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GENOTYPE X ENVIRONMENT INTERACTIONS AND STABILITY ANALYSIS IN BRINJAL (*SOLANUM MELONGENA* L.)

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ABSTRACT

Genotype response to changeable environmental factors as ex-pressed through genotype x environment interaction offers important information to growers as end users. Twenty five genotypes of brinjal (*Solanum melongena* L) were evaluated for their stability, with respect to yield and its contributing traits in four distinct environments viz. Kharif for autumn-winter crop, Summer for spring-summer crop for two years. The pooled analysis of variance indicated that the genotype and environment were highly significant for all the characters while genotype x environment interaction was found to be highly significant only for fruit set, number of fruits per plant, fruit weight, fruit yield per plant and fru it yield (q/ha) and significant for fruit length and these characters were subjected to stability analysis following the model of Eberhart and Russell (1966). The results of the present study clearly indicated that linear as well as non- linear components of genotype x environment interaction played an important role in the expression of all the characters. Considering all the yield attributing traits and yield together, it was found that four genotypes were most stable for yield(q /ha) with high mean yield performance. Rajendra Baigan –II, KS-224, KS-331and 71-19. The other genotypes namely Punjab Sadabahar, CHBR-1 and ABL-1 were also found highly stable for fruit yield (q/ha).

Key words : *Genotype x environment interactions, stability analysis, brinjal.*

Brinjal or eggplant or aubergine *(Solanum melongena* L.), an often-cross pollinated crop is one of the most common, popular and principal vegetable crops grown in India and other parts of the world belonging to the family Solanaceae. The possible centre of its origin is said to be Indo-Burma region. It can be grown in almost all parts of India except at higher altitudes. It is very popular among the people of all social strata and hence, it is rightly called vegetable of masses. A number of cultivars are grown throughout the country depending upon the yield, colour, size and shape of the various cultivars. It has a long bearing period when grown under mild climate but its bearing is shortened under hot summer and cold winter seasons. High temperature and high humidity in the morning hours hasten the opening of flowers and dehiscence of anthers (Singh and Kalda, 2001). The influence of environmental factors, such as temperature, day length and nutrition influence the yield and quality of brinjal. A number of promising varieties/ hybrids have been released in the country but very little efforts have been made to know the stability of the varieties in different environments. Successful new varieties must be stable and show high performance for yield and other essential agronomic traits. Their superiority should be reliable over a wide range of environmental conditions (Becker and Leon, 1988). Phenotypically stable genotypes are of great importance because the environmental conditions vary from year to year. Genotype x Environment interaction parameters have been reported to be useful for measuring adaptability by various workers (Stoffela *et al.,* 1983 and Poysa *et al.,* 1986). Therefore, the present study was aimed to evaluate and screen the potential genotypes of brinjal giving consistence performance over different year and to select the genotypes on the basis of stability parameters for important yield and yield contributing attributes.

MATERIALS AND METHODS

To assess the "Genotype x environment interaction studies in brinjal *(Solanum melongena* L.)'', the present investigation was carried out in the Department of Horticulture (Vegetables and Floriculture) at Bihar Agricultural College Farm, Sabour (Bhagalpur) under Rajendra Agricultural University, Bihar during the Kharif and summer seasons of 2003-04 and 2004-05. The data of both the years were pooled and analyzed. The experimental material consisted of twenty five genotypes of brinjal (Table-1) selected out of the germplasm collections being maintained in the department of Horticulture (Vegetables and Floriculture) of the Bihar Agricultural College, Sabour. All the twenty-five genotypes were grown in four distinct environments viz. Kharif (2003-04) for autumn-winter crop (E_1), Summer (2003-04) for spring-summer crop (E_2), Kharif (2004-05) for autumn-winter crop (E_3) and Summer (2004-05) for spring-summer crop. The design of experiment was Randomized Block with three replications. Evaluation was performed on three randomly selected competitive plants per replication for each entry for sixteen traits viz. plant height (cm), number of primary branches per plant, plant spread (m2), number of leaves per plant, leaf area (cm^2), number of days to 50% flowering (DAT), number of flowers per cluster, number of fruits per cluster, fruit setting (%), number of days to first harvest (DAT), number of fruits per plant, fruit weight (g), fruit length (cm), fruit width (cm), fruit yield per plant (kg) and fruit yield (q/ha). The genotype (G) x environment (E) interaction was calculated by the pooled analysis of variance. The mean values of genotypes for different traits under different environments were used for this analysis. The analysis of stability parameters was estimated by the model suggested by Eberhart and Russel (1966).

