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Assessment of yield stability in egg-plant (*Solanum melongena* L.)

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Abstract
To understand the complexity of genotype stability in eggplant, an investigation was carried out over three year and wide variation among genotypes, environments and genotype x environment interaction was observed for all the traits. The linear, component of genotype-environment interaction alone as significant for all the traits, while the non linear component exclusively was significant for fruit length, fruit width, number of fruits per plant and fruit yield per plant. Stable genotypes were identified for wider environments and specific environments with high mean performance (over general mean) for fruit yield per plant. Considering the overall performance two parents Pusa Uttam and Pusa Upkar were found promising with high yield and stable performance for number of characters. These lines can be recommended for general cultivation and can also be utilized in breeding programme to incorporate stability. The 42 hybrids were found stable over environments for fruit yield of which the 18 hybrids showing high yield potential and was detected for general adaptability and proposed for commercial cultivation and only two hybrids, Pusa Purple Long x Pusa Upkar and Punjab Sadabahar x Pusa Upkar exhibiting below average stability and suitable for favourable environmental conditions.

Keywords: Eggplant, *Solanum melongena*, genotypes, stability

1. Introduction
Selection of individual genotypes over environments help in identifying stable lines and as such can be grown in the farmer's field commercially. The environment of selection, the quality of the environment in particular and effectiveness of selection in contrasting environments have been discussed in this crop by several workers such as Krishna Prasad *et al*. (2002) [9], Mohanty (2002) [5] and Vaddoria *et al*. (2009) [13]. Stability analysis of the traits is often done using standard statistical methods such as Eberhart and Russell (1966) [2], Perkins and Jinks (1968) [7] and Finlay and Wilkinson (1963) [3] in order to identify stable varieties suitable to particular environment. The main characteristics, of this analysis is that it leads towards breeding for wider adaptation. Since the traits are pooled in one calculation, the variety having highest mean yield along with unit regression coupled with minimum deviation from regression values helps to identify the stable genotypes under favourable and un favourable conditions. A genotype can be considered superior, if it has the potential for high yield under favourable environmental conditions and at the same time has a great deal of phenotypic stability. The potentiality of a genotype and stability of its performance can be judged by multi-environmental test. Further, study of stability parameters for fruit yield along with its component traits help in identification of buffering action of component characters in stability of fruit yield. Hence, the present investigation was under taken to evealuated the 55 genotypes of eggplant over three successive years in four different environments and two different locations and results are being presented and discussed in this paper.

2. Materials and Methods
The experiment was laid out in a randomized block design with three replications at Rajasthan College of Agriculture, Udaipur and Krishi Vigyan Kendra, Chittorgarh, Rajasthan, during autumn-winter season, 2010 to 2012. A total of 55 genotypes (10 parents & their 45 crosses) of eggplant were evealuted in a four different environments on the two contrasting locations. Each plot comprised of three row at 75 cm apart of 7.20 m length each and plants spaced at 60 cm apart. The observations were recorded on five competitive plants for different characters *viz*., number of fruits per plant, fruit length (cm), fruit width (cm), fruit weight (g) and fruit yield per plant (kg). All the recommended agronomic practices were followed for growing successful crops in all the four environments.

The data were subjected to stability analysis (Eberhart and Russell, 1966) [2] to understand the effective relationship between stability parameters.

3. Results and Discussion

The pooled analysis of variance (Table 1) revealed significant difference both among genotypes and environments for all the characters in all the environments. This not only indicated the extent of diversity in growing conditions during the three years of experimentation but also reflected the degree of genetic variability among the hybrids. Significant mean squires due to genotype x environment interaction demonstrated that the phenotypic expression of the genotypes varied in different years for all the traits. Pronounced environmental effect influencing the fruit yield and its components of brinjal hybrids were also reported earlier Rai *et al*. (2000). The genotype-environment interaction + environment (linear) were significant for all the attributes. It detected variable genotypic response to environmental fluctuation and independent nature of genetic system governing the stability parameters. Further, partitioning this component clarified that the environment (linear) differed significantly for all the characters which substantiated marked variability between the years of cropping affecting the performance of the genotypes. Higher magnitude of environment (linear) effect as compared to genotype x environment (linear) interaction depicted that major part of the total variation was linear function of environment which might be responsible for high adaptation in relation to yield and its attributes in brinjal hybrids (Kumar *et al*. 2008) [10].

