Research Paper

STABILITY ANALYSIS IN CHICKPEA, *Cicer arietinum* L.

D. Shivani and Ch. Sreelakshmi

Agricultural Research Station, Tandur.

Abstract
Twenty five chickpea genotypes were studied for stability for various characters at Agricultural Research Station, Tandur, ANGRAU during rabi seasons of 2009-10, 2010-11 and 20011-12. Analysis of variance for seed yield and its component traits revealed that the genotypes differed significantly for all the characters except days to 50% flowering, number of primary branches per plant and seed yield (kg/ha). Variance due to non linear component of environments (pooled deviations) was significant for days to 50% flowering, primary branches per plant and test weight indicating the role of unpredictable portion of environment influencing this trait. The genotype ICC 11574 followed by ICC 5034 and ICCV 09104 had below average stability and were specifically adapted to favourable environments. The genotypes ICCV 86105, ICCV 09118, ICC 5360 and ICCV 08311 were adapted to favourable environments (bi>1), higher mean and significant deviations, while the genotypes ICCV 09314, ICCV 86111, ICCV 09308 and ICC 5583 were adapted to poor environments.
Key words: Stability analysis, Chickpea.

INTRODUCTION
In any breeding programme, it is necessary to find out phenotypically stable genotypes for yield, which could perform more or less uniformly under different environmental conditions. Seed yield is a complex character and largely depends upon its component characters, with an interaction with the environment resulting into the ultimate product, i.e., seed yield. To breed a stable variety, it is necessary to get the information on the extent of genotype x environment interaction for yield and its component characters. Therefore, an attempt has been made in the present study to evaluate different chickpea genotypes across the seasons to know the role of G x E interactions and also to analyze the stability of genotypes for different traits.

MATERIAL AND METHODS
Experimental material for the present study consisted of 25 chickpea genotypes and was laid out in a randomized complete block design with three replications at Agricultural Research Station, Tandur, ANGRAU during three consecutive rabi seasons of 2009-10, 2010-11 and 20011-12. A suitable spacing of 45 cm between rows with intra row spacing of 10 cm was followed with application of recommended dose of fertilizers to the experimental crop in all the growing seasons. A two way analysis of variance was performed and the stability parameters are computed following the model proposed by Eberhart and Russell (1966). The type of stability is decided on regression coefficient (bi) and mean values (Finlay and Wilkinson, 1963). If bi is equal to unity, a genotype is considered to have average stability (same performance in all the environments). If bi is more than unity, it is suggested to have less than average stability

(good performance in favourable environments) and if bi is less than unity, it is reported to have more than average stability (good performance in poor environments).

RESULTS AND DISCUSSION

Analysis of variance (Table 1) for seed yield and its component traits revealed that the genotypes differed significantly for all the characters except days to 50% flowering, number of primary branches per plant and seed yield (kg/ha) indicating the presence of variability in the material. Similarly, environments in which the genotypes were grown were also differing significantly for all the characters except number of primary branches per plant and seed yield. Variance due to G x E interactions was significant for all the characters except days to 50% flowering and number of primary branches per plant indicating the differential response of genotypes in expression of the characters to varying environments. The existence of G X E interactions for seed yield and its important component traits has also been reported by Mohammed and Maan (2007). Considering the stability of performance of genotypes for different characters across the environments it was observed that the variance due to non linear component of environments (pooled deviations) was significant for days to 50% flowering, primary branches per plant and test weight indicating the role of unpredictable portion of environment influencing this trait. Similar results were also reported by Oral Duzdemir (2011).

Stability parameters like regression coefficients (bi) and the deviations from the regression coefficients (S^2di) indicated that none of the genotypes were stable over the environments for seed yield except genotype ICCV 10 and ICC 5360 as the deviations of these genotypes were non significant (Table 2). Expression of stability of genotypes for seed yield has also been reported by Kumar *et al* (1996). However, 11 genotypes *viz.*, ICC 11574 followed by ICC 5034 and ICCV 09104 had below average stability and were specifically adapted to favourable environments as they possessed high mean seed yield and bi values greater than unity. Genotype ICC 5282 had better mean coupled with significant bi as well as S^2di values indicating the unpredictable nature of this genotype across the environments. The genotype ICC 10807 showed good performance in poor environments as it has bi value more than average stability. Stability analysis of number of pods per plant revealed that the genotypes ICC 3137 and ICC 5282 were quite stable across environments. The genotypes ICCV 86105, ICCV 09118, ICC 5360 and ICCV 08311 were adapted to favourable environments (bi>1), higher mean and significant deviations, while the genotypes ICCV 09317, ICCV 86111, ICCV 09308 and ICC 5583 were adapted to poor environments. The results obtained are in accordance with the earlier reports of -Babar Manzoor Atta and Tariq Mahmud Shah (2009). Significant role of G x E interactions was evident for total number of pods per plant and test weight which is in conformity with the earlier reports of Choudhary and Haque (2010).

