 NS	26.94 NS	9.06**	19.52 NS	0.06 NS	1.80 NS
Pooled error	156	7.59	48.54	3.33	13.68	0.05	1.96

*, ** Significant at 5% and 1% level respectively
NS= Not Significant

DOI: 10.5958/0975-928X.2016.00001.6

Table 2. Analysis of variance (mean squares) for different characters in six different environments

Source of variation	d.f.	Days to 80% maturity	Plant height	Cluster per plant	Pods per plant	100 seed weight	Seed yield per plant
E-1 Replication	2	4.35**	119.66**	2.14 NS	2.00 NS	1.44**	0.45NS
Genotypes	13	16.56**	25.71 NS	1.44 NS	11.68 NS	0.31 NS	0.99NS
Error	26	1.99	28.40	1.82	7.78	0.18	0.54
E-2 Replication	2	36.85**	1302.55**	154.83**	360.82**	1.08**	49.74**
Genotypes	13	6.04 NS	134.34*	14.59 NS	51.05 NS	0.24*	4.25NS
Error	26	3.16	63.14	11.71	30.86	0.09	4.07
E-3 Replication	2	1.78 NS	1514.38**	37.60**	192.59**	0.04 NS	19.35**
Genotypes	13	22.38**	219.19 NS	17.38**	34.05*	0.14**	5.49*
Error	26	7.14	126.00	4.97	14.20	0.03	1.94
E-4 Replication	2	187.45**	125.37**	66.37**	132.59**	0.29 NS	146.17**
Genotypes	13	215.47**	94.32*	18.83**	22.83 NS	0.40 NS	34.53*
Error	26	63.68	39.52	5.05	15.67	0.36	12.19
E-5 Replication	2	238.73**	315.04*	125.52**	215.30**	0.47*	127.32**
Genotypes	13	190.90**	313.72*	39.41*	115.13 NS	0.70**	5.46NS
Error	26	19.19	126.84	17.06	69.83	0.18	4.42
E-6 Replication	2	37.16 NS	903.04 NS	612.46**	1239.63**	0.06 NS	146.17**
Genotypes	13	90.31**	1315.44**	66.41**	298.90*	0.16 NS	34.53*
Error	26	41.37	489.73	19.34	107.95	0.12	12.19

*, ** Significant at 5% and 1% level respectively
NS= Not Significant

Table 3. Character wise pooled analysis of variance (mean squares) over all the environments for different characters in black gram.

Source of variation	d.f.	Days to 80% maturity	Plant height	Cluster per plant	Pods per plant	100 seed weight	Seed yield per plant
Genotype (G)	13	92.24**	244.10**	22.27**	44.97**	0.16**	11.83**
Environment (Env.)	5	2904.04**	5303.16**	277.37**	595.88**	1.50**	68.02**
G x Env.	65	17.66**	91.36*	6.08*	26.58*	0.09**	3.32**
Pooled error	156	7.59	48.54	3.33	13.68	0.05	1.96

*, ** Significant at 5% and 1% level respectively
NS= Not Significan

Electronic Journal of Plant Breeding,
ISSN 0975-928X

DOI: 10.5958/0975-928X.2016.00001.6

Table 4. Genotypic means with stability parameters for some important component characters

Sl.No.	Genotype(G)	STABILITY PARAMETERS								
		Days to 80% maturity			Plant height (cm)			Clusters per plant		
		$\overline{X}i$	bi	S^2di	$\overline{X}i$	bi	S^2di	$\overline{X}i$	bi	S^2di
1.	RBU1012	81.28	0.76**++	-6.1	49.27	0.82*	24.86*	10.76	1.26**	-3.39
2.	NDU3-4(AVT2)	78.78	0.87**	11.2**	41.70	1**	-47.96	8.71	0.65	1.42**
3.	Uttara	79.89	1.02**	-4.84	41.56	1.37**	-50.7	8.43	0.98**	-6.87
4.	PantU-19	82.44	1.1**	-3.96	48.51	1.2**	-42.94	12.01	1.71**	-4.51
5.	KU323	79.33	0.96**	1.84	39.29	1.13**	-31.21	7.74	0.81*	-1.79
6.	PantU-35	79.89	0.86**	-2.08	40.52	0.72**	33.99*	13.81	1.41*	4.54**
7.	PantU-31	75.72	0.89**	25.42**	30.56	0.64**++	-54.47	8.48	1.11*	1.67**
8.	KU-99-22	79.33	0.95**	-2.9	34.88	0.78**	-39.41	7.42	0.63**+	-5.33
9.	KOBG-653	82.00	0.85**++	-7.83	42.92	1.06**	-28.14	10.99	1.29**	-1.85
10.	SB 27-3	80.44	1.05**	-6.25	35.51	0.65**+	-41.62	8.23	0.85*	-2.87
11.	Type 9	93.39	1.6**	45.51**	27.82	0.25+	14.69	7.88	0.71**	-5.1
12.	IPU02-1	80.44	1.04**	-6.27	39.16	1.15**	-48.52	7.58	0.9**	-5.99
13.	NDU5-3	80.22	0.98**	-8.35	48.34	1.83**	2.76	8.88	1.07**	-6.84
14.	NDU99-(Ch)	79.89	1.05**	-7.46	41.37	1.38**	-35.11	8.00	0.61	1.99**
	Mean	80.93			40.10			9.21		
	C.D. (G) at 5%	3.13			7.93			2.08		
	C.D. (E) at 5%	2.05			5.18			1.36		

