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GENOTYPE x ENVIRONMENT INTERACTION OF BRINJAL GENOTYPES AGAINST FRUIT BORER

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ABSTRACT
Total 34 genotypes including ten parents, twenty one hybrids and three commercial checks were evaluated for fruit yield per plant and fruit borer infestation at three different environments *viz*., Horticultural College and Research Institute, Venkataramannagudem (E1), Andhra Pradesh; Horticultural Research Station, Pandirimamidi (E2), East Godavari, Andhra Pradesh and Horticultural Research Station, Aswaraopet (E3), Khammam, Telangana State during summer, 2014. The stability analysis indicated that significant G x E interaction for both the attributes revealed that the genotypes had linear response to environmental change. Further, linear and non-linear components contributed significantly to the differences in stability among the genotypes tested. The three hybrids *viz.*, IC285140 x Bhagyamathi, Heera x Gulabi and Pusa Shyamala x Gulabi were identified as most widely adapted hybrids for yield and resistance to fruit borer based on stability analysis. Thus, these stable crosses can be recommended for commercial cultivation over wide range of environments or can be used in further breeding programmes.

KEYWORDS: Brinjal, Fruit and Shoot borer, G x E interaction, Stability.

INTRODUCTION
Brinjal *(Solanum melongena* L.) also known as eggplant or garden egg, is a major solanaceous fruit vegetable with chromosome number 2n=24. It is grown extensively throughout the country, in almost all the states covering an area of 0.72 million hectares with an annual production of 13.44 million tonnes. But the productivity of brinjal is only 18.6 tonnes per hectare (National Horticulture Board, 2013). This low productivity is attributed to incidence of various pests and diseases. Fruit and shoot borer (*Leucinodes orbonalis* Guen.) is the most serious insect pest of brinjal throughout the country (Srinivasan and Sunderbabu, 1998). It attacks the plant in any season and stage of growth, causing dead shoot in vegetative stage and fruit boring later rendering them unmarketable. This pest may cause as high as 100 % fruit damage (Rahman, 2007). Insecticidal control not only is uneconomical but also invites environmental pollution and health hazard. Consequently, host plant resistance would be useful either as a complete control measure or as a part of the integrated pest management programme with limited dependence on pesticides. Hence, the present study was initiated to find out resistant or tolerant brinjal hybrids against fruit borer in different environments under field conditions.

MATERIALS & METHODS
The experimental material consisted of 34 promising long and round brinjal genotypes including seven lines *viz*., IC 090053, IC 285140, IC 421194, IC 545893, IC 90806, Pusa Shyamala and Heera, three testers namely Bhagyamathi, Gulabi and Shyamala and the resulting 21 F1 hybrids developed by crossing the seven lines and three testers in line x tester mating design and three commercial checks *viz*., Ravaiyya, Kanaka Durga and US172. All these genotypes were evaluated in a Randomized Block Design with three replications for their stability during summer, 2014 at three different locations, *viz*., Horticultural College and Research Institute, Venkataramannagudem (E1), Andhra Pradesh; Horticultural Research Station, Pandirimamidi (E2), East Godavari, Andhra Pradesh and Horticultural Research Station, Aswaraopet (E3), Khammam, Telangana State. All the entries were transplanted at the age of 30 days in randomized block design with three replications. The plot size was maintained 4.5 x 3.75 m accommodating 25 plants in each plot at a distance of 90 x 75 cm from row to row and plants to plants and all recommended package of practices were followed to raise a healthy crop. Observations were recorded on yield per plant and fruit borer infestation from five randomly selected plants from each entry in each replication. The data were analyzed on the basis of mean performance over all the environments as per the stability analysis suggested by Eberhart and Russell (1966).

RESULTS & DISCUSSION
The pooled analysis of variance for stability (Table 1) indicated that presence of significant G x E interaction for both the characters under study.

