Electronic Journal of Plant Breeding,
ISSN 0975-928X Vol 7 No 2 DOI: 10.5958/0975-928X.2016.00032.6

Stability for different characters in variable environments in Lentil (*Lens culinaris* Medik.)

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(Received: March 2015, Accepted: September 2015)

Abstract:
Present research work was undertaken to estimate the genotype and environment interactions of 48 lentil genotypes across different environments, to identify the suitable genotypes for heat tolerance in lentil. Stability and adaptation through different stability parameters and performance traits of 48 lentil genotypes were studied. Genotypes IC201655 and IC201786 showed high seed yield and pods/plant stability. The genotype Asha recorded general adaptation showing above population mean for seed yield/plant, 100 seed weight and harvest index. Genotype Howrah local 2 recorded such trend for seed yield and harvest index. Howrah local 2 also recorded days to maturity close to population mean. Genotype North 24 Parganas local recorded such trend for harvest index and 100 seed weight (above population mean) and days to maturity (below population mean). Genotype IC201710 would likely to perform well under favourable situation for seed yield/plant, pods/plant and harvest index. Correlation among stability estimate revealed that there were high significant correlations between seed yield and pods per plant. Therefore if pods per plant are stable then seed yield will also be stable. These findings can be very useful in lentil breeding programme related to heat tolerance.(based on what?)

Key words: stability, variable environments, correlation, tolerance

Introduction

Lentil (*Lens culinaris*Medik.) is one of the very important cool season food legumes with high protein content. It also increases soil fertility level by fixing atmospheric nitrogen. As it is a cool season crop it is very much sensitive to heat stress. According to a report of the Intergovernmental Panel on Climatic Change (IPCC), the global mean temperature will rise 0.3°C per decade (Jones et al., 1999). At this alarming situation crop genotypes which can thrive well in this changing climatic condition will be needed. So identification of the suitable lentil genotypes well adapted to different environment (normal and late sown condition) may contribute a lot in lentil breeding programme related to heat tolerance. Genotypic adaptability to environmental variations is important for the stabilization of crop yield. Yield is a quantitative character and it is very much influenced by varying environmental condition. So selection of superior genotypes must be based on stability of their performance in different environmental situations. Eberhart and Russell, 1966 proposed that an ideal population of genotype has the highest yield over a wide range of environments, regression coefficient value of 1.0 and mean square deviation is zero. Karimizadeh et al., 2012, performed that multienvironmental test for recommendation of variety are found to significant for G×Einteractions based on combined analysis of variance. Szilagyi et al., 2011, studied stability analysis of lentil for seed yield and identified some genotypes suitable for favourable environments. Bicer and Sakar, 2006, tested lentil genotypes for yield stability and

identified some lines which consistently produced high yields. Therefore, present research work was undertaken to estimate the genotype and environment interactions through stability parameters and performance of some characters of forty eight lentil genotypes across environments and to identify the suitable genotypes for heat tolerance in lentil .

Materials and Methods

The experimental material comprises of forty eight lentil genotypes. These genotypes were evaluated in normal and late sown condition. The field trial was conducted in normal and late sown condition. Field trials for normal sown condition were conducted for three years (sowing time was November in the year 2010, 2011 and 2012) at Calcutta University Experimental Farm,Baruipur, South 24 Parganas. Field trials for late sown condition were conducted in two locations; one at Calcutta University Experimental Farm, Baruipur, South 24 Parganas and another at farmer's field of Udaynarayanpur. Sowing time, years and locations of the field trials in late sown condition were as follows:

- Second week of December, 2010 at Calcutta University Experimental Farm, Baruipur.
- Second week of December, 2010 at farmer's field of Udaynarayanpur
- Fourth week of December, 2012 at Calcutta University Experimental Farm, Baruipur.
- Fourth week of December, 2012 at farmer's field of Udaynarayanpur.

Thus the total number of environments evaluated was 7. The randomized blocks design (RBD) with three replications was used in each trial. Normal cultural practices were performed as and whenever required. After harvest data of seed yield(g.) per plant, number of pods/plant, 100 seed weight(g.) and harvest index were recorded. Days to maturity for each genotype were also recorded.

Stability parameters were estimated following the Eberhart and Russell model (1966).Regression coefficient and deviation from regression were used as stability measure. Statistical analysis was done by Statistical Package Spar 2.

