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Stability analysis of fruit yield and related traits in Ridge Gourd

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Abstract

The investigation was carried out to study stability parameters on eight quantitative traits of ridge gourd. The result showed significant genotypic mean square for most of the characters *viz.*, days to opening of first female flower, number of node at which first female flower appeared, days to first fruit harvest, number of fruits per vine and total fruit yield per vine indicating enough variability among the 8 parents and their 28 F_1's. The mean square due to environments were highly significant for all the characters (except fruit length), suggesting the existence of considerable variation among genotypes, as well as environments. The G x E interaction when tested against polled error was found significant for number of secondary branches per vine. The mean square due to environment (E) + genotype (G) interaction was obtained significant for days to opening of first female flower, number of fruits per vine and fruit yield per vine. Joint consideration of means performance and stability parameters revealed that cross AHRG-1 x Salumber Long had exhibiting below average stability hence, that cross was suited for better environment.

Key words: *Fruit yield, ridge gourd, stability and genotypes x environments*

Introduction

Ridge gourd [*Luffa acutangula* (Roxb.) L.] commonly known as '*kalitori'*, angled gourd, angled *loofah* or ribbed gourd is an important cucxurbitacious crop, which is consumed as vegetable. Ridge gourd well known for preparations of chutneys and curries in India, which is easily digestible and prevent constipation with good nutritive value and high yield potential. It is beneficial for jaundice patients and cure for tetanus (Pal and Jain, 1998). The farmers of different states grow the landraces available with them. Since, there are few varieties and majority of them were developed from available germplasm, the performance of ridge gourd germplasm / genotype is of great importance in respect of screening them for their stability, sustainability as well as for possibility of cultivation in non-conventional areas including unfavorable environments. G x E interaction study is important not only from the genetically and evolutionary point of view but is also related to agricultural production problem in general and to plant breeding, in particular (Breese, 1969). Phenotype is the product of interaction between genotype and environment. A particular genotype can express its full genetic potential only under the optimum environmental conditions. Even then stable genotypes are the ones giving consistent performance over a series of environmental conditions.

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Materials and Methods

The experiment was conducted at the Horticulture farm, College of Agriculture, Bikaner and KVK Research farm, Bhartiya Krishi Vigyan Kendra, Fatehpur Shekhawati, Sikar during rainy season, 2011. The experimental material consisted eight genetically diverse parents namely, Pusa Nasdar, Swarna Uphar, AHRG-1, Salumber Long, Jaipuri Long, Swarna Manjari, Arka Sujath and Arka Sumeet were crossed in diallel fashion excluding reciprocals during summer season, 2011. All the eight parents and their 28 F_1's were evaluated in randomized block design with three replications under four different environments created by two different sowing time and locations *viz*., location Bikaner during *Kharif* 5th July, 2011 (E_1) and 25th July, 2011 (E_3), and Fatehpur-Shekhawati during *Kharif* 5th July, 2011 (E_2) and 25th July, 2011 (E_4). All the recommended package of practices were followed for raising the crop. The observations were recorded on days to opening of first female flower, number of node at which first female flower appeared, days to first fruit harvest, number of fruits per vine, fruit length, fruit girth, fruit weight and fruit yield per vine from five

randomly selected plants in each replication. Stability analysis was done using Eberhart and Russell (1966) model.

Results and Discussion

The stability analysis of variance mean square data (Table 1) exhibited significant differences attributable to genotype and environment in ridge gourd . The results are in close conformity of Soni (2009) and Samadia (2007) in bottle gourd and Yadav and Ram (2010) in muskmelon. G x E interaction variance was non-significant for almost all the characters. Mean squares due to environment linear were significant for almost all the characters except fruit length, indicating that environments differed significantly. Similarly results were reported by Soni (2009), Samadia (2007) and Shaikh *et al*.(2012) in bottle gourd and Yadav and Ram (2010) in muskmelon. An ideal stable genotype would be that, which possessed unit regression coefficient (b_i=1) and deviation from regression not significant from zero (S^2d_i=0) as well as higher mean performance over population mean (Eberhart and Russell, 1966). The stability parameters, such as regression coefficient (b_i) and deviation from regression (S^2d_i) along with mean performance of genotypes for various characters were computed to assess the stability and suitability of performance over the location parameters are presented in Table 1 to 4.