Among the different yield traits, test weight is the most important character for determining the yielding ability of chickpea genotypes. The study revealed that genotype ICC 3137 showed stable performance over the environments as seen from non significant deviation and bi values being nearer to unity. The genotypes ICCV 86105 and ICC 15996 revealed higher mean values, regression coefficient more than unity and deviations from regressions revealed that these genotypes were adapted to favourable environments only. These results are in concomitant with the earlier reports of Adeel Shafi (2012). Non linear component of environment was highly significant for test weight indicating the unpredictable nature of environment which is also in agreement with the earlier reports of Singh and Bejiga (1990).

Although the study did not reveal genotypes exhibiting stability for more than one trait influencing the seed yield, it is highly relevant in identifying genotypes with wider adaptation over seasons or suitable to a specific season for a particular character. Thus it needs more number of genotypes to be involved in further evaluations over the seasons to identify genotypes possessing stability for yield and its influencing traits.

REFERENCES

Adeel Shafi, Ghulam Shabbir, Zahid Akram1,Talat Mahmood, Ahmad Bakhsh , and Ijaz Rasool
     Noorka (2012) Stability analysis of yield and yield components in chickpea (*cicer*

arietinum l.) Genotypes across three rainfed locations of Pakistan. *Pakisthan J ournal of Botany* 44: 1705-1709.

Babar Manzoor Atta and Tariq Mahmud Shah (2009)Stability analysis of elite chickpea genotypes tested under diverse environments. *Australian Journal of Crop Science Southern Cross Journals* 3:249-256.

Eberart S A and Russell W A 1996. Stability parameters for comparing varieties. *Crop Science.* 6:36-40.

Finlay. K.W and Wilkinson. G.N (1963) The analysis of adaption in a plant breeding programme. *Australian Journal of Agricultural Research*, 14:742-754.

K. B. Singh, Geletu Bejiga (1990) Analysis of stability for some characters in Kabuli Chickpea. *Euphytica* 49: 223-227.

Kumar, J and Singh, K B and Malhotra, R S and Miranda, J H and Dasgupta, T (1996) Genotype xenvironment interaction for seed yield in chickpea. *Indian Journal of Genetics and Plant Breeding*, 56 : 69-78.

Mohammed Y. Hammed and Maan M. Al-Badrany (2007) Stability of chickpea (*Cicer arietinum L.)* varieties under rainfall conditions in northern Iraq. *African Crop Science Conference Proceedings.* 8: 219-224

Oral Duzdemir (2011) Stability analysis for phenological characteristics in chickpea. *African Journal of Agricultural Research* 6: 1682-1685.

R.N. Choudhary and M.F. Haque (2010) Stability of yield and its components in chickpea (*Cicer arietinum* linn) for chhotanagpur region. *Legume Research* 33: 164 - 170, 2010

Table 1. Joint regression analysis for yield and yield components in chickpea

Source	df	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Total number of pods per plant	Test weight (g)	Seed yield (kg/ha)
Rep with in Env.	6	12.716	86.713***	22.975**	11.886**	65.393**	4.046	14000.940
Genotypes	24	9.809	27.933**	11.619*	3.456	37.326*	86.471***	36511.590***
Env+(Gen*Env)	50	23.767*	28.427**	38.049***	2.906	146.065***	29.565***	59613.090
Environments	2	159.095***	120.529***	720.545**	6.116	2223.078***	26.164**	139331.20***
Gen *Env	48	18.129	24.589*	9.611*	2.772	59.523***	29.707***	56291.50**
Env. (Lin.)	1	318.190***	241.058**	1441.089**	12.232*	4446.157***	52.327*	278662.50
Gen*Env (Lin.)	24	23.745*	38.514***	14.536**	2.887	100.549***	50.254**	68895.350
Pooled deviation	25	12.012**	10.238	4.499	2.551*	17.758	8.793**	41940.14
Pooled error	144	5.907	16.009	6.021	1.377	16.452	4.265	12026.05
Total	74	19.240	28.267	29.477	3.084	110.799	48.021	52120.71