The characterization of genotypes in respect to their kind of adaptation was done by using those parameters, is schematically represented in Fig.1.

Results and Discussions

Anova for seed yield and component characters over seven environments are presented in Table 1. Significant MSS value of genotypes and environments were observed for five characters studied. From this observation it can be evident that the genotypes had divergent linear response to environmental changes. G×E interaction MSS also showed significant values indicating differential behaviour of genotypes under the seven environments. Pooled deviation also exerted significant value indicating the deviation from regression contributed to the differences in genotypic stability. Significant genotype environment interaction for pods per plant and harvest index was also observed by Kumar et al., 2007.

In the present study$(\bar{V}_i - \bar{V})$was calculatedfor each character [where,$\bar{V}_i$ = mean value of each genotype over the seven environments and $\bar{V}$ =population mean]to study the response of each genotype over the population mean value of that character and deviation from regression (S^2d) of each genotype were used for stability and linear regression (bi) was used to test the varietal response. Present study considered Eberhart and Russell (1966) model. Estimates of stability parameters based on seven environments for the five traits i.e seed yield/plant, number of pods/plant, 100 seed weight, harvest index and days to maturity are presented in Table 2.A., 2.B., 2.C., 2.D., and 2.E. respectively. Genotypic adaptation for different characters showing, above and close to population mean are represented in Table 3.

Seed yield/Plant:

Out of the forty eight lentil genotypes studied, eighteen showed seed yield stability by their non-significant S^2d values, among them WBL 81, IC 201655, IC 201693,IC 201785, IC 201786, IC 208342 and IC 208377 recorded seed yield more than population mean, and non-significant S^2d value meaning that they recorded high yield stability. Thus, considering mean performance, bi values and S^2d it can be predicted that they can be generally adapted. Genotypes namely IC 201710, WBL 77(Moitree), 14-4-1, Ranjan, IC 208356, Asha, Howrah local 2, IC 201705, IC 201786, Ballia local, IC 208377, IC 201785, IC 201675, IC 201693, Bihar local, WBL 81, IC 248956, IC 201787, IC 201655, WBL 185, Krishnanagar local, IC 212666, IC 208342 and IC 201678 showed high and close to mean seed yield value. Among them Asha, Ranjan, Howrah local 2, IC 201785, IC 201786 , IC 208377, Bihar local, WBL 81, IC 201655, IC 201678, IC 201693, IC 208342, IC 201705 and IC 248956 included in the general adaptation group as they showed higher and close to mean performance values and non-significant bi values. Genotypes WBL 77(Moitree), 14-4-1, IC 201710, IC 208329, IC 208356, IC 201787, IC 212666 has favourable adaptation as they have significant bi value more than unity and above/close to population mean performance. Ballia local and WBL 185 was characterised for adverse environment for their significant, less than 1 Bi value and above and close to population mean performance. Rest of the genotypes which were not considered have either very high S^2d value or very poor mean performance.

Pods/Plant:

Among forty eight genotypes twenty one had registered pods per plant higher(mention the value) and or close to population mean value. Among them IC 201655 and IC 201786 registered high pods/plant stability for their non-significant S^2d, non-significant Bi value and performance of above population mean. This result indicates that these genotypes would produce maximum pods in all environments with high stability. Genotypes like Ranjan, 14-4-1, IC 201705, IC201710, IC 212666, IC 248956, IC 201787 and IC 212683 showed higher and close to population mean value and significant Bi value, more than unity but high significant S^2d value so they might have favourable adaptation.). Rest of the genotypes were either lower than population mean or variable bi and S^2d values.

100 seed weight:
Among forty eight genotypes twenty three had shown 100 seed weight higher than and or close to population mean. Very small, non-significant S^2d values were observed for UP local, IC 201646, IC 201664, IC 201749 and IC 201787, among them only UP local registered mean performance close to population mean and non-significant positive Bi value indicating its high stability for 100 seed weight and its general adaptability. Genotypes like Howrah local 2, IC 208329, IC 208356, Midnapore local 1, Ranjan and 14-4- 1 had mean performance of above or close to population mean and high, significant Bi value more than unity indicating these genotypes might have favourable adaptation for this characters. Midnaporelocal 2, IC 201678, IC 201794, Bihar local, IC 201681 and IC 208342 had good mean performance and significant, less than unity Bi value indicating their adverse adaptation for this character. Genotypes like WBL 185, North 24 Parganas local, Asha,WBL 77(Moitree), Ballia local, IC 201693, IC 201785, UP local, IC 201710, IC 208377, IC 212683 showed above or close to population mean and non-significant Bi value so they might have general adaptation. Rest of the genotypes had low performance (justify) and variable bi and S^2d values.

