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Stability Differences among Okra Genotypes for Seed Quality

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ABSTRACT Performance of 16 okra genotypes in respect of seed quality related traits were evaluated under three environments for stability analysis. GxE interactions were significant for number of seeds per pod, seed weight per pod, seed yield per hectare, seed germination and seed vigour index. Linear component as well as non-linear component equally contributed GxE interactions in number of seeds per pod, seed weight per pod, seed yield per hectare and seed germination. Linear component was significant against non-linear component in seed vigour index only. Punjab-8 and Punjab Padmini were stable for all the characters, however, all the genotypes were stable for seed yield per plant and seed vigour index.

Keywords: GxE interaction, linear, non-linear, okra

Okra (*Abelmoschus esculentus* (L.) Moench) is an important annual vegetable crop grown throughout the country. The productivity of okra per unit of land and per unit of time has remained very low in India and the non-availability of quality seed is one of the reasons for this low productivity [1]. The seed quality of okra is greatly influenced by genetic, physiological and environmental factors. It is very essential to know whether the seed quality is influenced by change in environments and also by genotypes with least genotype x environment interaction. Such varieties ensure the quality over seasons of production. Although, a number of varieties have been recommended for cultivation, the information on the stability for seed quality is lacking. Therefore, present investigation was carried out to evaluate stability of some of the seed quality characteristics in sixteen okra genotypes in three environments.

MATERIALS AND METHODS

The field experiment was conducted with sixteen diverse genotypes of okra at Punjab Agricultural University, Ludhiana during three sowing seasons viz, spring (last week of February, 2002), summer (last week of April, 2002) and rainy (last week of June, 2002). The experiment was laid out in RBD with three replications in each season. Each treatment was comprised of 20 plants, spaced at 45 x 30 cm. Observations were recorded on five randomly selected plants of each genotype in each replication for days to harvest, for seed extraction, number of seeds per pod, seed weight per pod (g), seed yield per plant(g), seed yield per hectare (q/ha) thousand seed weight(g), seed germination(%) and seed vigour index.

The seedling vigour index was calculated as per Baki and Anderson [1]

$$\text{Seedling vigour index} = \frac{\text{Germination(\%)} \times \text{Seedling length(cm)}}{100}$$

The three seasons were considered as three environments in stability analysis. The mean data were subjected to stability analysis as followed by Eberhart and Russell[2].

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RESULTS AND DISCUSSION

The computation of ANOVA for seed quality characters is given in table1 which showed significant mean squares due to genotype for seed weight per pod, seed yield per plant and seed yield per hectare. It indicated the presence of high variability among the tested genotypes. However, significant genotype-environment interaction (GEI) were reported for all characters except seed yield per plant, thousand seed weight and days to harvest for seed extraction. Similar results were reported by Adetunji and Chheda[3]. It indicated that the genotypes responded differentially to the changing of environments. Further partioning of GEI revealed that the interactions were equally contributed by linear and non-linear components (pooled deviation) in number of seeds per pod, seed weight per pod, seed yield per hectare and seed germination. However, linear component contributed in seed vigour index, whereas, non-linear component contributed in days to harvest for seed extraction, seed yield per plant and thousand seed weight. It was evident from the significance of GxE (linear) and pooled deviation (non-linear), respectively.

Different measures of stability have been used by various workers. Earlier, Finley and Wilkinson[4] considered regression coefficient (b) as a measure of stability but later Eberhart and Russell[2] regarded 'b' as a measure of responsiveness and deviation from regression (S^2 di) as a measure of stability. Breese[5], Samuel *et al.* [6] and Paroda and Hayes[7] also advocated that the linear regression (b) could simply be regarded as a measure of response of a particular genotype, which in fact depends largely on the number of genotypes included in a particular study, taking the deviation around regression line as a measure of stability, genotype with the lowest deviation being the most stable and vice-versa.

Considering all these above, the genotypes viz. Arka Abhay, Arka Anamika, Hisar Unnat Punjab-7, Punjab-8, Punjab Padmini and Pusa Sawni possessed highest mean performance (in negative desirable direction) and regression coefficient was more than one (table-2), thus making these genotypes stable for favourable environment. But due to significant S^2di for all genotypes, the results cannot be predicted with accuracy. Similar results were reported by Mishra *et al* [8].

