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Study of Stability analysis for yield and quality in Tomato (*Solanum lycopersicum* L.) over the seasons

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Abstract
The present investigation was carried out in rabi, kharif and summer seasons at the Vegetable Research Station, Rajendranagar, Hyderabad. Six parents *viz.*, LE-53, LE-62, LE-64, Arka Alok, Arka Meghali and Arka Vikas were crossed in diallel mating design. The resultant 30 F_1's were evaluated along with their parents and two standard checks (Lakshmi and US-618) for characters *viz.*, fruit length (cm), fruit width (cm), average fruit weight (g), fruit yield per plant (kg), TSS (^{0}Brix), lycopene (mg/ 100g) and shelf life (days).
Present study revealed that, none of the hybrids have not stable for all traits. Among the all hybrids *viz.*, Arka Vikas × Arka Meghali, Arka Meghali × LE-64, Arka Vikas × Arka Alok were identified as stable and best performing hybrids for fruit yield per plant with a significant higher mean hence, those are suitable for wider environments. Among all the hybrids, stability has been recorded by the Arka Alok × Arka Vikas and Arka Alok × LE-62 for fruit length, LE-62 × LE-53 and Arka Meghali × Arka Vikas for fruit width, Arka Vikas × LE-62 for lycopene, LE-53 × Arka Vikas and Arka Meghali × Arka Vikas for shelf life. The hybrid LE-62 × Arka Meghali followed by four hybrids and the hybrid Arka Meghali × LE-62 followed by six hybrids has been shown stability for the average fruit weight and TSS, respectively. Among all parents, Arka Meghali, LE-64 and LE-53 were recorded stable performance in wider environments for fruit width, TSS and lycopene, respectively.

Keywords: Tomato, stability, yield per plant, quality

1. Introduction
Tomato (*Solanum lycopersicum* L., 2n=2x= 24, Family: Solanaceae) is usually a fruit vegetable. Its origin and domestication started in the Andean region of South America and in Mexico from the wild ancestor of *S. lycopersicum cerasiforme* [1]. The fruits are available year round and eaten raw or cooked and green tomatoes are also used for pickles and preserves. Tomato in large quantities is used to produce soup, juice, ketchup, puree, paste and powder etc., due to its high nutritional value.
In India average tomato productivity is low (21.2 t/ha) as compared to other countries like USA (88 t/ha), Spain (82.1 t/ha) and Brazil (60 t/ha) (NHB, 2015). The scenario of tomato production in the country has tremendously changed over the past few decades with increasing popularity of hybrids.
For the commercialization of new hybrids, it requires stable genotypes. Genotype × environment interactions are known to interferes with evaluation of genotypes and reduce the progress of selection in a plant breeding programme. Hence, estimation of the nature and magnitude of genotype × environment interactions for yield and yield components is essential to identify a stable genotype over environments. In view of the above, the present investigation was conducted to identify stable hybrids with high yielding and quality.

2. Material and methods
The present investigation was conducted by crossing six elite parents (LE-53, LE-62, LE-64, Arka Alok, Arka Meghali and Arka Vikas) in full diallel mating design. The resulted 30 F_1's, parents and two commercial checks (Lakshmi and US-618) were evaluated in the RBD design over three seasons (*kharif*, *rabi* and *summer*) at VRS, Rajendranagar, Dr. YSRHU to identify stable hybrids. The data were recorded for characters *viz.*, fruit length (cm), fruit width (cm), average fruit weight (g), fruit yield per plant (kg), TSS (^{0}Brix), lycopene (mg/ 100g) and shelf life (days).

Data obtained from the three seasons were subjected to a pooled analysis of variance [2]. The genotype x environment interactions were significant for most of the characters and hence the data were further analyzed to determine the phenotypic stability of different hybrids.