Significant mean square due to G x E (linear) component for all the characters elucidated that the genotypes had divergent linear response to environmental alteration and the difference among the regression coefficients of the genotypes on the environmental indices was real. Therefore, prediction of performance over environments was possible for these characters on the basis of regression analysis. On the other hand, the non linear component exclusively was significant for fruit length, fruit width, number of fruits per plant and fruit yield which illustrated substantial difference in stability among the genotypes and most part of G x E interaction was absolutely unpredictable. Hence, prediction of performance across environments would be difficult for these traits on the basis of regression analysis. Nevertheless the deviation from regression alone might be envisaged for interpretation of stability of these attributes (Mohanty, 2002) [5].

Finlay and Wilkinson (1963) [3] advocated the regression coefficient as a measure of stability, whereas, Eberhart and Russell (1966) [2] stressed both linear and nonlinear components of G x E interaction in judging the phenotypic stability of a genotype. Later, Paroda and Hayes (1971) [6] suggested that the linear regression could be regarded as a varietal response to environmental modification, while the deviation around the regression slope would be the most suitable measure of its stability. Thus genotypes with least deviation from regression were considred stable and *vice versa*. In the present investigation, the mean performance along with the regression coefficient the accessions were classified (Table 2&3) and discussed and the deviation from linearity of genotypes represented its adaptability (Table 4&5). Accordingly the accessions were classified (Table 3&4) and discussed for their stability and adaptability in respect of various characters studied.

Fruit length of the parents test entries ranged from 8.65 (BR-112) to 20.51 (Azad-331) and in crosses ranged from 7.94 (Selection-2 x BR-112) to 22.64 (Pusa Upkar x Azad-331) with a mean of 14.02. Only the linear component was significant explaining predictable performance over environments. However, a significant deviation from linearity was observed for the two parents and 13 crosses. The remaining eight parents and 32 hybrids were recognized as stable across environments of which two parents and six hybrids exhibited above average stability supplemented with unit regression coefficient and were proposed for general adaptability. The hybrids Pusa Purple Long x Sel-2, Pusa Purple Long x Mukta Shree, Pusa Purple Long x Type-3, Pusa Uttam x Punjab Sadabahar, Punjab Sadabahar x Mukta Shree, Punjab Sadabahar x Azad-331, Mukta Shree x Type-3, Mukta Shree x Azad-331 and Type-3 x BR-112 exhibited specific adaptability for favourable environments because of their better performance and greater sensitivity. The hybrid Punjab Sadabahar x Udaipur Local displayed poor responsiveness but regained and manifested its inherent potentialities fully under unfavourable environments. Hence it might be considered more stable and more adaptive (Mehta *et al*. 2010) [11].

Fruit width of parents ranged from 3.19 (Azad-331) to 8.58 (Udaipur local) and in crosses ranged from 2.84 (Pusa Purple long x Punjab Sadabahar) to 9.19 (Pusa Uttam x Udaipur local) with a population mean of 5.90. The linear component was significant explaining predictable performance over environments. 23 entries (parent Mukta Shree and 22 hybrids) expressed significant deviation from regression and were termed as unstable over environments. Among the stable (9) ones, the parent Pusa Uttam registered above average performance coupled with regression coefficient around unit and were assessed for general adaptability. The stable parents Sel-2, Type-3, Pusa Upkar BR-112 & Udaipur Local displayed a linear regressions significantly less than unit and found suitable for poor environments. The 24 hybrids were recognized as stable across environments of which six accessions exhibited above average stability supplemented with unit regression coefficient and were proposed for general adaptability. The hybrid Pusa Upkar x Udaipur Local exhibited specific adaptability for favourable environments because of their better performance and greater sensitivity. They might be regarded less stable. On the contrary, the hybrid Pusa Purple Long x Pusa Uttam, Pusa Uttam x Sel-2 and Sel-2 x Pusa Upkar displayed poor responsiveness but regained and manifested its inherent potentialities fully under unfavourable environments.

Number of fruits per plant of parents ranged from 9.04 (Udaipur local) to 26.61 (Pusa Purple long) and in crosses ranged from 7.71 (Type-3 x Udaipur local) to 36.60 (Pusa Purple long x Pusa Uttam) with an average of 20.10. The linear component alone was significant but four hybrids showed significant mean square deviation. Other 51 accessions (10 parents & 41 hybrids) were determined as stable across environments of which 14 genotypes (2 parents & 12 hybrids) provided above average number of fruits per plant accompanied by regression coefficient non-significantly deviating from unit and were detected for general adaptability. The hybrids Pusa Purple Long x Pusa Uttam, Pusa Purple Long x Type-3, Pusa Uttam x Azad-331, Punjab Sadabahar x Sel-2 and Punjab Sadabahar x Type-3 exhibited specific adaptability for favourable environments because of their better performance and greater sensitivity. The parents Pusa Upkar and Azad-331and hybrids Pusa Purple Long x Pusa Upkar and Pusa Purple Long x Azad- displayed poor responsiveness but regained and manifested its inherent potentialities fully under unfavourable environments (Mohanty, 2002) [5].