Out of eight parents six parents *viz.*, Pusa Nasdar, Swarna Uphar, AHRG-1, Salumber Long, Jaipuri Long and Arka Sujath showed early opening of first female flower, lower number of node at which first female flower appeared and early in first fruit harvest. Arka Sumeet was also showed lower number of node at which first female flower appeared as it had lower mean than the general mean (Table 2). Parent Swarna Uphar showed average stability for opening of first female flower and first fruit harvest and parent Pusa Nasdar for number of node at which first female flower appeared as they had lower mean than the general mean and regression coefficient equal to unity (b_i=1) and non-significant deviation (S^2d_i) from the regression. Out of twenty eight F_1's nine F_1's, viz. Pusa Nasdar x Swarna Uphar, Pusa Nasdar x AHRG-1, Pusa Nasdar x Arka Sumeet, Swarna Uphar x AHRG-1, Swarna Uphar x Arka Sumeet, AHRG-1 x Salumber Long, AHRG-1 x Jaipuri Long, AHRG-1 x Swarna Manjari and AHRG-1 x Arka Sumeet had lower mean than the general mean for all these traits (Table 2). Crosses *viz.*, Pusa Nasdar x Salumber Long, Pusa Nasdar x Jaipuri Long, Jaipuri Long x Swarna Manjari and Swarna Manjari x Arka Sujath for days to opening of first female flower and days to first fruit harvest, Swarna Uphar x Salumber Long for number of node at which first female flower appeared and days to first fruit harvest, Salumber Long x Arka Sujath for days to opening of first female flower, Salumber Long x Swarna Manjari for number of node at which first female flower appeared and five crosses Pusa Nasdar x Swarna Manjari, Pusa Nasdar x Arka Sujath, Pusa Nasdar x Arka Sujath, Salumber Long x Jaipuri Long and Salumber Long x Arka Sumeet for days to first fruit harvest showed as they had lower mean than the general mean (Table 2). Crosses *viz.*, Pusa Nasdar x Jaipuri Long, Pusa Nasdar x Arka Sumeet and Swarna Uphar x Arka Sumeet for days to opening of first female flower and days to first fruit harvest and Pusa Nasdar x AHRG-1, Swarna Uphar x Salumber Long, Swarna Uphar x Swarna Manjari and Salumber Long x Arka Sumeet for days to first fruit harvest showed average stability as they had lower mean than the general mean and regression coefficient equal to unity (b_i=1) and non-significant deviation (S^2d_i) from the regression while none of the crosses were not average stability.

Parent Pusa Nasdar for number of fruits per vine, fruit girth, fruit weight, fruit yield per vine, Jaipuri Long for number of fruits per vine, fruit girth and fruit yield per vine, AHRG-1 for number of fruits per vine, fruit girth and fruit yield per vine, Salumber Long for number of fruits per vine, fruit length, fruit girth and fruit yield per vine, Swarna Manjari for number of fruits per vine, fruit girth and total fruit yield per vine, Swarna Uphar for number of fruits per vine and fruit length, Arka Sumeet for fruit length and fruit girth showed higher for these traits as they had higher mean than the general mean (Table 3 and 4). Jaipuri Long and Swarna Manjari for total fruit yield per vine showed average stability as they had lower mean than the general mean and regression coefficient equal to unity (b_i=1) and non-significant deviation (S^2d_i) from the regression while none of these parents not showed average stability for all these traits. Out of twenty eight F_1's crosses AHRG-1 x Swarna Manjari, Jaipuri Long x Swarna Manjari and Jaipuri Long x Arka Sumeet for number of fruits per vine, fruit length, fruit girth, fruit weight, total fruit yield per vine, Pusa Nasdar x Arka Sujata and Swarna Uphar x Jaipuri Long and Jaipuri Long x Arka Sujata for number of fruits per vine, fruit length, fruit weight, total fruit yield per vine, Pusa Nasdar x Swarna Manjari, Swarna Uphar x AHRG-1, AHRG-1 x Jaipuri Long for number of fruits per vine, fruit girth, fruit weight and total fruit yield per vine, Swarna Uphar x Jaipuri Long for number of fruits per vine, fruit length, fruit weight and fruit yield per vine, Salumber Long x Jaipuri Long for number of fruits per vine, fruit length and fruit yield per vine, Salumber Long x Swarna Manjari for number of fruits per vine, fruit weight and fruit yield per vine, Pusa Nasdar x Swarna Uphar for number of fruits per vine and fruit girth, Pusa Nasdar x Salumber Long for fruit length and fruit weight, Pusa