Harvest index:
Twenty three out of forty eight genotypes registered harvest index of more than or close to population mean. Only one genotype i.e Howrah local 2 showed non-significant S^2d value, non-significant positive bi value and high mean performance. So this genotype can be said highly stable for the character harvest index. Howrah local, Midnapore local 1, Ballia local and IC 248959 had significant, less than 1 Bi value and high or close to population mean value, so they might have adverse adaptation. Bi value was significant and positive in WBL 77 (Moitree), IC 201710, IC 208377, Midnapore local 2 and Bihar local and their high or close to mean performance indicated their favourable adaptation. On the other hand Purulia local, Sagardeep local, UP local, North 24 Parganaslocal, WBL 81, Asha, Ranjan, 14-4-1, Howrah local 2, IC 201664, IC 201693, IC 208329, IC 208342 and IC 208356 had non-significant Bi value and high mean performance indicating their general adaptability. Rest of the genotypes either showed low mean performance or variable Bi and S^2d values.
Days to maturity:
Short duration genotypes can escape the terminal heat stress in field condition. So when we studied stability for this character the genotypes with minimum days to maturity were selected instead of genotypes with higher days to maturity than population mean. In our study it was observed that twenty nine out of forty eight genotypes registered maturity duration more than population mean. Nineteen out of forty eight genotypes showed maturity duration less than population mean. S^2d values were significant for the entire genotypes. North 24 Parganas local, Bihar local and Howrah local 2 registered below or close to population mean and non-significant Bi value indicating their general adaptability. Howrah local, Midnapore local 1, Sagardeep local, UP local, Asha and WBL 77 (Moitree) resulted below or close to population mean and positive, significant bi value indicating their favourable adaptation. On the other hand some genotypes like Purulia local, Midnapore local 2, 14-4-1, Ballia local, IC 201655, IC 201693, IC 201698, IC 201743, IC 201744 and IC 201749 showed below or close to population mean and significant Bi values of less than unity indicating their adaptation in adverse environment.

Combined study:
Most of the cases highdegree of stability i.e. non-significant S^2d and non-significant Bi value was poor performer i.e. below population mean. They can be grouped as low stability genotypes as suggested by Becker and Leon, 1988. Such inference also reported by Finlay and Wilkinson, 1963 in barley. Generalized observation exerted from the stability parameters and mean performance of some high performer were tabulated (Table 3.) according to their general, favourable and adverse adaptation. Two genotypes namely IC 201655 and IC 201786 recorded high seed yield and pods/plant stability. The genotype Asha recorded general adaptation showing above population mean for seed yield/plant, 100 seed weight and harvest index. Genotype Howrah local 2 recorded suchtrend for seed yield and harvest index. Howrah local 2 also recorded days to maturity close to population mean. Thus these two stood apart from others. The other genotype North 24 Parganaslocal recorded such trend for harvest index and 100 seed weight and days to maturity (below population mean). However from the study it was observed that IC 201710 would likely to perform well under favourable situation for seed yield/plant, pods/plant and harvest index.
Correlation among stability estimates of individual characters are presented in Table 4. High significant correlations were recorded between seed yield and pods per plant. From this result it can be inferred that if pods per plant are stable then seed yield will also be stable. These findings can be very useful in lentil breeding programme related to heat tolerance.

Acknowledgement
The authors are grateful to Professor P.K.Das, Retired,Head,Department of Genetics,Bidhan Chandra KrishiViswaVidyalaya,Mohanpur,West

Bengal for his kind help, generous contribution and continuous guidance.