TABLE 1: Analysis of variance for yield and yield fruit borer infestation (%) in brinjal

Source	df	Fruit yield/plant (kg)	Fruit borer infestation
Varieties	33	2.54**	94.13**
Environment + (Variety x Environment)	68	0.18**	11.29**
Environments	2	2.00**	103.94**
Variety x Environment	66	0.13**	8.49*
Environments (Linear.)	1	6.98**	207.88**
Variety x Environment (Linear.)	33	0.11**	12.15**
Pooled Deviation	34	0.05	4.68**
Pooled Error	198	0.07	1.61

*: Significant at 5% level; **: Significant at 1% level

TABLE 2: Mean performance and stability parameters for yield per plant and fruit borer infestation (%) in brinjal

Parent/Hybrid	Yield/plant (kg)						Fruit borer infestation (%)					
	E1	E2	E3	Pooled	b_i	S^2d_i	E1	E2	E3	Pooled	b_i	S^2d_i
IC 090053	2.04	1.82	1.93	1.93	0.24	-0.06	32.39	28.80	31.94	31.04	0.82	-1.61
IC285140	3.21	2.83	3.09	3.04	0.32	-0.02	20.30	17.51	17.97	18.60	0.42	0.81
IC 421194	2.65	2.21	2.07	2.31	0.94	-0.07	31.28	25.48	30.50	29.09	1.32	-1.56
IC 545893	1.76	1.51	1.89	1.72	-0.05	0.01	34.78	30.77	27.61	31.05	0.20	23.74**
IC 90806	2.62	2.32	2.51	2.48	0.28	-0.04	23.34	21.21	19.20	21.25	0.07	6.87*
Pusa Shyamala	4.41	4.18	3.76	4.12	0.94	-0.03	27.50	18.79	26.02	24.10	1.94	-1.25
Heera	3.81	3.32	3.07	3.40	1.16	-0.07	27.05	23.34	26.34	25.58	0.82	-1.52
Bhagyamathi	2.64	2.33	2.49	2.48	0.33	-0.04	15.74	16.04	18.94	16.91	0.27	3.82
Gulabi	3.22	2.84	2.72	2.93	0.82	-0.07	21.25	17.71	18.99	19.32	0.62	0.52
Shyamala	1.86	1.60	2.06	1.84	-0.15	0.03	29.38	23.85	32.00	28.41	1.61	3.27
IC 090053 x Bhagyamathi	3.40	2.74	2.43	2.86	1.55	-0.07	29.04	26.12	27.88	27.68	0.58	-1.14
IC 090053 x Gulabi	3.28	2.85	2.47	2.87	1.23	-0.06	27.83	22.36	32.86	27.69	1.86	14.25**
IC 090053 x Shyamala	2.52	2.28	1.94	2.25	0.85	-0.05	37.03	28.95	35.03	33.67	1.74	-0.57
IC285140 x Bhagyamathi	4.40	4.38	3.90	4.23	0.65	0.01	16.86	17.00	18.80	17.55	0.17	0.38
IC285140 x Gulabi	2.75	2.37	2.64	2.59	0.31	-0.01	30.97	25.61	34.67	30.42	1.69	7.39*
IC285140 x Shyamala	4.05	3.61	2.90	3.52	1.69	0.02	25.70	22.90	26.01	24.87	0.71	-1.48
IC 421194 x Bhagyamathi	4.76	3.62	3.08	3.82	2.68	-0.07	28.72	28.15	29.09	28.65	0.18	-1.53

*: Significant at 5% level; **: Significant at 1% level

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Table 2: Contd.