RESULTS AND DISCUSSION

In the present study, the pooled analysis of variance for genotypes x environment interaction showed that there is significant difference between the genotypes, environment and G x E interaction (Table-2) indicating the inconsistent performance of genotypes across the environments.The pooled analysis of variance indicated that the genotype and environment were highly significant for all the characters while genotype x environment interaction was found to be highly significant only for fruit set, number of fruits per plant, fruit weight, fruit yield per plant and fru it yield (q/ha) and significant for fruit length and these characters were subjected to stability analysis following the model of Eberhart and Russell (1966). Rest of the characters which were found non-significant was excluded from stability analysis. Non-significant G X E interaction revealed that the genotypes responded similarly in all the environments. This is in agreement with the results of Singh *et al.* (1985), Khurana *el al.* (1987), Srivastava *et al.* (1997), Mohanty and Prusti (2000) and Prasad *et al.* (2002) in brinjal. Pooled ana lysis of variance for stability model (Table-3) showed that mean differences among the genotypes were highly significant for all the characters revealing thereby that the genotypes varied considerably over a wide range of environments. Highly significant mean squares due to environment plus genotype x environment interaction revealed that the genotypes interacted considerably with the environmental condition that existed over two years. The linear component of G X E interaction was significant for all the characters.

Table-1 : List of Brinjal genotypes included in the experiment.

S. No.	Genotypes	Source
1.	ABL-1	Gujarat Agril. Univ., Anand Cam pus
2.	ABR-1	Gujarat Agril. U niv., Anand Cam pus
3.	ABR-2	Gujarat Agril. Univ., Anand Campus
4.	A ru na	P.D.K.V., Akola
5.	BB-40	O.U.A.T., Bhubaneshwar
6.	BB-46	O.U.A.T., Bhubaneshwar
7.	BB-60-C	O.U.A.T., Bhubaneshwar
8.	BB-71	O.U.A.T., Bhubaneshwar
9.	CHBR-1	H.A.R.P., Ranchi
10.	DBL-1 1	I.A.R.1., New Delhi
11.	JNDBL-1	Gujarat Agril. Univ., Junagadh Cam pus
12.	KS-224	C.S.A.U.A.T., Kalyanpur
13.	KS-227	C.S.A.U.A.T., Kalyanpur
14.	KS-331	C.S.A.U.A.T., Kalyanpur
15.	KS-352	C.S.A.U.A.T., Kalyanpur
16.	Muktakeshi	B.A.C., Sabour
17.	N DB-18	N.D. Univ. of Agril. & Tech., Faizabad
18.	NDB-26-1	N.D. Univ. of Agril. & Tech., Faizabad
19.	N DB-28-2	N.D. Univ. of Agril. & Tech., Faizabad
20.	Pusa Kranti	I.A.R.I., New Delhi
21.	Pusa Purple Long	1.A.R.I., New Del hi
22.	Punjab Sadabahar	P.A.U., Ludhiana
23.	Rajendra Annapurna	B.A.C., Sabour
24.	Rajendra Baigan-11	B.A.C., Sabour
25.	71-19	B.A.C., Sabour

In case of fruit set linear and non-linear components of genotype x environment interaction were found to be significant (Table-2 and 3), which indicated that the response of genotypes varied over a range of environments. The stability parameters (bi = I , Sd^2 = 0 and high mean) for fruit set exhibited that out of twenty-five genotypes, five genotypes namely JNDBL-1, NDB-26-1, Pusa Kranti, Rajendra Baigan-11 and 71-19 were found to be highly stable over different environments.