[3] methodology used for stability analysis of genotypes under different environments. In this methodology three parameters namely (i) overall mean of each genotype over a range of environments (μi), (ii) the regression of each genotype on the environmental index (bi) and (iii) a function of the squared deviation from the regression (S^2d_i) were estimated.

$$Yij = \mu i + bi\ Ij + \delta ij$$

3. Results and discussion

According to [3], the ideal genotype would be the one which has high mean value, unit regression coefficient (b_i=1) and minimum deviation from regression (S^2d_i=0). The linear regression (b_i) is treated as a measure of the response of a genotype and deviation from the regression (S^2d_i) is considered as a measure of stability. In the present study, if the regression coefficient (b_i) values, found non-significant are treated as unity. If deviation from regression (S^2d_i) values, found non-significant are considered to be within the "minimum deviation" *i.e.*, zero, whose genotypes were statistically within the range of minimum deviation from regression and performance can be predicted. Hence, the genotypes which possess the above values are considered to be stable.

3.1 Pooled analysis of variance for stability

The ANOVA recorded significant differences among genotypes (Table 1). Mean sum of squares due to environments was significant for all the traits which indicated the strong influence of the environment on genotypes. The genotypes were significantly differed for fruit length and lycopene content which showed the wide variability for these traits over seasons. None of the traits recorded significant mean sum of squares due to genotypic x environment interactions. Partitioning of mean squares due to environments + (genotypes x environments) were significant for all the characters emphasizing the existence of G×E interactions for all the traits.

Sum of squares due to E+ (G×E) was further partitioned into that of the environment (linear), genotype × environment (linear) and pooled deviation. Significant variation due to environment (linear) and genotype × environment (linear) was observed for all the traits indicated the linear contribution of environmental effects and additive environment variance on these characters and the genotypes significantly differing for their linear response to environments, respectively. The mean sum of squares for pooled deviation was significant for all the traits indicating the non-linear response and unpredictable nature of genotypes by significantly differing for stability.

3.2 Fruit length (cm)

Among all genotypes, two parents and twenty six hybrids recorded non significant S^2d_i values and the performance can be predicted over the seasons (Table 2). All the stable parents found to possess less fruit length than the best check US-618 (4.04).

Among the stable hybrids, Arka Alok × Arka Vikas (4.15 cm) and Arka Alok × LE-62 (4.03 cm) exhibited more fruit length than check Lakshmi (4.02 cm) with unit regression coefficient, hence found to be widely adapted to all environments with average stability. The hybrid LE-64 × LE-62 (3.49 cm) exhibited more than unit regression coefficient hence recognized as specifically adapted to favourable environments. These results are in consonance with the finding of [4] for fruit length in tomato.

3.3 Fruit width (cm)

Three parents and seventeen hybrids recorded non significant S^2d_i values; hence their performance can be predicted for fruit width. The other genotypes recorded significant S^2d_i values indicating the predominance of an unpredictable component of G x E interaction for this trait (Table 2).

Among the stable parents, Arka Meghali (5.21cm) recorded more fruit width than best check US-618 (5.13 cm) and regression coefficient (b_i) equal to unity indicating average stability and expected to perform well in all the environments.

Among the seventeen stable hybrids, LE-62 × LE-53 (5.37 cm) and Arka Meghali × Arka Vikas (5.24 cm) recorded higher fruit width than the best check US-618 (5.13 cm) and unit regression coefficient (b_i=1) indicating average stability and adaptable to different environments for this trait. The hybrid Arka Alok × Arka Meghali (4.76 cm) with regression coefficient significantly greater than unity (b_i>1) considered below average stability and adaptability to favourable environments for this trait. Similar results were also reported by [4, 5] for fruit width in tomato.

3.4 Average fruit weight (g)

Among all genotypes evaluated, two parents and thirteen hybrids recorded non-significant mean square deviation from regression (S^2d_i) suggesting the performance can be predictable for average fruit weight (Table 2).