Nasdar x AHRG-1 for fruit girth and fruit yield per vine, Swarna Uphar x Swarna Manjari for fruit length and fruit weight, Swarna Uphar x Jaipuri Long for fruit weight and fruit yield per vine, Swarna Uphar x Arka Sumeet for fruit length and fruit weight, AHRG-1 x Salumber Long for number of fruits per vine and fruit yield per vine, Salumber Long x Arka Sumeet and Swarna Manjari x Arka Sumeet for fruit girth and fruit weight, Pusa Nasdar x Arka Sumeet for fruit girth, Pusa Nasdar x Jaipuri Long for fruit weight, Swarna Uphar x Arka Sujath and Salumber Long x Arka Sujata for fruit length showed higher these traits as they had higher mean than the general mean (Table 3 and 4). Pusa Nasdar x Swarna Uphar and AHRG-1 x Jaipuri Long for number of fruits per vine and AHRG-1 x Salumber Long for total fruit yield per vine showed average stability as they had higher mean than the general mean and regression coefficient equal to unity (b_i=1) and non-significant deviation (S^2d_i) from the regression. These findings are in agreement with the findings of Dubey *et al.* (2005) and Soni (2009) in cucurbits.

Table 1. Analysis of variance for stability parameters of various characters over the environments in Ridge gourd

Source of Variance	d.f.	Days to opening of first female flower	No. of node at which first female flower appeared	Days to first fruit harvest	No. of fruits per vine	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Total fruit yield /vine (kg)
Genotypes (G)	35	72.66**	12.13**	494.25	14.52**	10.21	1.61	168.97	0.27**
Environment (E)	3	1813.70**	56.41**	1449.17*	53.90**	5.74	4.04*	396.06*	0.97**
G x E	105	19.21	6.77	321.38	1.935	7.41	1.12	133.28	0.04
E + G x E	108	69.06**	8.15	352.71	3.38**	7.36	1.20	140.58	0.07**
E (Linear)	1	5441.10**	169.22**	4347.52**	161.71**	17.22	12.14**	1188.17**	2.93**
G x E (Linear)	35	23.40	8.18	43.05	2.59*	8.89	0.65	143.06	0.05
Pooled Deviation	72	16.64*	5.90**	447.76*	1.56**	6.48**	1.32**	124.82**	0.03**
Pooled Error	280	2.49	2.20	315.79	0.31	2.38	0.86	67.47	0.01

* and ** significant at 5 and 1 per cent levels, respectively.

Table 2. Estimates of stability parameters for days to opening of first female flower, number of node at which first female flower appears and days to first fruit harvest

Characters	Days to opening of first female flower			No. of node at which first female flower appeared			Days to first fruit harvest		
	X	b_i	S^2d_i	*X*	b_i	S^2d_i	*X*	b_i	S^2d_i
Crosses									
P_1 x P_2	55.233	0.85	9.26**	20.08	1.58	23.22**	60.72	0.74	-290.36
P_1 x P_3	56.758	1.00	6.99*	20.35	0.83	-1.71	61.99	0.93	-285.40
P_1 x P_4	56.633	1.17	5.98*	22.49	0.14	3.23	61.98	1.25	-297.99
P_1 x P_5	54.2	0.92	-0.97	22.83	-0.3	4.22	59.73	0.91	-302.64
P_1 x P_6	59.367	1.07	17.43**	23.43	1.58	-1.13	65.38	0.80	-228.84
P_1 x P_7	58.592	1.63	2.68	22.55	3.89*	-0.48	63.98	1.71	-283.83
P_1 x P_8	56.725	1.02	2.49	22.08	3.22	-0.38	62.35	0.98	-292.12
P_2 x P_3	53.467	0.72	0.74	20.08	1.91	21.62**	59.55	0.70	-306.79
P_2 x P_4	59.058	0.83*	-2.24	20.84	-2.56	2.73	63.63	0.94	-299.52
P_2 x P_5	58.725	0.76	11.16**	27.15	4.44	10.21**	64.76	0.61	-260.00
P_2 x P_6	60.8	1.01	13.48**	23.88	1.75	-1.35	66.09	1.21	-307.74
P_2 x P_7	65.4	0.87	85.54**	25.46	1.09	3.41	70.68	1.02	-244.28
P_2 x P_8	53.875	0.91	3.03	21.53	0.83	1.60	59.01	0.92	-300.51