Linear as well as non-linear components of genotype x environment interaction were found to be

Table-2 : Pooled analysis of variance (Mean sum of squares) for sixteen characters of brinjal for genotype x environment interactions.

Source of variation	d.f.	Plant height (cm)	No. of pr. branches /plant	Plant spread (m^2)	No. of leaves per plant	leaf area (cm^2)	No. of days to 50% flowering (DAT)	No. of flowers per cluster	No. of fruits/cluster
Genotypes	24	566.8112**	15.1691**	0.01998**	4245.706**	363.1261**	203.501 **	3.65439**	2.859559**
Environments	3	5376.398**	33.7259**	0.35831**	39133.14**	5181.456**	1802.22**	4.08234**	0.628515**
Genotype x Environment	72	6.60917NS	0.l J201NS	0.00046NS	59.73401NS	J.095301NS	0.95852 NS	0.00784NS	0.00428NS
Pooled error	200	21.0036	0.17207	0.00086	87.59152	56.90187	10.9717	0.04808	0.010093

Table-2 : Contd......

Source of variation	d.f.	Fruit set (Degree)	No. of days to first harvest	No. of fruits/plant	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Fruit yield/plant (kg)	Fruit yield (q/ha)
Genotypes	24	265.2836**	272.581 **	60.2371**	9793.4751**	160.687**	13.9144**	0.492097**	37914.3**
Environments	3	1088.6679**	2182.44**	168.169*	9645.5711**	48.4755**	4.29512**	4.049541**	305942**
Genotype x Environment	72	3.9981 **	5.36219NS	2.54154**	49.0851**	0.5049*	0.02923NS	0.020181**	1457.92**
Pooled error	200	2.0464	18.9648	0.47141	31.61 17	l.14513	0.08036	0.003836	357.443

*Significant at (P=0.05) probability, **Significant at (P=0.01) probability

significant (Table-2 and 3) for number of fruits per plant indicating that the response of genotypes varied in different environments. Similar results were also observed by Mohanty and Prusti (2000) and Rai *et al.* (2000) in brinjal. The genotypes BB-60-C, KS-227 and KS-331 having mean values above population mean, average regression (bi, nearer to unity) and low deviation from regression (Sd^2', around zero) were found to be stable over different environments. While, the genotypes BB-46, BB-71, KS-224 and KS-352 were poor performers but highly stable genotypes.

Both linear as well as non-linear components of genotype x environment interactions with respect to fruit weight were found to be significant (Table-2 and 3). The genotypes BB-40, BB-71, KS-224, KS-227, NDB-26-1, Pusa Purple Long and 71-19 had high stability and adaptation to unfavorable environments.

The linear and non-linear components of genotype x environment interactions were found to be significant (Table-2 and 3) in respect of fruit length. This is in conformity with those reported earlier by Mishra *et al.* (1998) and Prasad *et al.* (2002). The genotypes namely BB-71, JNDBL-1, KS- 331, Pusa Purple Long and Rajendra Annapuma were found to be highly stable in respect of length of fruit over all the environments

Both linear and non-linear components of genotype x environment interactions for fruit yield per plant were found to be significant (Table-2 and 3), which indicated that the response of genotypes in different environments differed significantly. Similar result was also reported by Vadivel and Bapu (1989). A perusal of stability parameters (bi, Sd^2 and high mean) for fruit yield per plant exhibited that out of twenty-five genotypes, seven genotypes, namely ABL-1, CHBR-1, KS-224, KS-331, Punjab Sadabahar, Rajendra Baigan-II and 71-19 had high mean values above the population mean (0.84 Kg), average response of regression coefficient (bi, approaching unity) and non-significant deviation from regression (Sd^2, around zero), were found highly stable over all the environments. On the other hand, only two genotypes BB-71 and NDB-18 showed mean fruit yield per plant lower than the population mean but showed stability over different environments.