Among the parents, LE-53 (57.37 g) and Arka Vikas (55.20 g) exhibited low mean fruit weight than best check US-618 (69.29 g) with unit regression coefficient (b_i=1) indicating average stability with adaptability to wide environments.

The hybrids *viz.*, LE-62 × Arka Meghali (66.87 g), Arka Vikas × LE-53 (66.34 g), Arka Vikas × LE-62 (64.51 g), Arka Alok × Arka Meghali (63.51 g) and LE-62 × LE-64 (63.17 g) were statistically at par for average fruit weight with best check US-618 with unit regression coefficient considered to be widely adaptable to different environments with the average stability. Among all hybrids, LE-62 × LE-53 (73.13 g) with regression coefficient greater than unity (b_i>1) and desirably more average fruit weight than best check suggesting average stability and adaptability to favourable environments for this trait. These results are in agreement with the findings of [4, 6] and [7] for average fruit weight in tomato.

3.5 Fruit yield per plant (kg)

Among all genotypes, it recorded non significant mean sum of square deviation from the regression (S^2d_i) by two parents and 10 hybrids suggesting satisfactorily within the range of minimum deviation from the regression whose performance can be predicted over the environments (Table 2).

Among the stable parents, LE-62 (2.14 kg) statistically at par for yield per plant with best check US-618 (2.30 kg) and unit regression coefficient (b_i=1) indicating average stability and can be recommended for wider environments for yield per plant.

Among the stable hybrids, three hybrids *viz.*, Arka Vikas × Arka Meghali (3.41 kg), Arka Meghali × LE-64 (3.36 kg) and Arka Vikas × Arka Alok (3.06 kg) have recorded significantly more yield per plant over the best check US-618 (2.30 kg) and regression coefficient value equal to unit (b_i=1) hence, considered to be stable hybrids and can be recommended for wider environments. Similar results were also reported by [8, 6, 5, 7, 9] and [10] for this trait.

3.6 Total Soluble Solids (^{0}Brix)

Among all genotypes, one parent and thirteen hybrids registered the non significant deviation from regression hence; performance can be predicted over the seasons for TSS (Table 3).

The parent, LE-64 (5.45) recorded high and statistically at par for TSS with best check US-618 (5.20) and unit regression coefficient (b_i) suggesting average stability and can be widely adapted to different environments.

Among stable hybrids *viz*., Arka Meghali × LE-62 (5.64), LE-53 × LE-62 (5.45), LE-64 × LE-62 (5.41), LE-53 × Arka Vikas (5.37), Arka Alok × LE-53 (5.35), LE-64 × Arka Alok (5.33) and LE-53 × LE-64 (5.28) exhibited high TSS than best check US-618 (5.20) coupled with regression coefficient equal to unity can be assessed with average stability and adaptability to wider environments. These results are in line with the findings of [11, 12, 5] and [10] for TSS in tomato.

3.7 Lycopene (mg/100g)

One parent and six hybrids recorded non significant mean sum of square deviation from regression values (S^2d_i) for this trait. Hence, their performance can be predicted over the seasons for lycopene (Table 3).

The parent, LE-53 (8.03 mg/100g) recorded more lycopene than best check US-618 (8.01 mg/ 100g) with unit regression coefficient (b_i=1) indicating adaptability to different environments with average stability.

Among the stable hybrids, Arka Vikas × LE-62 (9.80 mg/100g) registered significant higher lycopene than best check US-618 with b_i=1, which could be recommended for wide environments with stable performance. Only one hybrid Arka Alok × Arka Meghali (4.39 mg/100g) was found to be specifically adapted to unfavourable environments because of above average mean performance with regression coefficient significantly lower than unity (b_i<1). These results are consonant with the findings of [10] for lycopene in tomato.

3.8 Shelf life (mg/100g)

Among all genotypes, two parents and ten hybrids registered non significant mean sum of square deviation from regression hence their performance can be predicted for shelf life (Table 3).