P_3 x P_4	57.267	0.39	33.34**	20.22	1.13	1.07	64.33	0.70	-261.29
P_3 x P_5	58.192	0.58	53.46**	20.97	0.70	-1.98	63.57	0.52	-253.26
P_3 x P_6	54.717	0.81	2.99	20.80	0.75	8.82**	62.42	1.47	-306.71
P_3 x P_7	58.667	0.80	17.65**	23.90	1.12	6.79*	65.54	1.29	-273.00
P_3 x P_8	57.283	0.80	1.74	20.83	1.14	-0.84	62.30	0.79	-299.80
P_4 x P_5	59.142	1.30	5.12*	23.84	1.02	0.42	64.40	1.52	-306.56
P_4 x P_6	61.167	1.05	15.04**	20.50	-0.34	-0.85	66.14	1.08	-291.52
P_4 x P_7	59.767	1.68*	-1.31	23.31	0.82	-2.04	65.58	1.73	-294.51
P_4 x P_8	57.742	0.83	14.09**	23.34	0.69	3.10	63.03	0.95	-298.87
P_5 x P_6	57.117	1.54	3.59	23.23	2.32	-1.79	62.62	1.59	-291.08
P_5 x P_7	61.558	1.39	24.52**	24.65	-0.68	2.14	67.00	1.59	-302.25
P_5 x P_8	61.333	1.66	29.75**	23.18	1.95	4.49	66.63	1.72	-250.18
P_6 x P_7	51.675	0.21	25.91**	24.49	0.46	2.77	56.91	0.29	-293.29
P_6 x P_8	66.292	1.30*	-2.29	24.70	2.66	10.86**	71.29	1.27	-290.50
P_7 x P_8	68.6	1.30*	-2.08	24.13	1.00	0.86	126.41	-1.62	1477.60**
Parents									
Pusa Nasdar (P_1)	55.642	0.92	5.42*	21.05	0.95	-1.92	61.50	0.71	-279.16
Swarna Uphar (P_2)	57.833	0.96	-1.52	21.83	0.81	6.55*	62.69	1.08	-306.05
AHRG-1 (P_3)	52.233	1.11	1.57	20.57	-0.35*	-1.95	57.58	1.30	-310.51
Salumber Long (P_4)	57.125	0.61	78.04**	23.48	0.92	8.63**	62.40	0.47	-231.31
Jaipuri Long (P_5)	55.992	1.59	12.19**	21.00	-0.73	20.47**	61.52	1.62	-262.04
Swarna Manjari (P_6)	61.5	1.54	11.96**	21.03	-0.2	-1.58	66.38	1.64	-312.54
Arka Sujath (P_7)	57.758	0.86	5.66*	21.54	1.57	1.84	62.93	0.86	-304.00
Arka Sumeet (P_8)	71.73	0.00	19.55**	21.47	-0.10	0.07	77.42	0.70	-296.43
General Mean	58.59	1.00		22.41	1.00		65.57	1.00	
S.E. (b_i) $\pm$	2.355	0.33		1.402	1.121		12.22	1.93	

* and ** significant at 5 and 1 per cent levels, respectively

Table 3. Estimates of stability parameters for number of fruits per vine, fruit length and fruit girth

