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STABILITY ANALYSIS FOR SEED YIELD AND YIELD ATTRIBUTING TRAITS IN CHICKPEA (*CICER ARIETINUM* L.) UNDER MID HILLS OF JAMMU & KASHMIR, INDIA

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ABSTRACT

Stability parameters were studied during rabi seasons 2007-08, 2008-09 and 2009-10 among seventeen genotypes of chickpea (*Cicer arietinum* L.) for seed yield and its components. The objective of this study was to explore the effect of genotype (G) and genotype × environment interaction (GE) on grain yield. The development of genotypes, which can be adapted to a wide range of diversified environment, is the ultimate goal of plant breeders in a crop improvement program. Genotype GNG 469 was the most stable for seed yield / plant. Genotypes were found stable for yield and yield contributing traits *viz.,* number of seeds / pod (SCS3, 90201, C81 and PBG1), number of pods / plant (95909, 90201) and 100 seed weight (C17, SCS3). The study validated that the seeds / pod, 100 seed weight and plant height were important characters for improvement of seed yield / plant in chickpea.

Key words: Chickpea, G x E interactions, Stability analysis

Chickpea (*Cicer arietinum* L) is an important source of vegetable protein in the world. The major chickpea producing countries in Asia are India (65%), Pakistan (7.5%) and Turkey (6.5%). India grows chickpea on 8.56 million ha are producing 7.65 million tonnes (F.A.O. 2011) and productivity 858 kg/ha. The climatic conditions of Jammu province are very fluctuating having erratic, low rainfall and very low temperature i.e. cold stress during the rabi season (December to February) particularly in Poonch district. Crop productivity can be increased by planting high yielding varieties having resistance against abiotic factors (cold), biotic (Ascchota Blight) and higher degree of adaptability. The genotypes x environment (G x E) interaction studies had immense importance in breeding programmes for identifying stable genotypes that are widely or specifically adapted to unique environments (Verma *et al*. 2008). The present investigation was carried out to identify stable and high-yielding genotypes of chickpea for cultivation in the Jammu division through stability analysis

The experiments were conducted at the experimental farm of Krishi Vigyan Kendra, Poonch of Sher-e- Kashmir University of Agricultural Sciences & Technology-Jammu during rabi 2007-08, 2008-09 and 2009-10 under rainfed conditions. The material for present study consisted of 17 varieties of chickpea (81-0-800, 96907, 90201, C-81, 96910 C306, C-235, C-294, GNG-469, SCS-3, PBG1, 88-2, 95909, HPG17, 96911, 96904 and C17) with wider adaptability in areas of their recommendation. In all the three years, the experiments were laid out in randomized block design with three replications, the rows being 2.5m long at 30cm between rows and 15 cm between plants. The data was recorded on ten randomly selected plants using standard procedures for number of primary branches/plant, number of secondary branches/plant, plant height (cm), days to 50 % flowering, days to maturity, seed yield /plant (g), number of seeds/pod and 100-seed weight (g). The recommended package and practices was followed

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to raise a good healthy crop. The pooled mean values of all the characters were used for detailed statistical analysis. The data were subjected to analysis of variance as per the procedure suggested by Sukhatme and Amble (1989). Genotype and environment interactions were found to be significant in respect of all the characters studied; hence the pooled data were subjected to stability analysis (Eberhart and Russel 1966) to assess the stability of different genotypes. A genotype with regression coefficient of unity and the deviation not significantly different from zero was taken to be a stable genotype with unity response.

The combined analysis of variance (Table1) revealed significant differences among the genotypes and environments for all the traits suggesting the presence of variability both among genotypes and environments. The mean squares due to G x E interaction were significant for all the traits. Significant mean squares due to environment (linear) indicated considerable differences among environments and their predominant effects on all the traits. Pooled deviation was significant for all the traits except number of primary branches/plant and seeds / pod indicating the importance of non-linear components in the manifestations of G x E interaction of these significant traits. Similar results were also reported by Alwawi et *al.*, (2009). Eberhart and Russel (1966) suggested a stable genotypes having regression coefficient (b> 1) approximately to unity, higher mean performances and deviation from regression (mean square deviation) as small as possible. HPG17, C294, 96907 and PBG1 recorded more plant height than population mean, regression values greater than unity (b> 1) and least S^2di values indicating their stability and adaptation to specific favorable environment for plant height (Table 2). For number of primary branches /plant , genotypes C81 and C306 revealed more population mean, regression coefficient less than unity and associated with least square deviation hence recommended for unfavorable environments only. For number of secondary branches /plant genotypes 88-2, C235, GNG 469 and C17 recorded more than population mean, regression value less than unity (b< 1) and S^2di value least indicated better performance, high stability and adaptation to unfavorable environment, while 95909 and 96907 revealed high mean performance, regression coefficient greater than unity and associated with least deviation from regression $S^2di = 0$ indicated they are stable for good environment only. For days to 50% flowering, genotype, GNG469 was found early with average regression coefficient (b< 1) and least deviation from regression coefficient ($S^2di= 0$) and thus found to be stable genotypes. Genotype 96910 was found early with average regression coefficient (b> 1) and least deviation recommended for unfavorable environments. Genotypes GNG 469 revealed high mean population, average regression coefficient around unity (b= 1) and small deviation from regression coefficient, therefore identified as stable genotypes for seed yield per plant. SCS-3 recorded more number of seeds per pod than population mean, regression values greater than unity (b> 1) and low mean square deviation from regression (S^2di) values indicating adaptation to favorable environment (Table 3). Genotypes C-90201, C81 and PBG1 exhibited regression values (b< 1) and least S^2di values indicted their better performance and stability in unfavorable environments.