The parents, Arka Meghali (7.78 days) and LE-53 (7.72 days) recorded low shelf life than best check US-618 (9.56 days) with unit regression coefficient (b_i=1) considered to be with average stability and adapted to different environments.

Among stable hybrids *viz*., LE-53×Arka Vikas (9.72 days) and Arka Meghali × Arka Vikas (9.67 days) recorded more shelf life than best check US-618 (9.56) coupled with regression coefficient equal to unity and were stable hybrids for this trait.

The parent LE-62 (1.22 kg/ plant) was stable for high fruit yield per plant and fruit length among all traits under study.

4. Conclusion

Based on stability analysis, the hybrids *viz*., Arka Vikas × Arka Meghali, Arka Meghali × LE-64, Arka Vikas × Arka Alok were identified as stable and best performing hybrids for fruit yield per plant and other traits hence, suitable for wider environments. Among the parents, LE-62 was the stable with high *per se* performance for yield per plant. Among all the hybrids, stability has been recorded by Arka Vikas × LE-62 for lycopene, LE-53 × Arka Vikas and Arka Meghali × Arka Vikas for shelf life. The hybrid LE-62 × Arka Meghali followed by four hybrids and the hybrid Arka Meghali × LE-62 followed by six hybrids has been shown stability for the average fruit weight and TSS, respectively. Hence, these hybrids were suitable for wider environments. However, these hybrids may be further tested over locations and seasons before recommending for commercial cultivation.

Table 1: ANOVA of stability for fruit yield and quality traits in tomato.

S. No.	Characters	Df	Mean sum of squares							
			Rep within Env.	Genotypes	Env.+ (Genotype × Env.)	Environments	Genotypes × Env.	Environments (Lin.)	Genotypes × Env.(Lin.)	Pooled Deviation
			6	37	76	2	74	1	37	38
1	Fruit length (cm)		3.18	107.86**	139.37**	3585.56**	46.23	7116.7**	54.41*	42.17**
2	Fruit width(cm)		0.01	0.41	0.92	21.75**	0.36	42.75**	0.74*	0.61**
3	Average fruit weight (g)		0.01	0.49	0.82**	17.46**	0.37	34.64**	0.62**	0.40**
4	Fruit yield/ plant (kg)		0.01	5.91	3.19	25.17*	2.6	43.93**	6.52**	4.94**
5	TSS (^{0}Brix)		0.9	121	189.90**	5541.80**	45.26	10994.61**	102.26**	75.20**
6	Lycopene (mg/100g)		3.18	107.86**	139.37**	3585.56**	46.23	7147.97**	72.28**	42.17**
7	Shelf life (days)		0.01	0.41	0.92	21.75**	0.36	43.04**	0.54**	0.61**

*, ** Significant @ 5% and 1% level respectively.

Table 2: Mean performance and stability parameters for fruit length, fruit width, average fruit weight and fruit yield per plant in tomato.