Parent/Hybrid	Yield/plant (kg)						Fruit borer infestation (%)					
	E1	E2	E3	Pooled	b_i	S^2d_i	E1	E2	E3	Pooled	b_i	S^2d_i
IC 421194 x Gulabi	4.55	4.03	3.53	4.04	1.55	-0.04	24.99	19.76	28.39	24.38	1.62	6.07*
IC 421194 x Shyamala	3.14	2.78	3.07	3.00	0.25	-0.01	35.15	29.86	31.95	32.32	0.93	2.62
IC 545893 x Bhagyamathi	2.79	2.50	3.04	2.78	-0.20	0.07	36.14	26.25	35.50	32.63	2.32	-1.62
IC 545893 x Gulabi	3.48	2.96	2.60	3.01	1.36	-0.06	32.82	29.41	30.38	30.87	0.56	0.94
IC 545893 x Shyamala	3.06	2.69	2.98	2.91	0.28	-0.01	33.34	27.40	33.27	31.33	1.43	-1.55
IC 90806 x Bhagyamathi	4.46	3.95	3.16	3.86	1.91	0.05	23.81	20.69	21.07	21.86	0.46	1.75
IC 90806 x Gulabi	4.60	3.95	3.35	3.97	1.90	-0.03	22.61	18.63	24.07	21.77	1.12	0.03
IC 90806 x Shyamala	3.36	2.91	2.87	3.04	0.83	-0.06	38.03	33.94	31.50	34.49	0.29	19.22**
Pusa Shyamala x Bhagyamathi	3.62	3.15	2.55	3.11	1.59	-0.01	31.50	24.58	33.77	29.95	1.91	2.54
Pusa Shyamala x Gulabi	5.19	4.68	4.34	4.74	1.33	-0.06	25.63	25.63	23.01	24.76	-0.28	2.06
Pusa Shyamala x Shyamala	4.29	3.73	3.38	3.80	1.43	-0.06	31.08	26.67	29.24	29.00	0.87	-0.40
Heera x Bhagyamathi	5.51	5.35	4.59	5.15	1.26	0.09	27.00	23.75	27.71	26.15	0.86	-1.13
Heera x Gulabi	5.90	4.97	4.45	5.11	2.29	-0.06	26.38	18.77	27.55	24.23	1.96	-0.03
Heera x Shyamala	5.61	4.94	4.38	4.98	1.87	-0.04	25.53	24.31	21.99	23.95	-0.08	4.77*
Ravaiyya	2.98	2.28	2.78	2.68	0.58	0.12	46.36	35.96	49.35	43.89	2.83	5.99*
Kanaka Durga	2.61	2.23	2.68	2.51	0.08	0.05	21.52	20.19	22.86	21.53	0.46	-0.51
US 172	4.42	3.83	3.14	3.80	1.91	0.00	24.40	19.38	29.21	24.33	1.72	12.77**
SE of b_i				0.49						0.64		

*: Significant at 5% level; **: Significant at 1% level

Higher magnitude of mean squares due to the genotypes and environments indicated considerable differences among the genotypes and environments for both the characters and these characters were influenced greatly by environments thereby suggesting large differences among environments along with the greater part of genotypic response was a linear function of environments *i.e.* the environments created by sowing over locations was justified and had linear effects. These results are in agreement with the earlier findings of Krishna *et al*. (2002) and Vaddoria *et al*. (2009). The partitioning of environments + (genotypes x environments) mean squares (Table 1) showed that environments (linear) differed significantly and were quite diverse with regards to their effect on the performance of the genotypes for fruit yield and fruit borer infestation. Further, the higher magnitude of mean squares due to environments (linear) as compared to genotypes x environments (linear) indicated that linear response of environments accounted for the major part of total variation for both the characters studied. Similar results were reported by Rai *et* al. (2001) and Vaddoria *et al*., (2009). Among the parents, Bhagyamathi, IC 285140 and Gulabi was identified as below average responsive as it possessed least fruit borer infestation (X =16.91, 18.60 and 19.32 respectively) with bi < l and non-significant deviation from regression (Table 2). Further, the prediction of performance would be possible for other parents except IC 545893 and IC 90806 as they exhibited non-significant deviation from regression. IC 545893 and IC 90806 recorded significant deviation from regression *i.e*., performance of these two parents cannot be predictable. Interestingly, among all the parents, Pusa Shyamala recorded highest yield per plant than commercial checks. The crosses, Heera x Bhagyamathi (5.15 kg), Heera x Gulabi (5.11 kg), Heera x Shyamala (4.98 kg), IC 285140 x Bhagyamathi (4.23 kg), Pusa Shyamala x Gulabi (4.74 kg), IC 421194 x Gulabi (4.04 kg) and IC 421194 x Bhagyamathi (3.82 kg) registered highest yield per plant than the checks. Among the crosses, IC 421194 x Bhagyamathi exhibited more than one bi value, hence is adaptable to favourable environments with less than average stability. Heera x Bhagyamathi exhibited less than one bi value hence, it is adaptable to poor environments with more than average stability. The stability of the genotypes was determined on the basis of three stability parameters *viz.*, overall mean (X), regression coefficient (bi) and deviation from regression (S2di). The most widely adapted hybrids identified on the basis of fruit yield per plant long with less infestation of fruit borer was IC285140 x Bhagyamathi, Heera x Gulabi and Pusa Shyamala x Gulabi. Such crosses could be exploited for heterosis breeding for developing high yielding along with fruit borer resistance types in brinjal. These stable crosses which are high yielders and less fruit borer infestation can be recommended for cultivation over wide range locations in Andhra Pradesh.

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