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Genotype × Environment (GxE) interaction and stability analysis of diverse elite *kabuli* chickpea lines for phenological and yield related traits under normal and heat stress environment

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ABSTRACT

68 kabuli chickpea lines were studied for different traits to know the role of genotype x environment (G×E) interaction and analyze stability under high temperature across the normal, late and very late planting dates at JNKVV, Jabalpur during *rabi* 2014-15. Differences among genotypes were significant for all traits; G×E interaction showed significant differences for days to maturity and seed yield. Variance due to environment found significant for all characters except days to maturity. G×E interaction (linear) exhibited significant differences for days to maturity and seed yield. Pooled deviation found significant for seed yield. Promising lines *viz*., CSJK46, PhuleG0517, ICCV13310, ICCV13312, FLIP-07-236C, FLIP-07-283C, FLIP-07-286C, JGK1, JGK 25 and JGK 26 found stable for most of the characters and may be grown under wide range of environments including high temperature conditions. ICCV13312 and JGK26 found highly stable with mean values greater than grand mean and regression coefficient lesser than one with deviation from regression minimum. Genotypes HK10-109, IPCK2009-145, CSJK4, PKV4, ICCV13306, ICCV13303, JGK24, JGK23 and JGK3 found most promising lines in minimum yield reduction in all planting dates.

Key words: Chickpea, Genotype environment interaction, Stability analysis.

INTRODUCTION

In any breeding programme it is necessary to find out phenotypically stable genotypes for seed yield which could perform more or less uniformly under different environmental conditions. Seed yield is complex character and largely depends upon its component characters, an interaction with the environment resulting into the ultimate product *i.e*., seed yield. G×E interactions are of major importance to the plant breeder in developing improved varieties. When varieties are compared over a series of environments, the relative rankings usually differ. Therefore, an attempt has been made in the present study to evaluate different kabuli chickpea lines across the season to know the role of G×E interaction and also analyze stability under high temperature of genotypes for different traits. Sustainability in chickpea production in this part of the world can be achieved through the development of heat tolerant, high yielding, stable genotypes possessing wider agro-ecological adaptability (Naveed *et al*., 2016).

MATERIALS AND METHODS

The present investigation was carried out during *Rabi* 2014-15 at JNKVV, Jabalpur (M.P.) to evaluate the 68 indigenous and exotic *kabuli* chickpea lines obtained from JNKVV Jabalpur; IIPR, Kanpur; ICRISAT, Pattancheru and ICARDA, Morocco to evaluate and isolate superior *kabuli* lines in different environments by manipulating different planting dates *i.e*., normal planting (EI -25 Nov 2014), late planting (EII -25 Dec 2014), very late planting (EIII-25 Jan 2015) and Pooled. Experiments were laid out in randomized completely block design with three replications, 45cm row distance using 4m row length including three checks *i.e*., JGK1, JGK2 and KAK2. Standard statistical analysis was employed to generate data for different analysis in accordance with method described by Eberhart and Russell (1966) by using recommended agronomic practices for normal crop growth.

RESULTS AND DISCUSSION

Experimental material responded differently to varying environmental conditions implying that for achieving sustainability inchickpea production; studies pertaining to G×E interactions should be an integral part of chickpea improvement plans. G×E interaction showed the significant differences for DM, BY and SY indicates differential response of the genotype to different planting conditions in close harmony with Singh and Singh (2013), Carreras *et al*. (2013) and Tilihun *et al*. (2015) for DM, BY and SY. The variance due to environment found significant for all the characters

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Table 1: ANOVA for stability analysis.