Parents (P)/Crosses (C)	Fruit length (cm)			Fruit width (cm)			Average fruit weight (g)			Fruit yield per plant (kg)		
	µ Mean	b_i	S^2d_i	µ Mean	b_i	S^2d_i	µ Mean	b_i	S^2d_i	µ Mean	b_i	S^2d_i
LE-53 (P1)	3.67	-0.21	0.02	4.80	0.74	0.06	57.37	0.99	-6.15	1.64	0.79	0.00
LE-62 (P2)	3.61	1.01	-0.03	5.10	0.89	0.43**	71.71	1.55	570.32**	2.14	1.22	-0.01
LE-64 (P3)	3.70	1.10	0.36**	4.97	0.03	0.51**	71.21	1.05	120.25**	2.18	1.19	2.83**
Arka Alok (P4)	4.30	3.79	0.50**	3.95	1.56	0.14*	43.79	0.59	114.51**	2.14	0.98	2.09**
Arka Meghali (P5)	3.68	1.57	-0.03	5.21	-0.53	-0.02	67.53	1.33	179.68**	2.45	1.30	2.08**
Arka Vikas (P6)	3.84	0.75	-0.03	4.73	1.60	0.01	55.20	1.00	16.71	2.61	1.37	1.69**
LE-53 × LE-62 (C1)	3.99	1.15	-0.02	4.64	0.31	0.40**	53.45	0.84	16.90	2.20	1.33	1.04**
LE-53 × LE-64 (C2)	3.57	0.94	-0.01	4.17	0.84	0.09	44.94	0.67	33.99*	2.02	0.43	1.28**
LE-53 × A. Alok (C3)	3.32	0.58	-0.01	4.55	1.06	0.21**	52.88	1.00	52.45**	1.86	0.38	1.08**
LE-53 × A. Meghali (C4)	3.94	-0.24	0.11*	5.06	-1.08	0.14*	61.69	1.02	-3.50	2.30	0.95	1.39**
LE-53 × A. Vikas (C5)	3.61	1.15	0.09	4.87	0.57	0.28**	64.27	1.30	221.41**	2.15	0.72	-0.01
LE-62 × LE-53 (C6)	3.88	1.11	0.12*	5.37	0.29	-0.01	73.43	1.24*	-7.04	2.56	1.50	0.02
LE-62 × LE-64 (C7)	3.50	0.96	0.26**	4.61	0.34	0.00	63.17	1.12	3.37	2.49	1.22	0.33**
LE-62 × A. Alok (C8)	3.64	0.34	0.36**	4.23	1.41	0.26**	54.40	0.72	211.02**	2.40	1.08	0.09**

LE-62 × A. Meghali (C9)	3.51	1.36	0.09	4.81	0.49	0.35**	66.87	1.19	10.58	2.44	0.37	0.00
LE-62 × A. Vikas (C10)	3.83	0.70	-0.01	5.06	0.39	-0.01	73.48	1.39	102.11**	2.45	0.99	0.18**
LE-64 × LE-53 (C11)	3.58	0.56	0.05	4.50	1.52	0.17*	58.73	1.01	-6.46	2.53	0.41	0.05*
LE-64 × LE-62 (C12)	3.49	1.29*	-0.03	4.41	-0.18	0.02	43.48	0.78	2.65	1.99	1.18	0.01
LE-64 × A. Alok (C13)	3.87	1.31	-0.03	4.63	1.27	0.36**	60.18	0.79	276.06**	2.29	0.81	0.03