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Table. 1. Pooled Anova (Mss) For Seed Yield And Other Yield Components In Lentil

SOURCE	DF	MSS				
		Pods/Plant	100 seed weight	Harvest index	Days to maturity	Seed yield/Plant
		POOLED ANALYSIS OF VARIANCE				
Genotypes	47	3837.04**	2.84**	771.61**	303.64**	3.86**
Environments	6	242543.48**	50.43**	16012.21**	25609.82**	173.94**
G×E	282	2784.28**	0.37**	248.62**	17.35**	1.85**
Error	672	414.60	0.03	11.49	0.02	0.40
		EBERHART AND RUSSEL'S MODEL				
Genotypes	47	1279.01*	0.95**	257.20**	101.21**	1.29**
Env.+(Genotypes×Env.)	288	2593.09**	0.47**	192.34**	183.51**	1.81**
Environment. (linear)	1	485086.96**	100.85**	32024.43**	51219.65**	347.87**
Genotypes×Env.(linear)	47	1105.85	0.33**	102.04	19.20**	1.00**
Pooled deviation	240	873.95**	0.08**	77.40**	3.04**	0.53**
Pooled error	672	138.20	0.009	3.83	0.008	0.13

Table.2.a. Estimates Of Stability Parameters Based On Seven Environments For Seed Yield/Plant

Genotypes	Pooled mean of seed yield/plant over the 7 environments	$V_i - \bar{V}$	$B_{i(Eberhart\&Russel)}$	S^2d
Howrah local	1.82	-0.13	0.734	0.007
Purulia local	1.81	-0.14	0.687	0.040
Midnapore local 1	1.74	-0.21	0.476*	0.818**
Midnapore local 2	1.66	-0.29	0.647	0.428**
Sagardeep local	1.79	-0.16	0.477*	0.273**
WBL 185	2.00	0.05	0.469*	0.795**
UP local	1.46	-0.49	0.473*	0.059
Bihar local	2.06	0.11	0.855	0.340**
North 24 Parganas local	1.79	-0.16	0.785	0.019
WBL 58	1.70	-0.25	0.760	-0.036
WBL 81	2.06	0.11	0.880	0.064
Asha	2.46	0.51	1.174	0.864**
Ranjan	2.57	0.62	1.178	0.912**
WBL 77(Moitree)	2.67	0.72	1.412*	0.342**
14-4-1	2.66	0.71	1.478*	0.863**
Ballia local	2.25	0.30	0.647*	0.510**
Krishnanagar local	2.00	0.05	0.981	1.150**
Howrah local 2	2.35	0.40	0.900	0.461**
IC 201646	1.46	-0.49	0.442**	0.550**
IC 201655	2.01	0.06	0.811	-0.089
IC 201661	1.54	-0.41	1.147	-0.104
IC 201662	1.46	-0.49	0.824	0.191*
IC 201664	1.70	-0.25	0.926	0.336**
IC 201670	1.48	-0.47	0.693	-0.052
IC 201675	2.13	0.18	1.448	1.197**
IC 201678	1.95	0.00	1.226	0.348**

IC 201681	1.77	-0.18	1.113	0.539**
IC 201693	2.08	0.13	0.891	0.025
IC 201698	1.78	-0.17	1.368*	0.251*
IC 201705	2.28	0.33	1.293	3.179**
IC 201710	2.82	0.87	1.837**	0.360**
IC 201715	1.15	-0.80	0.644*	0.026
IC 201743	1.74	-0.21	1.099	0.329**
IC 201744	1.49	-0.46	0.696	-0.064
IC 201749	1.88	-0.07	1.128	0.172**
IC 201776	1.37	-0.58	0.770	-0.093
IC 201785	2.21	0.26	1.264	0.065
IC 201786	2.26	0.31	1.326	0.151
IC 201787	2.04	0.09	1.494*	0.655**
IC 201794	1.67	-0.28	0.952	0.277**
IC 208329	2.92	0.97	1.747**	0.754**
IC 208342	1.96	0.01	1.052	-0.021
IC 208356	2.55	0.60	1.462*	1.242**
IC 208377	2.25	0.30	1.150	0.113
IC 212666	1.98	0.03	1.558**	0.175*
IC 212683	1.84	-0.11	1.282	0.314**
IC 248956	2.05	0.10	1.194	0.220*
IC 248959	0.79	-1.16	0.153**	-0.020

Population mean= 1.95, Standard error (SE) (mean) = 0.30±.01, Standard error (SE)(b)= 0.27±.01

* and ** denotes significance at 5% and 1% respectively.

$V_i - \bar{V}$= Character mean – Population mean, Bi= Regression coefficient, S2d=Mean Square Deviation from Linear Regression.