For number of pods/plant genotypes, 95909 and 90201 manifested high mean population,

TABLE 1: Analysis of variance for yield and its contributing traits in combine over environments in Chickpea

Sources	DF	PH	NPB	NSB	DFL	SY	100SW	Seeds/Pod	Pods/Plant
					Mean sum of square				
Genotypes	16	225.11**	0.13**	2.08**	42.58**	525.40**	415.48**	0.33**	6889.39**
Env.+ (env x gen.)	34	318.16**	0.11**	1.47**	31.15**	24.36**	244.77**	0.18**	6437.06**
Env.(linear	1	8552.22**	0.46**	1.83**	564.08**	255.75**	461.15**	3.96**	154039.70**
Geno. x env.	16	120.62**	0.16**	0.19**	14.45**	11.72**	486.65**	0.13**	3927.89**
Pooled deviation	17	19.72**	0.05	2.66**	15.52**	22.65**	4.40**	0.01	116.12**
Pooled error	96	0.86	0.00	0.02	1.25	0.64	0.44	0.00	11.66

Significant at 5% ** Significant at 1%

DF-degree of freedom, PH-Plant height, NPB-Number of primary branches /plant, NSB- Number of secondary branches /plant, DFL- Days to 50% flowering, SY- Seed yield/plant, 100 SW- 100 Seed weight, PL-Pod length and PH- Plant height

TABLE 2: Analysis of variance and stability parameters using Eberhart Russel's (1966) model in combine over environments in Chickpea

Genotypes	PH			NPB			NSB			DFL			SY		
/ Varieties	Mean	Bi	MSD	Mean	bi	MSD	Mean	bi	MSD	Mean	Bi	MSD	Mean	bi	MSD
88-2	50.74	0.74± 0.16	14.44*	1.59	0.73± 0.22	0.001	4.99	0.91± 2.74	0.81	139.17	0.59± 11.59	9.27*	35.91	0.88± 1.6	41.60*
HPG 17	64.22	1.28± 0.21	0.14	1.29	0.80± 0.16	0.000	4.04	0.83± 5.42	3.17	142.88	1.00± 0.43	6.22 *	60.47	1.15± 1.2	23.53 *
95909	23.99	0.31± 0.13	22.42*	1.54	2.37*± 1.04	0.029	4.45	3.35± 4.06	1.78	146.09	1.30± 0.72	17.21*	19.89	0.49± 04	0.30
C-81	58.11	0.69± 0.02	9.80 *	1.77	-5.94± 1.93	0.101	3.87	2.46± 11.39	14.02*	152.56	1.27± 0.64	13.78*	56.83	1.25± 1.2	45.20*
96910	59.36	1.0± 0.07	0.33	1.49	-2.91± 0.84	0.019	3.45	1.26± 3.08	1.03	140.35	1.14± 0.27	2.42	20.04	-0.05± 0.05	7.49 *
96911	49.22	0.41± 0.26	3.00	1.60	0.82± 0.93	0.023	3.43	0.44± 1.40	0.21	140.54	1.09± 1.00	33.61*	48.02	1.20± 1.2	22.06*
96904	50.10	0.24± 0.19	35.05*	1.57	1.65*± 0.42	0.004	3.96	0.06± 1.68	0.30	143.42	1.11± 0.45	6.86 *	30.15	3.74± 3.7 0	170.9*
81-0-800	65.32	0.98± 00.31	19.83*	1.89	2.64*± 0.006	0.000	3.77	2.39± 0.70	0.05	142.09	1.17± 0.43	6.22*	29.74	0.002± 0.002	0.53
C-294	65.90	1.38± 0.19	0.004	1.58	2.39*± 1.56	0.066	4.10	0.63± 2.86	0.88	151.05	2.01± 0.54	9.75*	30.32	0.37± 0.3	1.36
C-306	68.50	1.81*± 0.06	18.23*	2.88	0.16± 0.05	0.000	6.17	1.73± 10.75	12.50*	148.49	0.06± 0.48	7.64 *	33.42	0.38± 1.4	0.11
96907	67.84	1.39*± 0.18	1.83	1.79	2.35*± 0.49	0.006	4.46	1.42 ± 3.77	1.54	145.64	2.46± 1.39	64.96 *	20.33	1.47 ± 1.6	15.30*
90201	58.67	0.96*± 0.22	17.47*	1.81	3.56*± 0.64	0.011	3.46	2.77 ± 2.55	0.70	148.05	0.86± 0.98	32.26*	31.43	1.69*± 0.2	3.45
C-235	53.81	0.56± 0.03	25.51*	2.19	3.94*± 0.99	0.026	4.84	-1.98± 7.09	5.43	147.95	-0.06± 1.06	37.68*	25.93	0.21± 0.6	3.62
PBG-1	69.35	1.35± 0.54	0.50	1.45	-0.51± 1.39	0.052	3.54	1.14 ± 3.75	1.25	146.88	0.88± 0.39	5.27 *	22.32	0.68 ± 1.5	0.02
SCS-3	57.75	0.56± 0.04	1.47	1.89	3.39*± 0.93	0.023	3.68	0.63 ± 0.24	1.52	143.07	1.30*± 0.09	0.30	50.12	1.50± 1.04	28.33 *
GNG 469	51.29	1.39*± 0.04	0.93	1.61	0.23± 0.31	0.002	4.81	-0.38± 0.37	0.00	143.61	0.08± 0.15	0.75	48.02	1.04± 0.9	0.44
C-17	76.09	1.76*± 0.57	164.35 *	1.63	1.18*± 4.46	0.539	4.29	-0.75± 0.32	0.01	143.83	0.24± 0.46	7.25*	45.80	0.92 ± 0.9	20.80 *
CV%	2.63			8.50			6.62			1.34			03.89		
PM	61.05			1.65			4.27			145.04			35.77		