LE-64 × A. Meghali (C14)	3.79	0.66	-0.03	4.65	-0.51	0.20*	56.18	0.90	5.81	2.56	0.87	0.03
LE-64 × A.Vikas (C15)	3.70	1.24	0.01	4.53	1.50	0.00	50.78	1.01	106.88	2.02	0.98	0.07*
A. Alok × LE-53 (C16)	3.46	1.73	-0.03	4.23	2.68	-0.02	59.90	1.10	29.89*	2.32	1.08	1.02**
A. Alok × LE-62 (C17)	4.03	0.94	-0.03	4.76	1.20	-0.03	67.92	1.30	105.67**	2.45	0.83	0.38**
A. Alok × LE-64 (C18)	3.84	1.05	-0.03	4.88	1.82	0.05	51.11	0.60	379.41**	2.23	1.46	0.57**
A. Alok × A. Meghali (C19)	3.95	0.57	0.01	4.76	1.86*	-0.04	63.51	1.05	-3.75	2.15	0.95	0.56**
A. Alok × A. Vikas (C20)	4.15	0.85	-0.03	5.64	-0.13	0.68**	43.58	0.60	97.81**	2.26	1.09	1.43**
A. Meghali × LE-53 (21)	3.80	1.48	-0.03	4.84	3.08	-0.03	65.31	1.33	258.96**	2.74	0.84	2.02**
A. Meghali × LE-62 (C22)	3.86	1.02	0.04	5.10	0.86	0.35**	48.16	0.82	-6.92	2.26	0.97	0.70**
A. Meghali × LE-64 (C23)	3.86	0.97	-0.03	4.73	2.11	0.11*	58.60	0.88	58.13**	3.36	1.33	0.02
A. Meghali × A. Alok (C24)	3.81	0.52	0.01	4.87	1.81	-0.02	50.76	0.73	80.32**	2.53	0.89	-0.01
A. Meghali × A. Vikas (C25)	3.94	1.26	-0.03	5.24	1.31	-0.03	63.59	1.19	54.12**	2.93	0.81	0.67**
A. Vikas × LE-53 (C26)	3.46	1.30	0.19*	4.91	2.39	0.10	66.34	1.14	-5.61	2.92	1.33	0.15**
A. Vikas × LE-62 (27)	3.98	0.68	0.30**	5.14	1.35	0.33**	64.51	1.06	0.59	2.50	0.89	0.12**
A. Vikas × LE-64 (C28)	3.70	1.11	-0.02	4.66	1.71	-0.02	59.14	0.90	51.23**	2.70	1.10	0.33**
A. Vikas × A. Alok (C29)	3.72	1.26	-0.03	4.70	1.73	0.03	54.60	0.91	-5.73	3.06	1.30	-0.01
A. Vikas × A. Meghali (C30)	3.91	0.36	-0.03	4.82	0.20	-0.03	55.07	0.76	150.61**	3.41	1.05	0.04
Lakshmi ©	4.02	1.02	-0.03	5.11	0.65	-0.03	56.40	0.98	-4.63	2.23	1.06	0.09**
US-618 ©	4.04	0.77	-0.03	5.13	0.88	0.10	69.29	1.19	-5.33	2.30	0.97	0.15**
Mean	3.777	1		4.80	1.00		59.014	1		2.414	1	
S.Em ±	0.205	0.5401		0.29	1.04		6.811	0.644		0.552	0.729	