Number of fruits per cluster of parents ranged from 1.09 (Type-3) to 3.45 (Pusa Upkar) and in crosses ranged from 1.05 (Mukta Shree x Type-3) to 3.87 (Pusa Uttam x Selection-2) with a general mean of 2.04. Only the linear component was significant explaining predictable performance over environments. However, a significant deviation from linearity was observed for the two crosses. All the parents and remaining 43 hybrids were recognized as stable across environments of which two parents (Pusa Uttam & Pusa Upkar) and 13 hybrids exhibited above average stability supplemented with unit regression coefficient and were proposed for general adaptability. The parent, Udaipur Local and hybrids Pusa Purple Long x Pusa Upkar, Pusa Purple Long x Azad-331, Pusa Purple Long x Udaipur local, Pusa Uttam x Udaipur local, Sel-2 x Udaipur local, Pusa Upkar x BR-112 and Azad-331 x Udaipur local exhibited specific adaptability for favourable environments. The stable parents Azad-331displayed a linear regressions significantly less than unit and found suitable for poor environments.

The average fruit weight of parents varied from 40.66 (Pusa Purple long) to 167.22 (Udaipur local) and in hybrids ranged from 42.49 (Pusa Purple long x Punjab Sadabahar) to 188.35 (Punjab Sadabahar x Udaipur local) with a population mean of 111.52 (g). The non linear component exclusively was significant denoting unpredictable performance of the accessions over environments. Fourty nine genotypes (9 parents & 40 hybrids) were adjudged as stable across environments on account of their non-significant deviation from regression. The hybrids Pusa Uttam x Punjab Sadabahar, Pusa Uttam x Sel-2, Pusa Uttam x Pusa Upkar, Pusa Uttam x Azad-331, Punjab Sadabahar x Udaipur local, Mukta Shree x Pusa Upkar and Pusa Upkar x Udaipur local acquired above average performance concommittant with regression coefficient approximate above to unit and were classified for specific adaptability for the better environments. None of the parents were suitable for better environments. The parent Type-3 and hybrids Pusa Purple Long x Pusa Uttam, Pusa Uttam x Mukta Shree, Pusa Uttam x Type-3, Pusa Uttam x BR-112, Pusa Uttam x Udaipur local, Type-3 x Udaipur local, Pusa Upkar x Azad-331 and BR-112 x Udaipur local displayed poor responsiveness but regained and manifested its inherent potentialities fully under un favourable environments (Suneetha *et al*. 2006) [12].

The highest fruit yield (4.88 kg/plant) was obtained from hybrid Pusa Uttam x Sel-2, whereas the lowest yield (1.25 kg/plant) was realized from the accession Pusa Purple long x Punjab Sadabahar with a population mean of 2.42 kg per plant. The parents ranged from 0.95 kg/plant (BR-112) to 3.71kg/plant (Pusa Uttam). The nonlinear component alone was significant imparting predominance of unpredictable factors of G x E interaction. The 51 genotypes (9 parents + 42 hybrids) were found stable over environments owing to their nonsignificant deviation from linearity. The parents i.e. Pusa Uttam & Pusa Upkar and 18 hybrids produced above average yield together with regression coefficient near unit and were identified for general adaptability. Only 2 hybrids, i.e. Pusa Purple Long x Pusa Upkar and Punjab Sadabahar x Pusa Upkar exhibited specific adaptability for favourable environments because of their better performance and greater sensitivity. None of the parents were suitable for specific adaptability.

Stability of genotypes for yield is the result of stability for its component traits (Grafius, 1956) [4]. The fruit yield of brinjal is a complex quantitative character dependent on several related attributes. In the present investigation, the general adaptability for fruit yield of parent Pusa Uttam and hybrid Pusa Uttam x Sel-2 might be attributed to its stability in all the contributing characters studied. The F_1 hybrids of brinjal are heterozygous and heterogeneous in nature. Such populations depend heavily on physiological homeostasis to stabilize productivity over a wide range of changing environments due to higher degree of individual buffering ability (Allard and Bradshaw, 1964) [1]. The general adaptability of the parent Pusa Uttam and hybrid Pusa Uttam x Sel-2 might be assigned to its developmental buffering capacity. Environmental mean (Table 6) revealed that E_1 is the most favourable environment for yield and its contributing traits and its, indicate the Udaipur location was found suitable for all the characters studied. The present study led to conclude that parent Pusa Uttam and hybrid Pusa Uttam x Sel-2 might be advocated for commercial cultivation. Since the yield stability is genetically controlled, the stable hybrids could be exploited in future improvement programmes to incorporate genes for stability through recombination breeding.

