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Short Communication

Stability analysis for grain yield and contributing traits in chickpea (*Cicer arietinum* L.)

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Chickpea (*Cicer arietinum* L.) is an important pulse crops in India and Asia adapted to the drought prone semi arid tropical regions. In the present study, an attempt has been made to identify high yielding stable genotypes of chickpea, particularly for the harsh and erratic environment of Rajasthan that further adds to variation in the growing conditions of the crop. The phenotypic stability of 22 genotypes of chickpea including two released checks i.e., GNG-663 (Vardan) and GNG-469 (Samrat) was studied for grain yield and contributing traits under three environments. The genotypes included in the study were the advance and stable breeding lines developed from different set of crosses between parents of good agronomic base. The experiment was laid out in a randomized block design with three replication in three environments i.e., rainfed (sown on 28th October, seasonal rainfall 13.2 mm, no irrigation during the crop season), timely sown irrigated (11th November) and late sown irrigated (6th December) *rabi* 2001-02. Each genotype was sown in four rows plot of 4 meter length. The net plot size was 7.2 m^2 and spacing between rows and plants with in rows were 30 and 10 cm, respectively. Observation for plant height, number of primary branches, number of secondary branches, 100-seed weight and number of pods per plant was recorded on ten randomly selected plants in each replications while days to 50% flowering, days to maturity and grain yield was recorded on whole plot basis. Components of G × E interaction and stability parameters were computed following Eberhart and Russel model [1].

Analysis of variance revealed significant differences among environments and their suitability for evaluating genotypes. The mean sum of squares for genotypes was also significant over the environments for grain yield and contributing traits like pods per plant and 100-seed weight revealing the presence of genetic variability among the genotypes. Significant mean sum of squares due to genotype × environment (G × E) interactions indicated that the genotypes interacted considerably with the environmental conditions [2]. Both linear and non-linear components of G × E interactions were significant showing the importance of linear and nonlinear components in the expression of all the traits under study except grain yield where pooled deviation (non-linear) was found non-significant (Table 1).

A perusal of stability parameters for grain yield indicated that out of twenty-two genotypes, 12 exhibited non-significant S^2di indicating their predictable performance (Table 2). Out of these twelve genotypes, six genotypes *viz.*, GNG-1451, GNG-1476, GNG-1479, GNG-1480, GNG-1485 and GNG-1486 were average performer with bi around unity. Three genotypes *viz.*, GNG-1451, GNG-1485 and GNG-1486 showing high *per se* performance for grain yield along with regression coefficient around unity and non-significant S^2di values can be considered as stable performer under different environmental conditions for higher grain yield. With respect to component traits, out of three genotypes, which exhibited stable performance for grain yields only one i.e., GNG-1486 also exhibited stable performance for its component trait i.e. pods per plant also. However, for other related traits the performance was not stable for this genotype.

Similar kinds of results have also been reported in the past by other workers [3-5]. GNG-1477 was identified as suitable genotype for favorable environments as indicated by its high regression coefficient (bi > 1) value with non-significant S^2di and high *per se* performance (Table 2). Overall the experiment has resulted into identification of some stable chickpea genotypes like GNG-1451, GNG-1485 and GNG-1486.

References

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Table 1. Joint regression analysis of variance for different traits over environments in chickpea

Source	Mean sum of squares								
	df	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches	No. of secondary branches	100-seed weight(g)	No. of pods per plant	Grain yield (kg/ha)
Genotypes	21	5.21++	1.13++	24.84++	0.13++	4.14++	30.74*++	135.77*++	2364955.33*++
Environments	2	2204.65**++	3251.98**++	2197.68**++	4.63**++	165.32**++	0.88**++	6731.55**++	39469416.00**++
G× E	42	6.73++	1.18++	27.10++	0.28++	4.73++	1.45++	86.09+	1256518.08
Environment + (G× E)	44	106.63**++	148.94**++	125.76**++	0.48++	12.03*++	1.42++	388.16**++	40725932.00***++
Environment (Linear)	1	4409.30**++	6503.96**++	4395.37**++	9.27**++	330.65**++	1.77++	13463.09**++	39469416.00**++
G× E (Linear)	21	8.58++	0.97++	21.16++	0.30++	5.64++	1.03++	62.85++	837513.24*
Pooled deviation (non-linear)	22	4.66++	1.32++	31.55++	0.26++	3.64++	1.78++	104.37++	419004.84
Pooled error	126	0.20	0.24	1.21	0.05	0.60	0.01	19.40	814192.15

+,++ Significant against pooled error M.S. at 5 and 1% levels; *,** Significant against pooled deviation M.S. at 5 and 1% levels, respectively