TABLE 3: Analysis of variance and stability parameters using Eberhart Russel's (1966) model in combine over environments in Chickpea

Genotypes/varieties	Seeds/Pod			Pods/Plant			100SW		
	Mean	bi	MSD	Mean	bi	MSD	Mean	bi	MSD
88-2	1.42	-0.22± 0.21	0.01	50.45	0.24± 0.07	54.8*	13.03	-0.18± 0.2	1.30*
HPG 17	2.47	1.99*± 0.28	0.01	124.49	1.30*± 0.09	77.2*	37.05	17.40*± 0.21	13.46*
95909	2.17	1.63*± 0.10	0.002	35.89	0.15± 0.05	0.29	22.85	0.55± 0.70	5.11
C-81	2.32	0.48± 0.37	0.03	79.00	0.02± 0.08	66.64*	18.23	0.49± 0.43	3.04
96910	1.70	-0.39± 0.13	0.004	77.37	0.54± 0.14	201.12*	15.75	-0.49± 0.33	37.71*
96911	2.56	1.63* ± 0.12	0.003	74.63	0.41± 0.03	13.23*	17.35	-0.20± 1.17	0.13
96904	2.64	1.90*± 0.06	0.001	81.63	0.60± 0.03	14.24*	15.12	0.10± 0.07	0.55
81-0-800	2.01	1.02± 0.09	0.002	224.11	0.20± 0.29	782.22*	15.25	-0.15± 0.14	0.06
C-294	2.28	1.63*± 0.18	0.008	132.13	1.20*± 0.04	17.36*	15.11	0.01± 0.04	1.40
C-306	1.85	1.19± 0.43	0.044	155.52	6.43*± 0.06	39.05*	14.70	-0.13± 0.22	0.35
96907	1.94	1.30± 0.98	0.002	167.55	1.78*± 0.13	155.09*	14.45	-0.39± 0.11	0.47
90201	2.17	0.05± 0.30	0.021	89.73	0.70± 0.007	0.49	12.40	-0.00± 0.13	0.05
C-235	1.62	0.24± 0.10	0.002	174.29	1.74*± 0.21	438.4*	14.80	-0.09± 0.04	1.29
PBG-1	2.22	0.69± 0.27	0.018	115.66	1.06± 0.03	11.75*	12.93	-0.20± 0.21	0.09
SCS-3	2.18	1.88± 0.42	0.041	113.01	0.98± 0.05	28.22*	23.06	-0.20± 0.59	0.19
GNG-469	1.85	1.22*± 0.11	0.00	119.78	1.00± .04	16.93*	25.13	0.33± 0.08	9.52*
C-17	1.87	0.71± 0.27	0.017	119.16	1.09± 0.05	27.24*	25.91	0.03± 0.59	0.01
CV %	4.43			05.20			05.83		
Population Mean	2.07			113.39			19.76		

regression less than unity (b< 1) and least deviation from regression indicated their stability but can be recommended for good environment only (Table 3). For 100 seed weight, genotypes C17 and SCS-3 recorded high mean values, regression coefficient less than unity (b< 1) and least (S^2di) values indicated better performance, high stability and adaptation to unfavorable environments (Table 3).

From the present study, it was concluded that among all the genotypes of chickpea GNG469 was the most stable for seed yield/plant and general adaptability and also had low response to the change of environment and thus can be suitable for cultivation under poor environments. However, genotypes HPG17, 96911 and PBG1 gave high seed yield but these were high responsive to the change of environment showing their adaptation to favorable environment. These genotypes could be utilized in future breeding programme for seed yield/ plant improvement in chickpea and pyramiding of components traits such as number of pods/ plant, 100 seed weight and number of seeds / pod.

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