Table 3: Mean performance and stability parameters for TSS (^{0}Brix), lycopene (mg/100g) and shelf life (days) in tomato.

Parents (P)/ Crosses (C)	TSS (^{0}Brix)			Lycopene (mg/100g)			Shelf life (days)		
	μ Mean	b_i	μ Mean	b_i	b_i	S^2d_i	μ Mean	b_i	S^2d_i
LE-53 (P1)	5.27	2.10	7.72	2.31	-0.03	0.14**	8.03	0.68	-0.03
LE-62 (P2)	5.30	1.39	8.33	1.79	1.11**	0.09*	5.65	0.72	25.47**
LE-64 (P3)	5.45	0.97	9.22	1.40	1.29**	0.01	6.44	1.25	1.60**
Arka Alok (P4)	5.25	0.49	7.17	0.16	1.01**	0.88**	5.32	0.49	5.30**
Arka Meghali (P5)	4.71	1.36	7.78	0.19	0.14	0.71**	7.10	2.04	2.57**
Arka Vikas (P6)	4.85	1.85	9.89	0.71	1.04**	0.21**	9.27	1.04	0.80**
LE-53 × LE-62 (C1)	5.45	1.03	6.00	-0.85	5.54**	0.04	7.06	0.95	21.02**
LE-53 × LE-64 (C2)	5.28	0.87	8.83	1.91	0.42*	0.05	8.82	1.15	4.44**
LE-53 × A. Alok (C3)	4.41	0.33	8.83	0.69	11.82**	0.03	5.11	0.95	0.87**
LE-53 × A. Meghali (C4)	4.98	0.05	9.81	1.64	0.43*	0.29**	6.25	1.16	0.08
LE-53 × A. Vikas (C5)	5.37	1.84	9.72	2.61	-0.03	0.00	7.58	0.85	8.00**
LE-62 × LE-53 (C6)	5.72	1.91	7.89	2.40	13.38**	0.33**	7.23	1.18	4.89**
LE-62 × LE-64 (C7)	4.33	0.54	9.56	0.14	7.03**	0.10*	5.72	1.23	1.88**
LE-62 × A. Alok (C8)	5.07	0.54	9.17	-1.60	1.89**	1.00**	7.60	0.86	1.62**
LE-62 × A. Meghali (C9)	5.25	1.57	6.50	-1.20	1.39**	0.31**	5.79	0.82	0.97**
LE-62 × A. Vikas (C10)	5.55	1.22	9.44	0.78	0.28	1.15**	5.08	0.63	1.96**
LE-64 × LE-53 (C11)	5.01	1.40	9.67	1.74	3.18**	0.84**	7.32	0.97	0.58**
LE-64 × LE-62 (C12)	5.41	1.32	9.50	1.34	0.56*	0.03	6.49	1.37	4.71**
LE-64 × A. Alok (C13)	5.33	0.77	8.67	-1.18	-0.09	0.01	5.14	1.00	0.54**
LE-64 × A. Meghali (C14)	5.48	0.24	7.72	0.73	6.42**	0.09*	7.70	0.97	-0.03
LE-64 × A.Vikas (C15)	5.14	0.14	9.56	-0.45	0.45*	0.55**	5.33	1.22	-0.01
A. Alok × LE-53 (C16)	5.35	1.96	8.72	0.85	0.34	0.02	6.74	1.30	2.00**
A. Alok × LE-62 (C17)	4.24	-0.16	6.44	1.08	-0.14	0.82**	5.54	1.18	6.46**
A. Alok × LE-64 (C18)	5.83	0.56	7.83	-1.56	18.95**	3.27**	4.84	1.05	0.04
A. Alok × A. Meghali (C19)	4.47	0.20	6.83	1.91	0.42*	1.94**	4.39	0.49*	-0.03
A. Alok × A. Vikas (C20)	6.03	0.70	7.94	2.48	3.27**	0.14**	5.63	0.99	0.98**
A. Meghali × LE-53 (21)	5.01	1.41	7.17	0.59	-0.13	0.17**	5.32	1.11	1.28**
A. Meghali × LE-62 (C22)	5.64	0.61**	8.28	1.53	-0.05	-0.02	7.64	0.96	4.25**
A. Meghali × LE-64 (C23)	4.74	0.47	7.83	0.87	0.69*	0.87**	7.50	0.89	4.99**
A. Meghali × A. Alok (C24)	5.21	0.75	8.39	1.37	-0.07	0.03	6.63	0.64	7.54**
A. Meghali × A. Vikas (C25)	5.07	2.07	9.67	2.35	0.08	0.05	3.93	0.71	3.90**
A. Vikas × LE-53 (C26)	5.42	1.32	9.44	1.49	0.73*	0.16**	7.36	0.87	30.21**
A. Vikas × LE-62 (27)	5.09	0.79	9.00	3.21	0.37	0.13**	9.80	1.08	-0.02
A. Vikas × LE-64 (C28)	4.84	1.67	8.00	1.34	0.56*	-0.01	5.60	0.53	27.14**
A. Vikas × A. Alok (C29)	5.17	0.70	9.33	2.23	4.55**	0.02	4.00	1.02	0.76**
A. Vikas × A. Meghali (C30)	4.69	0.89	11.00	1.46	0.92**	0.05	6.96	1.33	9.71**
Lakshmi ©	4.89	1.07	9.33	0.97	0.33	-0.02	7.41	1.12	-0.03
US-618 ©	5.20	1.10	9.56	0.58	0.23	-0.02	8.01	1.22	0.32**
Mean	5.14	1.00	8.57	1.00			6.51	1.00	
S.Em±	0.45	0.66	1.11	2.36			1.57	1.93	

*, ** Significant 5% and 1% level respectively.

5. References

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