Table 2. Estimates of stability parameters for different traits in chickpea

Genotype	No. of primary branches			No. of secondary branches			No. of pods per plant			100-seed weight			Grain yield (kg/ha)		
	$\bar{X}$	b	S^2d	$\bar{X}$	b	S^2d	$\bar{X}$	b	S^2d	$\bar{X}$	b	S^2d	$\bar{X}$	b	S^2d
GNG-1449	3.00	0.00	−0.05	12.44	0.46	1.52*	50.89	0.50	41.01*	18.4	3.8	0.72*	1468.12	1.08**	29102.4*
GNG-1450	2.67	0.93	0.11*	14.56	0.63	5.49**	55.56	1.17*	113.88*	13.7	1.83	2.28*	1593.79	0.89**	−2019.0
GNG-1451	3.00	1.25**	−0.04	14.67	1.82**	−0.46	64.67	1.09**	65.83*	13.2	4.04	0.11*	1790.63	1.02**	−3720.5
GNG-1452	3.67	0.90	0.57*	15.78	1.81**	0.37	55.00	1.34**	−19.08	13.8	2.22	0.12*	1402.44	0.87**	1028.7
GNG-1453	3.33	1.41*	0.08*	13.67	2.37*	14.56*	54.78	1.01**	−15.96	13.8	0.75	0.44*	1551.85	0.87**	−5840.9
GNG-1454	3.33	1.15	0.28*	11.67	0.65	1.27*	40.22	0.61**	−4.16	17.0	3.74	−0.01	1182.68	0.86**	5076.3*
GNG-1455	3.33	1.92**	−0.05	12.67	0.56	6.10*	56.67	0.99	106.24*	17.2	4.92	2.19*	1193.75	0.69**	−3530.6
GNG-1456	3.00	−0.77	0.37*	11.78	−0.40	3.62*	49.33	0.43	62.07*	20.8	9.83	11.08*	1215.82	0.91**	72208.9*
GNG-1457	3.00	1.41	0.08*	12.22	1.64	10.74*	54.56	1.18*	136.30*	16.8	0.22	6.86*	1461.95	1.05**	34834.2*
GNG-1476	3.33	1.66*	−0.03	12.67	0.85**	−0.64	54.89	1.25**	−16.51	17.9	−2.07	1.09*	1374.60	1.04**	−4432.9
GNG-1477	3.00	1.25**	−0.04	12.11	0.68**	−0.44	65.89	0.85**	6.10	25.2	0.69	0.75*	1892.02	1.32**	−4713.2
GNG-1478	3.33	1.41**	0.08*	11.89	1.53**	−0.39	49.56	1.21**	−19.70	16.0	3.04	0.19*	1557.51	1.03**	8138.8*
GNG-1479	2.67	1.60*	0.28*	10.33	0.54	9.10*	45.11	0.82**	21.20*	18.7	−1.03	−0.01	1453.26	1.05**	−2144.1
GNG-1480	3.00	2.02	0.24*	11.89	1.57**	−0.21	47.11	1.38*	213.82*	19.1	−4.06	1.05*	1393.45	1.04**	−5940.3
GNG-1481	2.67	1.86*	0.57*	12.33	1.20	5.78*	54.44	1.59**	−10.96	18.0	2.23	0.09*	1336.74	1.07**	109677.3*
GNG-1482	2.00	1.02	0.69*	12.67	1.04**	−0.67	53.00	1.40**	−11.89	19.3	−0.66	1.55*	1347.09	1.32**	3768.0*
GNG-1483	3.00	0.51	0.14*	12.78	1.15**	−0.49	59.56	1.11**	−13.92	19.1	4.64	1.87*	1714.14	1.03**	−2816.3
GNG-1484	2.33	0.93	0.11*	11.89	0.91**	−0.68	63.00	0.53	230.42*	19.6	−1.88	0.09*	1646.99	0.78**	32103.1*
GNG-1485	3.00	1.34*	0.08*	13.67	1.08	5.95*	66.00	0.75**	−19.72	19.6	−6.51	0.02*	1728.41	0.96**	2773.9
GNG-1486	2.67	1.34*	0.08*	12.89	0.89	3.10*	61.89	0.80**	−6.98	18.8	−3.63	0.85*	1671.69	0.96**	−863.9
GNG-663	3.33	0.22	0.89*	12.67	0.64	1.46*	58.89	0.79**	7.08	10.1	−0.09	0.07*	1620.71	1.02**	10327.9*
GNG-469	3.00	1.34*	0.08*	12.67	0.38*	−0.18	58.00	1.21**	75.80*	19.7	0.03	7.66*	1581.48	1.15**	5392.2*
Grand mean	2.78			12.72			55.41			17.5			1508.1		
S.E.(b)	0.78			0.49			0.41			4.7			0.1		

*,** Significant at 5 and 1% levels, respectively

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