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Research Article

STABILITY ANALYSIS IN CHICKPEA (*CICER ARIETINUM* L.) FOR HIGHER PRODUCTIVITY AND SUSTAINABILITY IN SOUTH EASTERN RAJASTHAN

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Abstract: Four advanced breeding lines and two check varieties from different zones of the country were studied for three years to identify high yielding, stable genotypes for south eastern Rajasthan. Variance due to genotypes, environments, genotype x environment was highly significant for days to maturity, 100 grain weight and grain yield per plant across the environments. NBeG 452 and GAG 1107 were found to be the most stable genotypes for yield and component traits.

Keywords: *Chickpea, Stability*

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Introduction

Chickpea (*Cicer arietinum* L.) is the most important pulse crop of India and the world. Its area in India and Rajasthan is 9.63 m. ha. and 1.5 m.ha with production of 9.38 m. tons and 1.4 tons and productivity of 974 and 911 kg/ha, respectively during 2016-17. Rajasthan is one of the major chickpea producing state of the country accounting to around 11 percent share to the country's total area and production. The productivity of the crop in south eastern part of Rajasthan i.e., zone V is higher than the state's mean productivity, inspite of that, the zone contributes only 2-3 percent to the total area and production of the state. The probable reasons for less area and production in the zone seem to be sensitivity of the crop to various abiotic and biotic stresses. The unpredictable and fluctuating environment is also one of the major constraints in achieving self-sufficiency and sustainability in food grain production which is much required for feeding the ever-increasing population. High temperature stress during late maturity stage also adversely affects the production. Therefore, the present study was done to have an insight about the nature and magnitude of genotype x environment interaction on morphological characters for identifying high yielding genotypes with stable performance across various environments.

Materials and methods

The present study was conducted with six genotypes of chickpea evaluated under three environments (2013-14 to 2015-16) at Agricultural Research Station, Kota in randomized block design with three replications. The genotypes/varieties selected for g x e analysis were from different source/origin [Table-1]. The spacing between row to row and plant to plant was maintained at 30 and 10 cm respectively. The observations were recorded on randomly selected five competitive plants from each plot for yield and yield contributing traits *viz*., 100- seed weight (g) and seed yield (g) and for days to maturity on plot basis. Stability parameters and G x E interaction components were computed as per Eberhart and Russel (1966) model [1].

Results and discussion

The result revealed high magnitude of genotype environment interaction, genotypes significantly varied for days to maturity and seed weight, reflecting genetic variability in experimental material as well as difference in the environmental conditions. The existence of genotype environment interaction for seed yield and component traits were earlier also reported by Adeel Shafi *et al.* (2012), Shivani and Sreelakshmi (2015) and Hasan and Deb (2017) in chickpea [2-4]. High magnitude of genotype x environment. The genotype having high mean with near unity bi and lowest S^2d_i are considered as an ideal genotype, stable over the environments. For the most complex and important character seed yield, only three genotypes had mean value higher than the population mean with the highest value being shown by NBeG 452 followed by Phule G 0405 and JG 36.

Table-1 *Details of genotypes/varieties origin/source*

SN	Genotype/Check	Origin/source
1	JG 315 (C)	Madhya Pradesh
2	GCP 101 (C)	Gujarat
3	Phule G 0405	Maharashtra
4	GAG 1107	Gujarat
5	JG 36	Madhya Pradesh
6	NBeG 452	Andhra Pradesh

Table-2 *Mean square for RBD in individual environment*

SN	Characters	Env	Replication	Genotype	Error
	df		[3]	[5]	[15]
1	Yield per plot in grams	E1	5062.05	59525	21300
		E2	17911.11	239306.67**	31140
		E3	16111.11	27502.46	11710
2	Maturity (days)	E1	5.44*	1.76	1.47
		E2	2.27	13.76**	1.34
		E3	2.15	30.84**	1.01
3	100 seed weight (g)	E1	2.19	55.33**	0.76
		E2	0.29	57.82**	0.88
		E3	0.97	22.50**	0.48

NBeG 452 having highest mean, bi near to one and non-significant S^2d_i value proved to be most stable over environments. Phule G 0405 and JG 36 had high values of S^2d_i indicating sensitivity to environmental changes. Phule G 0405 and GAG 1107 took a smaller number of days as compared to population mean for maturity, showed bi close to 1 and non-significant deviation from regression indicating their high stability and suitability for selection for earliness.