Table 1: Pooled analysis of variance for stability parameters (Eberhart and Russell, 1966) in eggplant

Source of variation	Genotypes (G)	Environment	G x E	Environments + (G x E)	Environments (linear)	G x E (linear)	Pooled deviation	Pooled error
d.f.	54	3	162	165	1	54	110	432
Fruit length (cm)	46.16**	152.02**	1.38**	4.12**++	455.95**++	2.53**++	0.79**	0.27
Fruit width (cm)	12.58**	20.58**	0.44**	0.81**++	61.6**++	0.63**++	0.34**	0.07
Number of fruits per plant	169.17**	402.23**	2.06**	9.33**++	1206.7**++	4.55**++	0.8**	0.6
Number of fruits per cluster	2.69**	3.19**	0.02**	0.08**++	9.35**++	0.05**++	0.004	0.01
Fruit weight (g)	6170.43**	4783.22**	53.27**	139.26**++	14349.5**++	111.05**++	23.93	19.22
Fruit yield per plant (kg)	3.95**	2.69**	0.03**	0.08**++	8.25**++	0.04**++	0.02**	0.01

* Significant at 5% against pooled error

** Significant at 1% against pooled error

+ Significant at 5% against pooled deviation

++ Significant at 1% against pooled deviation

Table 2: Stability parameters for fruit length, fruit width and number of fruits per plant.