In case of fruit yield, the response of the genotypes varied over a range of environments, as the linear and the non-linear components of G X E interaction were significant (Table-2 and 3). This is in agreement with the findings of Khurana *et al.* (1987), Sidhu (1989), Mohanty (2002) and Prasad *et al.* (2002) in brinjal. A close scrutiny of stability parameters for

Table-3 : Stability analysis for yield and yield components over four environments (Mean Sum of Squares).

Source of variation	d.f.	Fruit set (Degree)	No. of fruits/plant	Fruit weight (g)	Fruit length (cm)	Fruit yield/ plant (Kg.)	Fruit yield (q/ha.)
Genotypes	24	88.4279**	20.0790**	3264.4917**	53.5622**	0.164032*	12638.1031**
Env.+ (G x E)	75	15.795**	3.0555**	144.3148..	0.8079**	0.060452**	4558.5599**
Env. (Linear)	1	1089.1971 **	168.168**	9645.5711 **	48.4755**	4.049541**	305941.9828**
GxE (Linear)	24	2.8747**	2.29296**	33.9280**	0.3776**	0.019659**	1476.3749**
Pooled deviation	50	0.5287	0.1193	7.2754	0.061 1	0.000251	10.3403
ABL-1	2	0.4140	0.1030	3.7460	0.1357	0.000056	3.8407
ABR-1	2	0.8011	0.0227	0.8864	0.1006	0.000021	0.0719
ABR-2	2	1.0021	0.0172	11.1997	0.0072	0.000059	0.5215
Aruna	2	4.2459	1.6929	24.8592*	0.0273	0.002063	0.5640
BB-40	2	0.6502	0.0483	1.7755	0.0399	0.000044	12.8076
BB-46	2	0.0211	0.0017	0.7119	0.0083	0.000218	8.1043
BB-60-C	2	0.4900	0.0167	0.0430	0.0141	0.000081	1.1691
BB-71	2	0.2746	0.0183	0.0824	0.0368	0.000008	1.0890
CHBR-1	2	0.0719	0.0217	0.9825	0.0136	0.000012	0.7070
DBL-11	2	0.2303	0.0645	2.6947	0.0395	0.000002	0.3820
JNDBL-1	2	0.3795	0.1487	5.2293	0.1018	0.000692	56.9435**
KS-224	2	0.2031	0.0001	1.9685	0.0235	0.000081	7.6795
KS-227	2	0.2040	0.0354	0.8645	0.0128	0.000005	0.11 14
KS-331	2	0.1551	0.0404	1.6946	0.1463	0.000160	6.6210
KS-352	2	0.5199	0.1788	0.5943	0.0289	0.000002	0.6738
Muktakeshi	2	0.4912	0.1674	71.9371**	0.4276	0.000055	2.4410
NDB-18	2	0.4251	0.0313	2.4611	0.0035	0.000278	18.1390
NDB-26-1	2	0.1329	0.0044	0.0139	0.0408	0.000177	10.8955
NDB-28-2	2	0.5613	0.0205	8.2219	0.0489	0.000005	0.6708
Pusa Kranti	2	0.4324	0.0651	l.8801	0.0192	0.000444	25.3474*
Pusa Purple Long	2	0.3505	0.0331	2.8752	0.084!	0.000423	15.5825
Punjab Sadabahar	2	0.2633	0.1205	3.2252	0.021 !	0.000384	19.6499
R. Annapuma	2	0.3860	0.0834	18.0493	0.0547	0.000854	54.5256**
Rajendra Baigan-11	2	0.0004	0.0284	14.5426	0.0250	0.000050	4.5751
71-19	2	0.5102	0.0! 83	l.3473	0.0661	0.000094	5.3925
Pusa Purple Long	2	0.3505	0.0331	2.8752	0.084!	0.000423	15.5825
Pooled error	200	0.6821	0.1571	10.5372	0.1180	0.001279	1 19.1476

fruit yield (q/ha) revealed that the genotypes ABL-1, CHBR-1, KS-224, KS-331, Punjab Sadabahar, Rajendra Baigan-JJ and 71-19 exhibited average fruit yield above the population mean (225.80 q/ha) along with average response of regression coefficient (bi, approximately one) and significant deviation from regression (Sd^2, close to zero) indicated uniform performance (stability) over different environments. The genotypes BB-71 and NDB-18 were also found to be stable as they exhibited average regression coefficient (bi, around one) and low deviation from regression (Sd^2, nearer to zero) however, their mean values of fruit yield were inferior to the population mean (225.80 q/ha).