TABLE.2.B. Estimates of stability parameters based on seven environments for pods /plant

Genotypes	Pooled mean of pods/plant over the 7 environments	$\bar{V}_i - \bar{V}$	$B_{i(Eberhart\&Russel)}$	S^2d
Howrah local	78.33	-3.94	0.69	835.10**
Purulia local	71.96	-10.31	0.36**	60.19
Midnapore local 1	83.98	1.71	0.82	2874.29**
Midnapore local 2	76.29	-5.98	0.77	2351.07**
Sagardeep local	79.34	-2.93	0.72	2235.84**
WBL 185	81.63	-0.64	0.65	2098.13**
UP local	61.31	-20.96	0.35**	105.48
Bihar local	86.22	3.95	0.72	635.70**
North 24 Parganas local	68.71	-13.56	0.75	232.85*
WBL 58	74.05	-8.22	0.65	81.32
WBL 81	93.86	11.59	0.94	370.31**
Asha	81.71	-0.56	0.94	436.58**
Ranjan	100.08	17.81	1.43*	481.34**
WBL 77(Moitree)	82.39	0.12	1.08	344.91**
14-4-1	103.86	21.59	1.52*	613.41**
Ballia local	92.75	10.48	0.76	427.45**
Krishnanagar local	91.38	9.11	1.00	992.56**
Howrah local 2	73.35	-8.92	0.78	292.48**
IC 201646	83.98	1.71	0.77	1144.50**
IC 201655	99.62	17.35	0.93	-2.29
IC 201661	73.59	-8.68	1.27	267.53*
IC 201662	71.66	-10.61	0.96	550.96**
IC 201664	98.13	15.86	0.97	1188.19**
IC 201670	75.60	-6.67	1.09	37.25
IC 201675	99.53	17.26	1.16	1024.13**
IC 201678	76.42	-5.85	0.91	204.45*
IC 201681	79.90	-2.37	0.80	694.76**
IC 201693	75.47	-6.80	0.64	6.79
IC 201698	75.43	-6.84	1.35	1040.11**
IC 201705	109.80	27.53	1.52*	5059.37**
IC 201710	113.01	30.74	1.71**	1857.55**
IC 201715	52.94	-29.33	0.81	86.63

IC 201743	75.22	-7.05	1.35	189.38*
IC 201744	70.81	-11.46	0.88	133.83
IC 201749	90.47	8.20	0.98	823.23*
IC 201776	65.65	-16.62	1.19	395.37**
IC 201785	76.67	-5.60	0.93	200.94*
IC 201786	98.18	15.91	1.18	110.26
IC 201787	83.90	1.63	1.62**	368.18**
IC 201794	64.04	-18.23	0.89	888.15**
IC 208329	76.81	-5.46	1.02	402.01**
IC 208342	68.08	-14.19	0.95	265.54*
IC 208356	81.00	-1.27	1.03	76.18
IC 208377	91.02	8.75	0.99	423.59**
IC 212666	99.30	17.03	1.71**	536.03**
IC 212683	83.95	1.68	1.50*	1252.95**
IC 248956	100.89	18.62	1.44*	575.20**
IC 248959	57.92	-24.35	0.51*	46.11

Population mean= 82.27, SE(mean)= 12.07±.01 , SE (b)= 0.29±.01

* and ** denotes significance at 5% and 1% respectively.

$V_i - \bar{V}$= Character mean – Population mean, Bi= Regression coefficient,S2d=Mean Square Deviation from Linear Regression.

TABLE.2. C. Estimates Of Stability Parameters Based On Seven Environments For 100 Seed Weight