Characters	No. of fruits per vine			Fruit length (cm)			Fruit girth (cm)		
	X	bi	S^2di	*X*	bi	S^2di	*X*	bi	S^2di
Crosses									
P_1 x P_2	6.82	1.07	1.15**	19.91	-0.20	3.18	9.45	0.93	-0.87
P_1 x P_3	6.28	0.92	3.40**	19.55	-1.67	-1.10	9.90	2.14	-0.06
P_1 x P_4	5.19	-0.13	0.56	21.76	-0.97	1.76	8.84	-0.88	-0.35
P_1 x P_5	6.18	-0.52	0.63*	19.07	1.71	6.05	8.99	-0.50	0.75
P_1 x P_6	7.66	0.88	0.62	19.21	-1.90	2.23	9.54	1.89	0.13
P_1 x P_7	6.95	0.28	0.82*	21.76	-0.35	11.99**	9.14	2.67	-0.64
P_1 x P_8	6.39	0.63	0.19	20.54	2.45	2.46	9.24	-1.38	1.25
P_2 x P_3	8.11	1.19	0.44	20.29	0.66	4.38	9.25	2.46	-0.70
P_2 x P_4	7.43	1.25	-0.28	21.35	0.31	2.33	8.73	1.39	-0.47
P_2 x P_5	6.70	1.38	0.02	19.61	-2.64	0.07	8.54	-1.52	0.24
P_2 x P_6	6.32	0.70	0.01	21.02	0.34	1.75	9.07	0.41	-0.16
P_2 x P_7	4.63	0.70	0.12	21.56	-1.42	0.10	8.15	0.03	1.22
P_2 x P_8	5.21	0.86	0.96*	23.02	-6.16	2.78	9.39	1.90	0.33
P_3 x P_4	8.72	1.18	1.51**	20.88	2.37	0.02	8.45	1.06	-0.08
P_3 x P_5	9.46	1.10	1.79**	20.32	3.82	-1.75	9.73	0.34	-0.71
P_3 x P_6	7.66	0.51	9.33**	17.95	-1.01	-1.15	9.30	2.23	-0.67

P_3 x P_7	3.93	0.67	0.17	20.73	2.48	-1.87	8.92	1.53	-0.77
P_3 x P_8	5.63	0.16	3.97**	21.92	1.96	8.29*	8.99	0.28	-0.21
P_4 x P_5	7.86	0.41	1.72**	23.67	6.07	12.63**	8.47	1.95	0.11
P_4 x P_6	7.80	1.92	3.26**	17.51	-2.09	2.91	8.70	0.97	0.00
P_4 x P_7	6.36	0.83	-0.12	21.88	4.10	-0.20	8.17	-0.72	-0.72
P_4 x P_8	4.56	-0.33	0.17	22.35	-0.27	4.43	9.06	0.96	-0.84
P_5 x P_6	9.11	0.73	3.43**	22.41	17.85	36.83**	9.90	2.10	0.14
P_5 x P_7	7.67	1.21	0.21	21.22	3.05	3.70	8.82	0.26	-0.72
P_5 x P_8	6.48	1.79	0.68*	24.55	9.67	7.84*	9.59	1.04	0.82
P_6 x P_7	4.12	1.32	2.64**	19.95	1.81	-1.82	8.30	2.13	-0.51
P_6 x P_8	3.31	0.75	1.34**	21.08	2.26	1.70	9.16	-0.23	-0.73
P_7 x P_8	2.35	0.00*	-0.29	19.99	3.57	4.32	8.63	0.60	-0.61
Parents									
Pusa Nasdar (P_1)	9.48	2.84	2.67**	18.78	-0.40	-2.26	9.86	-0.19	0.68
Swarna Uphar (P_2)	6.64	2.12*	-0.30	21.22	0.78	11.68**	8.85	4.33	-0.04
AHRG-1 (P_3)	9.23	2.41	1.13*	19.03	-0.26	-0.38	10.78	2.68	13.88**
Salumber Long (P_4)	9.33	1.91	0.65*	24.05	4.33	-2.00	8.91	2.93	0.24
Jaipuri Long (P_5)	7.27	1.80	2.08**	22.19	-6.35	4.02	10.44	-0.27	7.28**
Swarna Manjari (P_6)	7.83	2.09	0.09	20.11	-0.56	0.39	9.89	1.20	-0.35
Arka Sujatah (P_7)	3.56	0.72	0.47	19.90	-4.93	5.47*	10.20	2.67	-0.24
Arka Sumeet (P_8)	3.57	0.66	-0.06	21.55	-2.43	16.25**	8.47	-1.40	-0.59
General Mean	6.55	1.00		20.89	1.00		9.16	1.00	
S.E. (b_i) $\pm$	0.72	0.59		1.47	3.68		0.66	1.98	