The results of the present study clearly indicated that linear as well as non- linear components of genotype x environment interaction played an important role in the expression of all the characters. Considering all the yield attributing traits and yield together, it was found that four genotypes were most stable for yield(q /ha) with high mean yield performance. Rajendra Baigan –II, KS-224, KS-331and 71-19. The other genotypes namely Punjab Sadabahar, CHBR-1 and ABL-1 were also found highly stable for fruit yield (q/ha).

Any generalization regarding stability of a cultivar for all characters is too difficult. The genotypes studied did not exhibit uniform stability and response patterns for all the characters. These two attributes appeared to be specific for individual character for a given genotype.

REFERENCES

1. Becker H. C., Leon J. Stability analysis in plant breeding // *Plant Breeding*. – 1988, vol. 101, p. 1–23
2. Eberhart, S. A. and Russell, W. A. 1966. Stability parameters for comparing varieties. *Crop Sci.* 6: 36-40.
3. Khurana, S.C., G.R. Singh; K.K. Thakral; Kalloo; M.L. Pand ita and U .C. Pandey (1987). Phenotypic stability for fruit yield in brinjal *(So/anum melongena* L.) *Haryana Agril. Univ. J. Res.,* 17 (2): 189-191.
4. Mishra, S.N., D. Mishra and N.C. Mishra (1998). Stability analysis in bri njal *(Solanum melongena* L.). *Indian. J. Hori.,* 55 (I): 78-80.
5. Mohanty, B.K. and A.M. Prusti (2000). Genotype x environment interaction and stability analysis for yield and its components in brinjal *(Solanum melongena* L.) *Ind. J. Agril. Sci.,* 70 (6): 370-373.
6. Poysa, V. W., Garton, R., Courtney, W. H., Metealf, J. G. And Muchmer, J. 1986. Genotype x environment interactions in processing tomatoes in Ontario. J. Amarican Soc. Hort. Sci. 111(2): 293-297.
7. Prasad, V .S.R.K., D.P. Singh; A.B. Pal; K.K. Gangopadhyay and R.S. Pan (2002). Assessment of yield stability and ecovalence i n egg plant. *Ind. J. Hort.,* 59 (4): 386-394
8. Rai, N.; A.K. Singh and T. Tirkey 0000). Phenotypic stability in long fruited brinjal hybrids *(Solanum melongena* L.). *Veg.Sci.,* 27 (2): 133-135.
9. Sidhu, A.S. (1989). Phenotypic stability in brinjal *(Solanum melongena* L.). *Ind. J. Genetics & plant breeeding,* 49 (I): 81-83.
10. Singh, G.P.; Kalloo; U.C. Pandey; K.K. Thakral and S.C. Khurana (1985). Phenotypic stability in brinjal *(Solanum melongena* L.) *Haryana. J. Hort. Sci.,* 14 (1-2): 118- 121.
11. Singh, Narcndra and T.S. Kalda (200 l). Bri njal *(Solanum melongena L.).Vegetables, Tubercrops* and *Spices, pp. 29-49,* I.C.A.R., New Del hi.
12. Srivastava, B.P.; K.P. Singh and J.P. Srivastava (1997). Stabil ity for fru it yield i n brinjal*(Solanum melongena* L.). *Vegetable Science,* 24 (I): 43-44.
13. Staffella, P. J., Bryan, H. H., Howe, T.K., Scott, J. W., Locasio, S.J. and Olsen, S.M. 1983. Stability differences among tomato genotypes on fruit yields. J. Amarican Soc. Hort. Sci. 109(5): 615-618.
14. Vad ivel, E. and J.R.K. Bapu (1990). Genetic variation and scope of selection for yield attributes in eggplant *(Solanum melongena* L.). *South Indian Horticulture,* 38 (6): 301-304.