Genotypes	Pooled mean of 100 Seed Weight over the 7 environments	$V_i - \bar{V}$	$B_{i(Eberhart\&Russel)}$	S^2d
Howrah local	1.97	-0.20	0.89	0.04**
Purulia local	2.16	-0.01	1.73**	0.13**
Midnapore local 1	2.18	0.01	1.42**	0.09**
Midnapore local 2	2.36	0.19	0.69*	0.13**
Sagardeep local	1.93	-0.24	0.92	0.02**
WBL 185	2.37	0.20	0.77	0.02**
UP local	2.17	0.00	1.04	0.01
Bihar local	2.30	0.13	0.72*	0.13**
North 24 Parganas local	2.32	0.15	0.90	0.02**
WBL 58	1.98	-0.19	0.99	0.03**
WBL 81	2.06	-0.11	0.63*	0.03**
Asha	2.54	0.37	0.87	0.07**
Ranjan	2.18	0.01	1.87**	0.03**
WBL 77(Moitree)	2.78	0.61	1.23	0.03**
14-4-1	2.22	0.05	1.44**	0.03**
Ballia local	2.39	0.22	1.12	0.10**
Krishnanagar local	2.05	-0.12	0.82	0.09**
Howrah local 2	3.07	0.90	1.58**	0.20**
IC 201646	1.84	-0.33	1.50**	0.00
IC 201655	1.91	-0.26	1.10	0.02**
IC 201661	1.71	-0.46	0.71*	0.09**
IC 201662	1.80	-0.37	0.47**	0.01*
IC 201664	1.65	-0.52	0.74*	0.00
IC 201670	1.79	-0.38	0.57**	0.10**
IC 201675	1.70	-0.47	0.79	0.03**
IC 201678	2.45	0.28	0.67*	0.10**
IC 201681	2.22	0.05	0.32**	0.35**
IC 201693	2.38	0.21	1.03	0.02*
IC 201698	2.04	-0.13	0.76	0.02**
IC 201705	1.90	-0.27	0.59**	0.06**
IC 201710	2.31	0.14	0.79	0.11**
IC 201715	1.94	-0.23	1.05	0.02**
IC 201743	1.85	-0.32	0.78	0.04**

IC 201744	1.88	-0.29	0.81	0.07**
IC 201749	1.74	-0.43	0.71*	0.00
IC 201776	1.83	-0.34	0.61**	0.05**
IC 201785	2.74	0.57	1.01	0.05**
IC 201786	2.05	-0.12	0.91	0.06**
IC 201787	1.83	-0.34	1.04	0.00
IC 201794	2.79	0.62	0.73*	0.02**
IC 208329	3.31	1.14	2.35**	0.22**
IC 208342	2.23	0.06	0.65*	0.07**
IC 208356	2.80	0.63	1.55**	0.22**
IC 208377	2.29	0.12	1.20	0.22**
IC 212666	1.85	-0.32	1.18	0.16**
IC 212683	2.17	0.00	1.14	0.03**
IC 248956	2.04	-0.13	1.56**	0.02**
IC 248959	1.84	-0.33	1.04	0.02**

Population mean= 2.17, SE (mean) =0.12±.01, SE (b) =0.19±.01

* and ** denotes significance at 5% and 1% respectively.

$V_i - \bar{V}$= Character mean – Population mean,**Bi=** Regression coefficient**, S2d=**Mean Square Deviation from Linear Regression.

TABLE.2. D. Estimates Of Stability Parameters Based On Seven Environments For Harvest Index

Genotypes	Pooled mean of harvest index over the 7 environments	$\bar{V}_i - \bar{V}$	$B_{i(Eberhart\&Russel)}$	S^2d
Howrah local	49.83	13.76	-0.04**	382.43**
Purulia local	41.82	5.75	1.16	76.09**
Midnapore local 1	41.40	5.33	0.40*	99.36**
Midnapore local 2	37.03	0.96	1.48*	98.16**
Sagardeep local	48.64	12.57	0.91	11.26**
WBL 185	33.60	-2.47	0.05**	171.06**
UP local	41.38	5.31	0.72	132.24**
Bihar local	36.28	0.21	1.66*	53.63**
North 24 Parganas local	43.00	6.93	1.13	44.74**
WBL 58	35.66	-0.41	0.91	67.95**
WBL 81	39.50	3.43	0.86	46.39**
Asha	39.18	3.11	0.96	34.17**
Ranjan	44.13	8.06	0.66	31.91**
WBL 77(Moitree)	45.05	8.98	1.43*	53.11**
14-4-1	43.36	7.29	0.94	76.07**
Ballia local	36.15	0.08	0.57*	25.27**
Krishnanagar local	33.86	-2.21	0.47*	206.02**
Howrah local 2	40.93	4.86	1.14	-0.29
IC 201646	30.58	-5.49	1.04	71.30**
IC 201655	33.82	-2.25	0.96	16.25**
IC 201661	23.19	-12.88	0.60	14.24**
IC 201662	30.71	-5.36	1.18	31.88**
IC 201664	37.79	1.72	1.06	91.25**
IC 201670	32.20	-3.87	0.98	62.79**
IC 201675	28.95	-7.12	1.36	57.02**
IC 201678	30.38	-5.69	1.78**	60.55**
IC 201681	31.66	-4.41	1.51**	36.02**
IC 201693	37.30	1.23	1.22	30.06**
IC 201698	27.28	-8.79	1.12	35.56**
IC 201705	33.43	-2.64	1.35	77.73**
IC 201710	39.96	3.89	1.47*	35.79**
IC 201715	33.69	-2.38	0.99	154.61**
IC 201743	32.34	-3.73	0.69	39.01**
IC 201744	30.26	-5.81	0.94	49.13**
IC 201749	33.02	-3.05	0.96	19.39**