All the genotypes for number of seeds per pod, seed weight per pod, seed yield per plant, seed yield per hectare, thousand seed weight and seed vigour index possessed negative regression coefficient, thus favours the suitability of all genotypes in unfavourable environments. For seed germination, the genotypes such as Arka Anamika, Pant Bhindi-1, Punjab Padmini, Varsha Uphar, VRO-4 and VRO-5 possessed highest mean performance and regression coefficient is less than 1. Thus these genotypes are stable for poor/unfavourable environment but significant S^2di values for these genotypes exeept Punjab Padmini revealed that the results cannot be predicted with accuracy for these genotypes. It was also observed from the table 2 that Punjab-8 and Punjab Padmini were stable for number of seeds per pod, seed yield per hectare and seed germination, whereas, all the genotypes were stable for seed yield per plant and seed vigour index as shown by non-significant S^2di values.

From the present investigation, it was concluded that Punjab-8 and Punjab Padmini along with Hisar Unnat, Punjab-7 and Pusa Sawni can be used as promising parents in further breeding programme for seed quality in okra.

Table 1. Pooled ANOVA for seed quality characters in okra

Source of variation	d.f.	Days to harvest	No. of seeds/pod	Seed weight/pod (g)pla	Seed yield/nt (g)	Seed yield (q/ha)	1000 seed weight (g)	Seed germination (%)	Vigour index
Genotype	15	8.70	8.70	8.70*	8.70	8.70**	8.70	8.70	8.70
Environment	2	43.57**	515.32**	1.47**	1071.43**	238.42**	243.60**	1004.04**	1675462.00**
Env.+(Gen.xEnv)	32	24.15**	24.15**	24.15**	24.15**	24.15**	24.15**	24.15**	24.15
Env.(Linear)	1	87.17	1030.60**	2.93	2142.86**	476.83**	487.18**	2008.08*	3350933.40**
Gen.xEnv.(Linear)	15	26.12	-22.44**	47.64**	-93.73	17.29**	8.46	-126.19*	-223352.50**
Pooled deviation	16	18.28**	4.92*	3.44*	2.24**	2.28*	9.91**	41.10**	7.85
Pooled error	90	0.24	2.69	0.01	5.13	1.12	0.49	5.04	5354.16

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

Table 2A. Estimates of stability parameters for seed quality characters in okra.

Genotypes	Days to harvest			No. of Seeds/pod			Seed weight/pod (g)			Seed yield/plant(g)			Seed yield/hectare (q/ha)		
	m	bi	S^2di	m	bi	S^2di	m	bi	S^2di	m	bi	S^2di	m	bi	S^2di
Arka Abhay (GI)	76.56	1.22	7.39**	33.61	-0.45	2.41	2.19	-8.69	1.76**	23.55	-0.32	1.19	11.13	-0.69	1.21
Arka Anamika (G2)	76.67	1.33	6.90**	37.08	-0.47	1.90	2.14	-9.14	1.30**	21.77	-0.34	0.80	10.23	-0.72	0.81
Hisar Unnat (G3)	76.67	2.34	30.63**	37.74	-0.87	10.79**	2.18	-16.9	8.13**	24.43	-0.64	5.73	11.48	-1.35	5.80**
KS 410 (G4)	77.00	3.32	38.63**	32.62	-1.17	9.82**	1.95	-22.4	6.54**	14.93	-0.84	3.82	7.10	-1.78	3.89**
Pant Bhindi-1(G5)	78.22	2.47	26.72**	32.69	-0.89	8.05*	1.86	-17.2	5.74**	16.17	-0.64	3.72	7.60	-1.37	3.78**
Parbhani Kranti (G6)	77.89	2.40	22.38**	38.66	-0.86	6.15	2.29	-16.4	4.23**	25.30	-0.61	2.60	11.90	-1.31	2.65*
Punjab-7(G7)	76.10	1.94	17.00**	39.71	-7.08	5.24	2.30	-13.5	3.76**	26.01	-0.51	2.47	12.23	-1.08	2.51
Punjab-8(G8)	75.56	1.15	5.18**	42.00	-0.41	1.42	2.39	-7.91	0.98**	30.14	-0.29	0.60	14.17	-0.63	0.61
Punjab Padmini(G9)	76.44	1.15	5.18**	46.47	-0.41	1.42	2.51	-7.91	0.98**	30.71	-0.29	0.60	14.44	-0.63	0.61
Pusa A-4(G10)	77.67	2.62	20.65**	41.82	-0.91	4.52	2.35	-17.3	2.82**	27.77	-0.65	1.46	12.95	-1.38	1.50
Pusa Sawni(G11)	76.44	2.57	14.70**	41.57	-0.86	2.26	2.31	-16.4	1.16**	26.36	-0.61	0.40	12.40	-1.38	0.42
Varsha Uphar (G12)	77.00	1.42	7.84**	43.90	-0.51	2.16	2.44	-9.74	1.48**	28.59	-0.36	0.91	13.44	-0.77	0.93
VRO-3 (GI3)	77.11	3.49	6.50**	35.16	-1.06	0.19	2.05	-19.8	0.91**	18.73	-0.72	2.21	8.65	-1.59	2.16
VRO-4(GI4)	78.11	2.80	23.97**	33.40	-0.97	5.35	1.97	-18.6	3.36**	18.07	-0.69	1.77	8.49	-1.47	1.81
VRO-5(GI5)	77.67	3.10	40.98**	33.68	-1.12	12.16**	1.94	-21.4	8.62**	16.81	-0.80	5.55	7.90	-1.71	3.64*
VRO-6(GI6)	78.33	2.14	17.68**	34.19	-0.70	4.86	2.02	-14.6	3.34**	17.63	-0.55	5.55	8.29	-1.16	3.69
Mean	77.08			38.02			2.18			22.94			1333.53		
S.E(m)	0.37			1.81			0.11			2.66			1.25		