Genotypes	Fruit length (cm)			Fruit width (cm)			Number of fruits per plant		
	μ_i	b_i	S^2d_i	μ_i	b_i	S^2d_i	μ_i	b_i	S^2d_i
Pusa Purple long	20.37	1.01	2.77**	2.33	0.63	-0.03	26.61	0.67**	-0.46
Pusa Uttam	13.01	0.43*	0.05	7.71	0.82	-0.04	20.25	1.38	0.11
Punjab Sadabahar	17.03	0.61	-0.05	3.38	0.60**	-0.07	25.36	0.51	0.23
Selection-2	10.07	0.41**	-0.17	7.13	0.30**	-0.06	15.89	0.61	0.4
Mukta Shree	11.97	0.33	0.86*	7.53	0.33	1.34**	13.29	0.21**	0.08
Type-3	12.73	0.39**	-0.12	6.70	-0.22*	0.12	11.24	0.25**	-0.51
Pusa Upkar	11.95	0.34**	-0.26	7.30	0.61*	-0.06	22.79	0.66**	-0.54
BR-112	8.65	0.41**	-0.15	6.24	0.37**	-0.06	16.50	0.58*	-0.13
Azad-331	20.51	0.6	0.36	3.19	0.46**	-0.06	23.69	0.36**	-0.51
Udaipur Local	12.14	0.48	0.31	8.58	-0.09*	0.03	9.04	0.49**	-0.59
PPL x Pusa Uttam	22.52	1.01	0.8*	8.19	0.39**	-0.06	36.60	1.94**	-0.57
PPL x Pb Sadabahar	19.01	1.24	-0.12	2.84	0.63	-0.05	28.31	0.66	-0.11
PPL x Selection-2	15.68	2.16**	0.02	4.67	-0.42	0.8**	21.43	1.19	-0.37
PPL x Mukta Shree	16.29	1.78**	0.07	5.09	1.13	0.02	16.79	1.22	-0.18
PPL x Type-3	15.79	2.03*	0.55	3.57	0.63	0.00	21.69	1.83**	-0.5
PPL x Pusa Upkar	14.31	1.48	1.59**	3.64	0.88	0.30*	28.07	0.59**	-0.4
PPL x BR-112	12.73	1.44	0.39	4.16	1.15	-0.02	22.56	1.16	0.28
PPL x Azad-331	17.82	0.58	2.92**	2.87	0.38**	-0.07	26.22	0.46*	-0.08
PPL x Udaipur Local	15.46	1.38	0.02	5.57	0.76	-0.03	16.65	1.05	0.75
Pusa Uttam x Pb Sadabahar	14.27	1.75**	-0.23	5.43	1.86**	-0.06	27.18	0.67	-0.12
Pusa Uttam x Selection-2	14.90	0.84	0.41	8.50	0.48**	-0.07	27.76	1.33	1.79*
Pusa Uttam x Mukta Shree	14.19	0.49**	-0.17	7.01	1.00	0.2	14.81	0.99	0.43
Pusa Uttam x Type-3	12.39	0.95	-0.1	5.84	1.81	0.42*	16.24	1.65	3.11*
Pusa Uttam x Pusa Upkar	11.58	1.25	0.34	7.13	0.97	0.06	18.56	1.33	0.79
Pusa Uttam x BR-112	11.98	1.07	2.07**	7.97	0.76	-0.04	16.68	1.39	1.61
Pusa Uttam x Azad-331	15.72	1.21	0.26	5.54	0.29	0.30*	27.62	1.67**	-0.55
Pusa Uttam x Udaipur Local	11.33	1.19	0.29	9.19	1.06	0.06	15.77	1.19	0.18
Pb Sadabahar x Selection-2	12.79	1.03	-0.07	4.35	2.17*	0.10	24.38	1.27*	-0.45
Pb Sadabahar x Mukta Shree	15.47	1.2**	-0.27	4.92	0.79	0.27*	19.17	1.48	0.08