*- Significant at 5% level, **- Significant at 1% level

Table 2 Estimates of different stability parameters in 25 genotypes of chickpea

Genotype	Days to 50% flowering			Days to maturity			Plant height (cm)			Number of primary branches per plant			Total number of pods per plant			Test weight (g)			Seed Yield (kg/ha)		
	Mean	bi	s^2di	Mean	bi	s^2di	Mean	bi	s^2di	Mean	bi	s^2di	Mean	bi	s^2di	Mean	bi	s^2di	Mean	bi	s^2di
1	46.44	-1.10	-6.03	90.11	-2.10	-17.56	30.52	0.96	-5.17	6.04	-2.52	3.32	32.67	2.79	-14.95	19.13	-2.01	87.36	858.78	-1.64	-8529.11
2	40.00	0.47	0.55	88.78	0.96	-16.11	29.81	0.91	-3.19	6.67	1.78	-1.60	20.11	0.85	15.39	26.70	3.81	-4.24	905.33	-1.57	7811.98
3	50.11	0.64	-5.69	95.22	0.57	-16.53	33.29	0.68	-6.65	6.78	-2.33	2.43	33.56	2.21	-18.21	19.14	4.27	-3.93	919.00	0.04	-8883.39
4	48.00	-0.39	-5.20	94.44	-1.05	5.22	30.95	0.20	-5.81	6.33	-0.23	-1.53	23.44	0.39	-14.99	18.26	2.08	-3.45	736.11	-0.03	30598.28
5	47.56	0.57	4.19	94.11	0.55	-14.59	33.22	0.18	-5.81	5.22	-4.79	-0.28	24.89	0.47	-17.60	21.88	-2.29	-3.72	624.11	-0.82	-3602.26
6	48.78	0.94	-4.45	93.44	1.44	-18.79	36.00	1.45	-5.36	6.33	0.64	-1.78	22.22	0.62	29.11	20.44	-1.82	-4.17	902.89	3.21	-11796.40
7	48.56	1.83	-5.29	95.56	0.98	-18.68	36.11	1.60	-6.65	5.90	2.11	0.77	22.67	0.64	-1.87	20.88	2.77	-3.75	883.44	1.76	154422.13
8	47.78	1.59	-3.12	93.22	2.63	-17.44	35.39	1.12	24.14	6.42	1.93	-1.62	25.96	1.78	-16.20	20.38	1.90	-3.38	818.33	2.60	53405.82
9	49.44	1.80	-6.1	94.56	2.87	34.06	37.24	1.79	-3.4	6.43	3.18	-1.2	26.53	1.88	2.62	24.63	14.47	7.86	795.89	-3.2	-11988.9

			3						1			9								0	4
10	48.78	0.88	37.53	97.33	2.12	-18.52	36.00	0.70	13.27	6.40	-1.87	-1.28	27.49	1.58	8.42	22.63	-1.46	-4.21	871.56	3.27	-4048.83
11	48.67	0.99	6.04	95.00	1.12	31.17	33.44	1.22	-3.08	5.33	-1.75	0.33	28.33	1.90	-14.16	28.11	4.28	-2.06	927.00	-1.12	-11932.93
12	45.56	-0.12	-3.62	91.44	0.37	5.70	34.42	0.68	-6.44	9.67	3.02	0.77	21.84	0.26	-11.32	22.03	1.18	-3.24	957.33	4.03	-3722.46
13	50.78	0.51	12.78	90.22	-2.18	1.06	30.73	1.06	-6.08	8.02	-0.44	0.11	27.00	-0.09	49.78	19.97	0.49	-4.06	1128.89	1.02	-2004.44
14	47.22	0.41	7.76	92.44	0.03	0.34	33.10	0.04	-6.50	6.33	2.46	13.90	28.09	0.39	-0.56	20.69	2.13	-4.26	880.67	3.82	1997.23
15	50.89	1.70	-3.49	97.44	0.86	-18.33	33.07	1.12	-2.84	6.20	5.25	-1.51	29.84	1.45	-0.06	22.14	3.35	-3.78	917.44	3.50	30660.84
16	50.22	1.24	29.13	92.78	1.24	-15.46	32.37	1.86	-4.89	6.87	3.91	-1.07	25.67	1.56	37.13	20.14	-1.47	-3.86	1084.33	1.00	-11204.92
17	49.11	0.04	13.66	93.00	-0.10	-16.05	32.26	1.03	-1.64	5.20	4.44	3.01	23.82	1.00	-15.85	19.29	4.59	-3.49	908.78	1.95	2148.26
18	50.11	2.88	-4.90	100.11	4.94	-18.74	30.51	1.26	-4.91	6.87	2.90	-1.58	23.20	0.50	10.98	25.41	1.45	-4.10	950.00	-0.06	94983.45
19	51.00	2.59	26.96	102.11	4.28	-9.49	33.38	1.61	-1.67	5.20	2.81	1.08	21.76	0.54	-9.19	21.37	-5.36	16.71	757.22	4.36	1909.15
20	48.33	1.85	4.95	95.44	2.10	-2.28	32.84	0.24	-6.06	9.43	0.93	0.10	20.02	-0.25	-7.68	44.64	0.21	5.72	789.56	-0.92	26639.37

21	48.78	1.76	-4.04	96.22	1.28	-7.60	35.33	1.08	-4.66	6.80	1.56	9.33	25.00	0.58	-18.38	28.25	-12.02	66.36	679.44	1.42	8205.56
22	48.89	0.76	30.32	96.22	0.96	-17.36	33.07	1.33	10.66	5.91	1.66	2.05	22.78	1.37	-17.26	23.62	8.86	1.77	865.00	-4.38	-11983.28
23	51.89	5.24	34.12	97.22	5.45	-17.42	31.82	0.62	-0.50	6.44	-1.02	-1.79	21.89	0.34	13.96	23.48	-2.36	-4.19	800.22	4.77	-2942.87
24	48.22	-1.15	-4.08	94.00	-1.67	-13.00	32.67	0.81	-6.64	6.11	1.40	-1.80	24.11	1.00	-15.20	17.80	1.05	-4.23	801.56	1.15	51640.61
25	50.89	0.01	-6.11	97.11	-0.70	-18.59	34.02	1.45	-5.15	6.10	-0.06	-1.25	27.22	1.24	9.74	25.76	-3.10	-4.24	820.78	-1.36	47675.64