* and ** significant at 5 and 1 per cent levels, respectively

Table 4. Estimates of stability parameters for fruit weight and total fruit yield per vine

Characters	Fruit weight (g)			Fruit yield per vine (kg)		
	X	bi	S^2di	*X*	bi	S^2di
Crosses						
P_1 x P_2	128.95	4.08	39.16	0.92	1.23	0.05**
P_1 x P_3	128.68	2.42	24.76	1.09	0.99	0.13**
P_1 x P_4	133.20	1.92	302.31**	0.71	0.24	0.00
P_1 x P_5	138.52	4.52	113.48	0.92	-0.38	0.09**
P_1 x P_6	130.52	3.33	138.56	1.06	0.59	-0.01
P_1 x P_7	131.97	-1.92	-57.69	0.94	0.41	0.01
P_1 x P_8	119.83	0.91	47.02	0.79	0.39	-0.01
P_2 x P_3	126.20	1.47	7.01	1.04	1.23	0.00
P_2 x P_4	131.20	3.17	67.35	1.09	1.58	0.01
P_2 x P_5	140.58	-1.90	77.94	1.12	1.86	0.02
P_2 x P_6	132.85	-0.52	-31.70	0.88	0.62*	-0.01
P_2 x P_7	128.77	2.56	108.85	0.66	-0.17	-0.01
P_2 x P_8	121.15	2.16	-31.06	0.66	0.57	0.00
P_3 x P_4	123.10	1.89	-68.16	1.09	0.98	0.01
P_3 x P_5	133.83	-0.76	-68.42	1.32	1.13	0.06**
P_3 x P_6	134.68	-3.35	-11.90	1.05	0.95	0.10**
P_3 x P_7	130.37	-0.24*	-76.24	0.79	1.52	0.15**

P_3 x P_8	126.48	-0.05	9.61	0.76	0.54	0.10**
P_4 x P_5	147.77	1.65	203.81*	1.19	0.13	0.00
P_4 x P_6	133.33	0.60	225.82*	1.06	2.70	0.03*
P_4 x P_7	129.17	3.34	-7.24	0.85	0.40	-0.01
P_4 x P_8	132.77	-0.78	417.81**	0.63	-0.10	0.00
P_5 x P_6	134.32	1.89	-20.68	1.25	0.41	0.05**
P_5 x P_7	138.28	-1.71	-30.28	1.09	1.31	-0.01
P_5 x P_8	136.13	-0.13	-10.58	0.93	1.90	0.00
P_6 x P_7	128.07	-0.62	-19.41	0.63	1.60	0.00
P_6 x P_8	140.07	-0.78	197.30*	0.52	1.10	0.04*
P_7 x P_8	119.64	1.67	-61.43	0.29	-0.18*	-0.01
Parents						
Pusa Nasdar (P_1)	135.42	5.75	-34.03	1.28	2.72	0.00
Swarna Uphar (P_2)	128.48	0.59	-62.24	0.87	1.84*	-0.01
AHRG-1 (P_3)	126.98	2.34	182.30*	1.20	1.94	-0.01
Salumber Long (P_4)	139.88	-1.08	-64.76	1.39	2.01	0.01
Jaipuri Long (P_5)	126.43	1.85	35.71	0.97	1.09	0.02
Swarna Manjari (P_6)	129.02	3.50	-21.88	1.02	1.65	0.00
Arka Sujath (P_7)	123.97	-0.44	153.77	0.49	0.76	0.02
Arka Sumeet (P_8)	118.37	-1.33	-7.54	0.47	0.41	-0.01
General Mean	130.8	1.00		0.92	1.00	
S.E. (b_i) $\pm$	6.50	1.90		0.11	0.65	

* and ** significant at 5 and 1 per cent levels, respectively

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