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

Table 2B. Estimates of stability parameters for seed quality characters in okra.

Genotypes	1000 seed weight (g)			Seed germination(%)			Vigour index		
	m	bi	S^2di	m	bi	S^2di	m	bi	S^2di
Arka Abhay (G1)	56.30	-0.60	4.37**	79.44	0.09	14.43*	1430.62	-0.007	3.60
Arka anamika (G2)	56.76	-0.64	3.82**	82.22	0.12	14.81*	1491.56	-0.008	3.04
Hisar Unnat (G3)	57.63	-1.17	10.80**	79.89	0.17	56.98**	1515.72	-0.01	15.62
KS 410 (G4)	54.25	-1.60	20.73**	73.44	0.31	86.24**	1145.26	-0.01	16.26
Pant Bhindi-1(G5)	54.25	-1.21	15.35**	80.11	0.21	54.57**	1184.89	-0.01	12.41
Parbhani Kranti (G6)	56.41	-1.16	12.39**	77.11	0.21	48.00**	1435.44	-0.01	9.85
Punjab-7(G7)	57.81	-0.95	9.86**	77.44	0.16	34.28**	1355.77	-0.01	8.00
Punjab-8(G8)	58.20	-0.56	2.86**	76.00	0.10	11.11	1480.99	-0.006	2.28
Punjab Padmini(G9)	59.04	-0.56	2.86**	86.67	0.10	11.11	1426.71	-0.006	2.28
Pusa A-4(G10)	56.88	-1.25	10.46**	73.11	0.26	49.39**	1384.47	-0.01	7.79
Pusa Sawni(G11)	56.61	-1.20	6.57**	77.33	0.28	40.41**	1135.16	-0.01	4.71
Varsha Uphar (G12)	58.61	-0.69	4.34**	87.44	0.12	16.83*	1612.15	-0.008	3.45
VRO-3 (G13)	55.66	-1.54	0.77**	79.33	0.51	40.19**	1265.89	-0.01	0.14
VRO-4(G14)	55.44	-1.34	12.23**	81.89	0.28	36.91**	1165.87	-0.01	9.37
VRO-5(G15)	55.89	-1.34	23.40**	81.22	0.26	84.40**	1165.75	-0.06	18.86
VRO-6(G16)	55.54	-1.03	9.79	79.22	0.19	37.92**	1140.30	0.01	7.78
Mean	56.56			79.49			1333.53		
S.E(m)	1.02			2.96			93.91		

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

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