IC 201776	26.48	-9.59	0.69	55.62**
IC 201785	34.55	-1.52	1.58*	11.50**
IC 201786	30.73	-5.34	0.81	26.66**
IC 201787	31.91	-4.16	0.99	37.20**
IC 201794	36.04	-0.03	0.69	158.54**
IC 208329	38.21	2.14	1.16	80.64**
IC 208342	46.32	10.25	1.05	48.43**
IC 208356	40.74	4.67	1.21	116.58**
IC 208377	42.60	6.53	1.69**	20.04**
IC 212666	27.25	-8.82	1.34	38.01**
IC 212683	27.18	-8.89	0.97	11.44**
IC 248956	35.20	-0.87	0.71	115.58**
IC 248959	36.75	0.68	0.54*	318.78**

Population mean= 36.07, SE (mean) = 3.59±.01, SE (b) = 0.34 ±.01

* and ** denotes significance at 5% and 1% respectively.

$V_i - \bar{V}$= Character mean – Population mean, **Bi =** Regression coefficient, **S2d=**Mean Square Deviation from Linear Regression.

Table. 2. E. Estimates Of Stability Parameters Based On Seven Environments For Days To Maturity

Genotypes	Pooled mean of days to maturity over the 7 environments	$V_i - \bar{V}$	$B_{i(Eberhart\&Russel)}$	S^2d
Howrah local	97.31	-7.13	1.29**	3.99**
Purulia local	90.81	-13.63	0.92*	1.97**
Midnapore local 1	99.45	-4.99	1.12**	2.11**
Midnapore local 2	103.31	-1.13	0.81**	1.21**
Sagardeep local	99.02	-5.42	1.15**	2.63**
WBL 185	105.31	0.87	1.05	2.01**
UP local	99.02	-5.42	1.15**	2.63**
Bihar local	97.36	-7.08	0.99	2.79**
North 24 Parganas local	96.93	-7.51	1.02	2.90**
WBL 58	109.50	5.06	0.82**	1.90**
WBL 81	107.14	2.70	0.77**	1.65**
Asha	102.64	-1.80	1.36**	2.18**
Ranjan	105.90	1.46	1.05	1.03**
WBL 77(Moitree)	100.93	-3.51	1.26**	4.41**
14-4-1	103.43	-1.01	0.92*	0.55**
Ballia local	103.45	-0.99	0.90**	1.38**
Krishnanagar local	105.00	0.56	0.94	2.83**
Howrah local 2	104.19	-0.25	0.98	6.61**
IC 201646	104.57	0.13	1.00	4.98**
IC 201655	103.45	-0.99	0.90**	1.38**
IC 201661	105.17	0.73	1.01	7.28**
IC 201662	107.07	2.63	1.09*	3.28**
IC 201664	104.57	0.13	0.97	2.60**
IC 201670	107.14	2.70	1.01	2.75**
IC 201675	105.81	1.37	0.96	7.66**
IC 201678	105.26	0.82	0.90**	9.87**
IC 201681	105.29	0.85	0.87**	9.30**
IC 201693	103.93	-0.51	0.80**	1.18**
IC 201698	104.10	-0.34	0.85**	1.46**
IC 201705	106.00	1.56	0.94	1.62**
IC 201710	105.05	0.61	0.92*	9.57**
IC 201715	105.64	1.20	0.92*	5.64**
IC 201743	103.69	-0.75	0.85**	1.77**

IC 201744	103.69	-0.75	0.85**	1.15**
IC 201749	103.86	-0.58	0.89**	4.38**
IC 201776	107.48	3.04	1.10**	0.66**
IC 201785	108.02	3.58	1.17**	0.61**
IC 201786	106.33	1.89	1.02	1.31**
IC 201787	106.19	1.75	0.95	3.14**
IC 201794	109.62	5.18	1.18**	4.38**
IC 208329	110.00	5.56	1.19**	2.60**
IC 208342	105.43	0.99	0.90**	2.26**
IC 208356	109.05	4.61	1.14**	1.36**
IC 208377	106.19	1.75	0.95	3.14**
IC 212666	108.67	4.23	1.12**	0.64**
IC 212683	108.67	4.23	1.12**	0.64**
IC 248956	107.14	2.70	1.01	0.34**
IC 248959	106.00	1.56	0.94	3.61**

Population mean= 104.44, SE $_{(mean)}$ = 0.71±.01, SE $_{(b)}$ = 0.05±.01

* and ** denotes significance at 5% and 1% respectively.