** bi and S^2di values significantly deviated from 0 at 5% and 1% levels respectively.
+, ++ bi values significantly deviated from unity at 5% and 1% levels respectively

Table 4.1. Genotypic means with stability parameters for some important component characters (conted**)**

Sl.No	Genotype(G)	STABILITY PARAMETERS								
		Pods per plant			100 seed weight			Seed yield per plant		
		$\overline{Xi}$	Bi	S^2di	$\overline{Xi}$	bi	S^2di	$\overline{Xi}$	bi	S^2di
1.	RBU1012	19.99	1.52**	-20.14	4.87	0.73	0.003	6.79	1.51**	-3.36
2.	NDU3-4(AVT2)	15.36	0.72	4.4*	4.69	0.86	0.04*	5.49	0.80	-0.19*
3.	Uttara	15.10	0.74	-3.82	4.35	1.71**	-0.05	4.55	0.48	-2.43
4.	PantU-19	20.70	1.78**	3.13*	4.42	0.99	0.04*	7.39	1.84**	-1.52
5.	KU323	13.38	0.66	3.31*	4.67	0.99*	-0.03	5.07	0.92*	-2.59
6.	PantU-35	21.52	1.87*	28.73**	4.48	1.73*	0.02	8.55	2.47**	-1.94
7.	PantU-31	17.98	1.23*	7.42*	4.60	1.69*	0.12**	6.10	1.42**	-1.93
8.	KU-99-22	13.07	0.44	-9.26	4.54	0.6*	-0.04	3.57	0.23*++	-3.65
9.	KOBG-653	18.81	1.33*	12.74**	4.51	0.49	0.14**	5.97	1.32**	-2.22
10.	SB 27-3	15.93	0.71	5.88*	4.21	0.4	-0.03	4.33	0.22+	-2.94
11.	Type 9	15.51	0.62**+	-17.58	4.45	1.14	0.06**	4.66	0.44*++	-3.34
12.	IPU02-1	14.52	0.71**	-18.13	4.54	0.57	-0.03	4.85	0.75**	-3.58
13.	NDU5-3	17.50	1.2**	-19.95	4.67	0.78	0.11**	6.09	1.35**	-3.56
14.	NDU99-(Ch)	14.40	0.46	-1.69	4.39	1.29*	-0.005	3.79	0.24	-1.97
	Mean	16.70			4.53			5.51		
	C.D. (G) at 5%	4.21			0.25			1.60		
	C.D. (E) at 5%	2.75			0.16			1.04		

*, ** bi and S^2di values significantly deviated from 0 at 5% and 1% levels respectively.

+, ++ bi values significantly deviated from unity at 5% and 1% levels respectively

DOI: 10.5958/0975-928X.2016.00001.6

Table 5. Different environment under experiment was conducted

Sl. No.	Environment	Treatment	Location	Initial Soil texture
1	E-1	Control (Without any treatment)	Research field of Genetics and Plant Breeding, (SASRD), Nagaland University, Medziphema.	Sandy Clay loam
2	E-2	Treatment with fertilizer only @20:40:20 NPK Kg/ha	Research field of Genetics and Plant Breeding, (SASRD), Nagaland University, Medziphema.	Sandy Clay loam
3	E-3	Treatment with Organic manure only @20 tons/ha	Research field of Genetics and Plant Breeding, (SASRD), Nagaland University, Medziphema.	Sandy Clay loam
4	E-4	Control (Without any treatment)	KVK Research farm of College of Horticulture and forestry, Central Agricultural University, Pasighat.	Sandy loam
5	E-5	Treatment with fertilizer only @20:40:20 NPK Kg/ha	KVK Research farm of College of Horticulture and forestry, Central Agricultural University, Pasighat.	Sandy loam
6	E-6	Treatment with Organic manure only @20 tons/ha	KVK Research farm of College of Horticulture and forestry, Central Agricultural University, Pasighat.	Sandy loam