Pb Sadabahar x Type-3	12.86	1.91	2.24**	4.24	1.41	0.49**	21.07	1.4*	-0.27
Pb Sadabahar x Pusa Upkar	13.84	1.08	0.11	4.26	0.29	0.26*	30.17	1.13	-0.22
Pb Sadabahar x BR-112	13.26	0.62	-0.02	4.04	1.39**	-0.07	22.58	1.18	-0.37
Pb Sadabahar x Azad-331	20.66	1.32**	-0.24	3.51	0.34**	-0.07	27.88	1.18	1.12
Pb Sadabahar x Udaipur Local	18.87	0.42**	-0.27	9.16	0.28	0.24*	30.44	1.00	-0.29
Selection-2 x Mukta Shree	11.26	0.94	-0.07	6.90	1.37	0.85**	11.00	1.40**	-0.55
Selection-2 x Type-3	11.84	0.92	0.91*	5.44	1.94	0.85**	14.36	1.33*	-0.41
Selection-2 x Pusa Upkar	13.47	1.02	2.02**	7.18	0.22**	-0.05	14.80	1.39	1.82*
Selection-2 x BR-112	7.94	0.17	0.1	6.03	1.02	0.14	19.20	1.24	0.68
Selection-2 x Azad-331	13.31	1.49	-0.01	5.21	2.22	0.18	17.56	0.15	2.59*
Selection-2 x Udaipur Local	10.24	0.01	0.38	8.72	0.88	0.09	11.56	0.57	0.06
Mukta Shree x Type-3	14.15	1.71*	0.17	6.21	1.59	0.32*	11.61	0.62	-0.07
Mukta Shree x Pusa Upkar	12.68	1.26	0.06	6.85	1.89	0.44**	19.65	1.33	0.00
Mukta Shree x BR-112	10.95	0.83	3.41**	7.11	1.64	0.24*	19.30	0.87	-0.43
Mukta Shree x Azad-331	16.10	1.55*	-0.05	5.58	0.92	0.26*	27.85	0.90	0.07
Mukta Shree x Udaipur Local	9.98	1.12	1.08*	8.70	2.15	0.35*	12.79	0.35	1.72
Type-3 x Pusa Upkar	12.05	0.81	0.28	5.50	1.16	0.08	22.96	0.70	0.18
Type-3 x BR-112	14.70	0.47**	-0.12	6.41	1.73	1.13**	22.39	0.98	0.43
Type-3 x Azad-331	16.84	1.4	0.51	4.22	1.3	2.94**	15.62	0.78*	-0.47
Type-3 x Udaipur Local	10.83	1.24	-0.09	6.41	2.55	0.41*	7.71	0.04**	0.70
Pusa Upkar x BR-112	8.76	0.64	0.42	6.49	1.63	0.49**	18.41	1.09	0.65
Pusa Upkar x Azad-331	22.64	0.74	0.49	7.30	1.54	0.38*	33.70	1.69	1.00
Pusa Upkar x Udaipur Local	11.70	0.26	1.09*	6.35	2.71**	0.12	19.27	1.26*	-0.44
BR-112 x Azad-331	14.22	2.05	1.23*	4.26	0.84**	0.20	16.63	1.4*	-0.15
BR-112 x Udaipur Local	9.53	0.36	1.73**	7.13	1.75	0.58**	11.87	0.67	0.29
Azad-331 x Udaipur Local	15.72	1.97	1.14*	4.96	1.48	0.72**	13.80	1.52**	-0.41
Mean	14.02	1.00	0.52	5.90	1.00	0.27	20.10	1.00	0.20
S.E. (mean)	0.42			0.22			0.63		
S.E. (bi)		0.38			0.64			0.24	

Table 3: Stability parameters for number of fruit per cluster, fruit weight and fruit yield per plant.