$V_i - \bar{V}$= Character mean – Population mean, B_i = Regression coefficient, S^2d=Mean Square Deviation from Linear Regression.

Table. 3. Genotypic Adaptation For Different Characters Showing Above And Close To Population Mean (Mention The Value In The Table For Comparison)

Character	Mean performance	Adaptation		
		General	Favourable	Adverse
Seed Yield/Plant	Above Population mean	Asha	WBL 77(Moitree)	BalliaLcoal
		Ranjan	14-4-1	
		Howrah local 2	IC 201710	
		IC 201785	IC 208329	
		IC 201786	IC 208356	
		IC 208377		
		IC 201705		
	Close to Population mean	Bihar local	IC 201787	WBL 185
		WBL 81	IC 212666	
		IC 201655		
		IC 201678		
		IC 201693		
		IC 208342		
		IC 248956		
Pods/plant	Above Population mean	WBL 81	Ranjan	
		Ballia local	14-4-1	
		Krishnanagar local	IC 201705	
		IC 201655	IC 201710	
		IC 201664	IC 212666	
		IC 201675	IC 248956	
		IC 201749		
		IC 201786		
		IC 208377		
	Close to Population mean	Midnapore local 1	IC 201787	
		Bihar local	IC 212683	
		WBL 77(Moitree)		
		IC 201646		

100 seed weight	Above Population mean	WBL 185 North 24 Parganas local Asha WBL 77(Moitree) Ballia local IC 201693 IC 201785	Howrah local 2 IC 208329 IC 208356	Midnapore local 2 IC 201678 IC 201794
	Close to Population mean	UP local IC 201710 IC 208377 IC 212683	Midnapore local 1 Ranjan 14-4-1	Bihar local IC 201681 IC 208342
Harvest index	Above Population mean	Purulia local Sagardeep local UP local North 24 Parganas local WBL 81 Asha Ranjan 14-4-1 Howrah local 2 IC 201664 IC 201693 IC 208329 IC 208342 IC 208356	WBL 77(Moitree) IC 201710 IC 208377	Howrah local Midnapore local 1
	Close to Population mean		Midnapore local 2 Bihar local	Ballia local IC 248959
Days to maturity	Below Population mean	North 24 Parganas local Bihar local	Howrah local Midnapore local 1 Sagardeep local	Purulia local

		UP local	
Close to Population mean	Howrah local 2	Asha	Midnapore local 2
		WBL 77 (Moitree)	14-4-1
			Ballia local
			IC 201655
			IC 201693
			IC 201698
			IC 201743
			IC 201744
			IC 201749

Table. 4. Correlation Between Stability Of Seed Yield And Its Components

S^2d	Correlation (r)
Seed yield &Pods/plant	0.694**
Seed yield & 100 seed weight	0.128
Seed yield & harvest index	0.033
Seed yield & days to maturity	-0.011

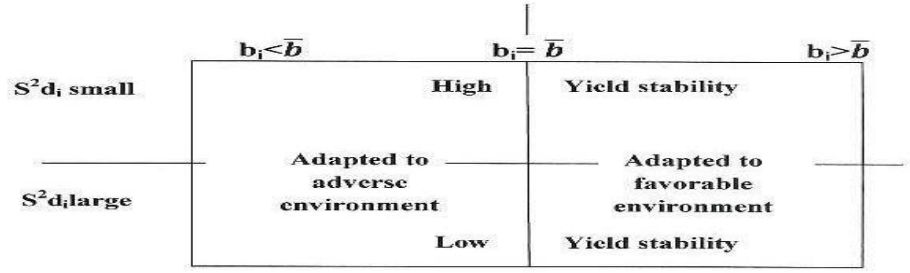

Figure. 1. Schematic representation of genotypic adaptation (adapted from Becker and Leon,1988)