Table-3 *Analysis of variance over the environments*

SN	Characters	Environment	Rep/Env	Genotype	G x E	Pool Err	Bartlet
	Df	[2]	[9]	[5]	[10]	[45]	[2]
1	Yield per plot in grams	14217441.17**	13028.09	51415.40	137459.37**	21380.00	3.45
2	Maturity (days)	5217.88**	3.29*	13.63**	16.3750**	1.28	0.54
3	100 seed weight (g)	9.37**	1.16	36.58**	49.5424**	0.71	1.39

Table-4 *Mean values of six chickpea genotypes for yield per plot (g), maturity (days), 100 seed weight (g)*

SN	Genotype	Yield per plot (g)				Maturity (days)				100 seed weight (g)			
		E1	E2	E3	Pool	E1	E2	E3	Pool	E1	E2	E3	Pool
1	JG 315 (C)	2465.5	1215.0	950.0	1543.5	128.5	120.0	151.0	133.2	20.7	14.6	15.2	16.8
2	GCP 101 (C)	2381.5	1440.0	933.3	1584.9	129.5	122.3	151.8	134.5	17.6	26.0	20.9	21.5
3	Phule G 0405	2348.8	1690.0	933.8	1657.5	129.3	121.3	146.3	132.3	17.3	20.1	20.2	19.2
4	GAG 1107	2640.8	1105.0	1033.3	1593.0	128.3	118.8	150.3	132.4	17.2	18.9	19.8	18.7
5	JG 36	2376.0	1695.0	833.0	1634.7	129.5	117.0	148.8	131.8	26.8	20.3	15.9	21.0
6	NBeG 452	2588.0	1535.0	1066.8	1729.9	130.0	120.3	144.8	131.7	18.4	17.3	19.1	18.2
	Mean	2466.8	1446.7	958.3	1623.9	129.2	119.9	148.8	132.6	19.7	19.5	18.5	19.2
	CD5%	219.8	265.8	163.0	120.2	1.8	1.8	1.5	0.9	1.3	1.4	1.1	0.7
	CV %	5.9	12.2	11.3	9.0	0.9	1.0	0.7	0.9	4.5	4.8	3.8	4.4

Table-5 *Pooled analysis of variance for yield components of six chickpea genotypes*

SN	Characters	Genotype	E+(G x E)	E (L)	G x E (L)	Pool dev.	Pool Err
	df	[5]	[12]	[1]	[5]	[6]	[45]
1	Yield per plot (g)	12853.8	621030.7**	197464.4**	1390229.3**	50626.3**	5345.0
2	Maturity (days)	3.4**	220.8**	72.4**	513.4**	1.73**	0.32
3	100 seed weight (g)	9.1**	10.7**	0.13	11.15**	12.09**	0.17

Table-6 *Stability parameters for yield traits of six chickpea genotypes across three environments*

SN	Genotype	Yield per plot in grams			Maturity (days)			100 seed weight (g)		
		μ_i	b_i	S^2d_i	μ_i	b_i	S^2d_i	μ_i	b_i	S^2d_i
1	JG 315 (C)	1543.50	1.04	27243.17*	133.17	1.08*	0.988*	16.83	2.81	16.690**
2	GCP 101 (C)	1584.92	0.95*	-4425.82	134.50	1.04	2.774**	21.48	0.12	35.349**
3	Phule G 0405	1657.50	0.89	51563.50**	132.25	0.87	-0.320	19.17	-1.63	3.208**
4	GAG 1107	1593.00	1.13	123514.5**	132.42	1.10*	-0.098	18.66	-1.77	0.920*
5	JG 36	1634.67	0.97	78760.9**	131.75	1.08	3.147**	21.00	7.54	14.771**
6	NBeG 452	1729.92	1.01*	-4969.02	131.67	0.83	1.990**	18.24	-1.06	0.588*

For seed weight, the genotypes NBeG 452 and GAG 1107 had lowest S^2d_i values, bi less than 1 and mean also less than population mean can be said to be suitable for breeding medium bold genotypes having above average stability. Based on the three stability parameters, it is concluded that the genotype NBeG 452 followed by GAG 1107 seems to be most stable for yield and component characters that can be further used for varietal development programme in chickpea for south eastern Rajasthan.

Application of research: Study of Chickpea (*Cicer arietinum* L.) for Higher Productivity and Sustainability

Research Category: Genotype environment interaction

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Study area / Sample Collection: Agricultural Research Station, Kota

Cultivar / Variety name: Chickpea (*Cicer arietinum* L.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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