Genotypes	Number of fruits per cluster			Fruit weight (g)			Fruit yield per plant (kg)		
	μ_i	b_i	S^2d_i	μ_i	b_i	S^2d_i	μ_i	b_i	S^2d_i
Pusa Purple long	1.32	0.35**	-0.01	40.66	0.17**	-19.15	1.30	0.47	0
Pusa Uttam	3.11	1.41	-0.01	128.88	0.33	7.3	3.71	0.93	0.02
Punjab Sadabahar	1.16	0.41**	-0.01	45.53	0.49**	-19.38	1.35	0.4*	-0.01
Selection-2	1.27	0.71**	-0.01	102.22	0.61**	-17.06	1.67	0.53	-0.01
Mukta Shree	1.22	0.35**	-0.01	159.78	2.01	79.92*	2.16	1.87	0.06*
Type-3	1.09	0.41**	-0.01	135.85	0.4**	-17.65	1.65	0.2**	-0.01
Pusa Upkar	3.45	1.41	0.00	142.11	0.89	-15.65	3.55	0.8	-0.01
BR-112	1.45	1	0.01	55.61	0.51**	-16.43	0.95	0.2**	-0.01
Azad-331	2.11	0.94**	-0.01	72.58	0.77	-13.96	1.88	0.53	-0.01
Udaipur Local	2.54	1.53**	-0.01	167.22	1.16	-12.77	1.76	0.8	0.01
PPL x Pusa Uttam	3.52	1.29	0.00	144.66	0.4**	-18.48	4.37	1.13	0
PPL x Pb Sadabahar	1.17	0.47**	-0.01	42.49	0.52**	-18.98	1.25	0.8	-0.01
PPL x Selection-2	1.25	0.65**	-0.01	73.50	-0.66*	63.58*	1.63	0.93	0
PPL x Mukta Shree	1.14	0.53**	-0.01	118.80	1.11	76.86*	2.35	1	-0.01
PPL x Type-3	1.16	0.53**	-0.01	93.40	1.11	-14.02	2.29	1.73	0.01
PPL x Pusa Upkar	2.23	1.88**	-0.01	91.00	1.5	53.15	2.71	1.93**	-0.01
PPL x BR-112	1.48	1.18	0.00	51.16	0.44*	-10.98	1.40	0.87	0
PPL x Azad-331	2.44	1.65	-0.02	60.17	0.42	-1.83	1.60	1.07	-0.01
PPL x Udaipur Local	2.74	1.18**	-0.01	98.73	1.56**	-14.16	1.27	0.47	0.01
Pusa Uttam x Pb Sadabahar	1.96	1.41**	-0.01	116.92	1.44**	-17.09	3.55	1.53	0.01
Pusa Uttam x Selection-2	3.87	1.12	0.00	179.13	1.91**	-11.53	4.88	1.6	0.01
Pusa Uttam x Mukta Shree	2.94	1.35	-0.01	145.37	0.76**	-19.19	3.37	0.13	0.03
Pusa Uttam x Type-3	2.67	1.24	0.01	138.88	0.41**	-14.37	4.01	0.8	0.03
Pusa Uttam x Pusa Upkar	2.27	1.29	0.00	152.29	1.45*	-12.7	3.38	1.07	0
Pusa Uttam x BR-112	2.21	0.94	0.00	141.57	0.61**	-19.08	2.99	0.87	0.02
Pusa Uttam x Azad-331	2.63	1.18	0.00	116.87	1.16*	-18.52	3.71	3.13	0.24**
Pusa Uttam x Udaipur Local	3.52	1.29**	-0.01	191.32	1.83**	-16.72	3.53	1	0.02
Pb Sadabahar x Selection-2	1.18	0.71**	-0.01	73.23	0.84	-15.39	1.83	0.53	0.09**
Pb Sadabahar x Mukta Shree	1.34	0.71	-0.01	137.14	-0.07	53.89	2.62	1.4	0
Pb Sadabahar x Type-3	1.08	0.24**	0.00	118.02	0.71	47.42	2.50	0.8	0
Pb Sadabahar x Pusa Upkar	2.46	0.88	0.06**	83.68	1.43**	-17.07	2.86	1.93**	-0.01
Pb Sadabahar x BR-112	1.38	1.18	-0.01	56.81	0.56**	-18.19	1.45	1.2	0
Pb Sadabahar x Azad-331	1.64	1.06	0.01	61.97	0.86	-16.18	2.04	0.67	-0.01
Pb Sadabahar x Udaipur Local	3.09	1.35	-0.01	188.35	1.57*	-12.42	2.46	0.2	0.1**
Selection-2 x Mukta Shree	1.15	0.47**	-0.01	135.60	0.41	1.98	2.18	0.8	0
Selection-2 x Type-3	1.25	0.53	0.00	111.93	1.4	-1	1.41	0.4	0
Selection-2 x Pusa Upkar	3.66	1.41	0.00	104.52	1.57*	-10.44	2.86	2.13	0.01
Selection-2 x BR-112	1.32	0.88**	-0.01	70.48	0.77	-9.55	1.62	0.87	-0.01
Selection-2 x Azad-331	2.60	1.00	0.00	84.49	0.39	50.53	2.35	1.27	-0.01
Selection-2 x Udaipur Local	2.33	1.41**	-0.01	94.29	1.17	127.89**	1.35	0.07	-0.01
Mukta Shree x Type-3	1.05	0.00**	0.00	148.58	0.97	-12.07	1.69	1.4	0
Mukta Shree x Pusa Upkar	2.31	0.00	0.02*	130.00	1.64*	-8.49	3.74	0.6	-0.01
Mukta Shree x BR-112	1.27	0.53	0.01	85.86	0.84	113.52**	1.65	1.47	0
Mukta Shree x Azad-331	1.48	1.06	0.00	99.73	1.49	26.98	3.14	1.27	0
Mukta Shree x Udaipur Local	1.69	1.29	0.00	134.61	1.52	66.42*	2.56	0.6	-0.01
Type-3 x Pusa Upkar	2.03	1.59*	-0.01	128.60	1.61	19.75	3.82	0.87	0
Type-3 x BR-112	1.83	2.29**	0.01	164.27	0.90	23.62	3.13	1.13	0
Type-3 x Azad-331	1.51	0.82	0.00	101.30	1.83**	-8.25	2.07	0.67	-0.01
Type-3 x Udaipur Local	1.78	1.29	-0.01	155.66	0.65*	-15.64	1.46	0.53	-0.01
Pusa Upkar x BR-112	2.32	2.06**	0.00	103.46	2.69**	-8.78	3.88	1.07	-0.01
Pusa Upkar x Azad-331	3.82	1.00	0.00	156.59	0.84*	-18.56	4.17	1.4	-0.01
Pusa Upkar x Udaipur Local	2.99	1.41	-0.02	138.57	2.93**	4.33	1.87	1.27	0
BR-112 x Azad-331	1.64	1.18	-0.02	59.93	1.02	-11.09	1.60	1	-0.01
BR-112 x Udaipur Local	1.96	1.12	0.00	112.56	0.93	-16.24	1.34	0.4*	-0.01
Azad-331 x Udaipur Local	2.28	1.29**	-0.01	86.47	0.21**	-19.04	1.36	1	-0.01
Mean	2.04	1.03	0.00	111.52	1.00	4.71	2.42	0.98	0.01
S.E. (mean)	0.08			3.58			0.08		
S.E. (bi)		0.21			0.33			0.46	

Table 4: Classification of eggplant parents for their stability and adaptability

Characters	Parents identified for		Specific adaptability for	
	Stableness (s^2d_i=0)	General adaptability (s^2d_i=0, xi>u and bi=1)	Better environment (s^2d_i=0, xi>u and bi >1)	Poor environment (s^2d_i=0, xi>u and bi <1)
Fruit length (cm)	8	Punjab Sadabahar & Azad-331		
Fruit width (cm)	9	Pusa Uttam		Sel-2, Type-3, Pusa Upkar BR-112 & Udaipur Local
Number of fruits per plant	10	Pusa Uttam & Punjab Sadabahar		Pusa Upkar & Azad-331
Number of fruits per cluster	10	Pusa Uttam & Pusa Upkar	Udaipur Local	Azad-331
Fruit weight (g)	9	Pusa Uttam & Pusa Upkar		Type-3
Fruit yield per plant (kg)	9	Pusa Uttam & Pusa Upkar		

Table 5: Classification of eggplant hybrids for their stability and adaptability

Characters	Hybrids identified for		Specific adaptability for	
	Stableness (s^2d_i=0)	General adaptability (s^2d_i=0, xi>u and bi=1)	Better environment (s^2d_i=0, xi>u and bi >1)	Poor environment (s^2d_i=0, xi>u and bi <1)
Fruit length (cm)	32	PPL x Pb Sadabahar, PPL x Udaipur local, Pusa Uttam x Sel-2, Pusa Uttam x Azad-331, T-3 x Azad-331 and Pusa Upkar x Azad-331	PPL x Sel-2, PPL x Mukta Shree, PPL x T-3, Pusa Uttam x Pb Sadabahar, Pb Sadabahar x Mukta Shree, Pb Sadabahar x Azad-331, Mukta Shree x T-3, Mukta Shree x Azad-331, T-3 x BR-112	Pb Sadabahar x Udaipur Local
Fruit width (cm)	24	Pusa Uttam x Mukta Shree, Pusa Uttam x Pusa Upkar, Pusa Uttam x BR-112, Pusa Uttam x Udaipur local, Sel-2 x BR-112 and Sel-2 x Udaipur local	Pusa Upkar x Ud. Local	PPL x Pusa Uttam, Pusa Uttam x S-2, S-2 x Pusa Upkar
Number of fruits per plant	41	PPL x Pb Sadabahar, PPL x Sel-2, PPL x BR-112, Pusa Uttam x Pb Sadabahar, Pb Sadabahar x Pusa Upkar, Pb Sadabahar x BR-112, Pb Sadabahar x Azad-331, Pb Sadabahar x Udaipur local, Mukta Shree x Azad-331, T-3 x Pusa Upkar, T-3 x BR-112 and Pusa Upkar x Azad-331	PPL x Pusa Uttam, PPL x T-3, Pusa Uttam x Azad-331, Pb Sadabahar x Sel-2 and Pb Sadabahar x Type-3	PPL x Pusa Upkar & PPL x Azad-331
Number of fruits per cluster	43	PPL x Pusa Uttam, PPL x Azad-331, Pusa Uttam x Sel-2, Pusa Uttam x Mukta Shree, Pusa Uttam x T-3, Pusa Uttam x Pusa Upkar, Pusa Uttam x BR-112, Pusa Uttam x Azad-331, Pb Sadabahar x Udaipur local, Sel-2 x Pusa Upkar, Sel-2 x Azad-331, Pusa Upkar x Azad-331 and Pusa Upkar x Udaipur local	PPL x Pusa Upkar, PPL x Azad-331, PPL x Udaipur local, Pusa Uttam x Udaipur local, Sele-2 x Udaipur local, Pusa Upkar x BR-112 and Azad-331 x Udaipur local	
Fruit weight (g)	40	Pb Sadabahar x Mukta Shree, Pb Sadabahar x T-3, Sel-2 x Mukta Shree, Sel-2 x T-3, Mukta Shree x T-3, T-3 x Pusa Upkar and T-3 x BR-112	Pusa Uttam x Pb Sadabahar, Pusa Uttam x S-2, Pusa Uttam x Pusa Upkar, Pusa Uttam x Azad-331, Pb Sadabahar x Udaipur local, Mukta Shree x Pusa Upkar and Pusa Upkar x Udaipur local	PPL x Pusa Uttam, Pusa Uttam x Mukta Shree, Pusa Uttam x T-3, Pusa Uttam x BR-112, Pusa Uttam x Udaipur local, T-3 x Udaipur local, Pusa Upkar x Azad-331 and BR-112 x Udaipur local
Fruit yield per plant (kg)	42	PPL x Pusa Uttam, Pusa Uttam x Pb Sadabahar, Pusa Uttam x Sel-2, Pusa Uttam x Mukta Shree, Pusa Uttam x T-3, Pusa Uttam x Pusa Upkar, Pusa Uttam x BR-112, Pusa Uttam x Udaipur local, Pb Sadabahar x Mukta Shree, Pb Sadabahar x T-3, Sel-2 x Pusa Upkar, Mukta Shree x Pusa Upkar, Mukta Shree x Azad-331, Mukta Shree x Udaipur local, T-3 x Pusa Upkar, T-3 x BR-112, Pusa Upkar x BR-112 and Pusa Upkar x Azad-331	PPL x Pusa Upkar, Pb Sadabahar x Pusa Upkar	

Table 6: Mean values in four environments for different characters

S. No	Characters	E_1	E_2	E_3	E_4	Pooled	General Mean		
							Xi	b_i	S^2d_i
1	Fruit length (cm)	15.62	13.94	14.93	11.79	14.07	14.02	1.00	0.52
2	Fruit width (cm)	6.70	5.66	6.06	5.28	5.93	5.90	1.00	0.27
3	Number of fruits per plant	23.28	19.42	21.18	16.97	20.21	20.10	1.00	0.20
4	Number of fruits per cluster	2.28	2.01	2.17	1.73	2.05	2.04	1.03	0.00
5	Fruit weight (g)	121.15	108.54	117.12	100.38	111.80	111.52	1.00	4.71
6	Fruit yield per plant (kg)	2.68	2.40	2.52	2.15	2.44	2.42	0.98	0.01

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