	SV	DFI	DF 50%	DPI	DM	TP	BY	SY
Rep within Env.	6	0.7	0.7	0.9	3.2***	6.8	6.9	1.4
Varieties	67	393.6***	410.3***	387.2***	65.2***	371.3***	134.5***	39.1***
Env.<(Var.*Env.)	136	16.0***	12.62***	20.2***	72.2***	366.7***	244.4**	34.4***
Environments	2	975.2***	705.2***	1151.7***	4878.4	1691.1***	1166.0**	161.8***
Var.* Env.	134	1.7	2.2	3.3	0.51***	119.8	51.6***	10.9**
Environments(Lin.)	1	1250.5***	410.5***	1303.5***	1756.9***	2820.3***	1331.0***	1023.6***
Var.* Env.(Lin.)	67	1.9.0	1.8	3.6	0.7***	130.5	97.3***	15.5***
Pooled Deviation	68	1.4.0	2719.0***	3129***	0.2	107.5***	5.8	6.2***
Pooled Error	402	0.7	0.6	0.7	0.9	6.0	6.2	0.89
Total	203	140.6	143.9	141.3	69.9	368.2	208.2	36.0

DFI= days to flower initiation, DF 50%= days to 50% flowering, DPI= days to pod initiation, DM= days to maturity, TP= total pods^{-1}, BY= biological yield^{-1} and SY= Seed yield^{-1}.

Table 2: Stability parameters for days to flower initiation, days to 50% flowering, days to pod initiation and days to maturity.

Genotypes	DFI			DF 50%			DPI			DM		
	μ	βi	σ²di	μ	βi	σ²di	μ	βi	σ²di	μ	βi	σ²di
HK 10-124	40.0	1.1	1.13	44.9	1.0	1.35	52.8	1.3	3.7	112.6	1.0	-0.95
HK 10-109	42.4	0.8	-0.51	48.3	0.6	6.80	55.0	1.2	13.5	107.5	1.1	-0.60
NBeG 177	41.3	1.4	-0.04	46.7	1.3	2.30	53.4	1.4	-0.5	110.5	1.0	-0.94
IPCK 2004-29	41.6	1.2	0.22	47.7	1.0	12.6	54.0	1.5	1.80	111.2	1.0	-0.37
IPCK 09-79	42.7	1.4	3.20	47.8	1.4	0.91	55.2	1.7	-0.70	112.8	1.0	0.17
CSJK 46	39.0	1.4	-0.53	43.5	1.3	0.93	49.6	1.1	2.73	125.1	1.1	0.43
PG 071	36.3	1.4	-0.53	42.0	1.5	-0.47	49.4	1.3	-0.42	110.5	0.9	-1.00
GNG 2228	42.8	1.5	1.99	47.5	1.6	-0.43	54.1	1.4	1.11	109.4	1.1	-0.92
IPCK 2010-92	50.6	1.1	14.4	56.2	1.2	31.2	62.0	1.5	-0.08	107.5	1.0	-0.94
GNG 2237	39.5	1.0	-0.42	44.2	1.0	1.35	51.3	1.0	-0.49	106.6	1.0	-1.02
NBeG 402	39.0.0	0.9	-0.69	44.3	1.0	0.65	50.4	0.8	-0.57	106.0	1.1	0.68
IPCK 2009-145	51.7	1.4	7.80	57.6	1.5	15.4	64.7	2.0	3.69	110.0	1.0	-1.02
Phule G 0625-6	38.5	1.2	-0.24	43.4	1.3	3.21	50.5	1.0	2.21	110.3	1.0	-1.02
BGD 128	35.0	1.4	-0.04	40.4	1.3	0.20	46.6	1.3	-0.18	107.3	1.0	-1.02
Phule G 0625-9	36.8	1.3	-0.54	42.1	1.3	-0.60	49.0	1.3	0.71	106.3	1.0	-1.02
BDNGK 807	37.2	1.0	-0.65	42.1	0.7	-0.65	49.1	1.1	5.51	108.2	1.1	-0.67
CSJK 4	37.0	0.9	-0.52	41.3	0.8	0.90	49.0	0.9	3.65	108.6	1.1	-0.78
NBeG 176	39.8	1.0	1.43	44.5	0.9	4.56	52.3	1.0	-0.49	108.6	1.0	-1.02
CSJK 77	37.4	1.2	0.18	42.3	0.9	1.83	49.0	1.0	-0.74	107.0	1.0	-0.88
HK 10-103	36.4	1.1	-0.30	41.2	1.0	0.30	47.7	0.8	1.02	113.0	1.0	-1.02
HK 09-211	39.3	0.9	-0.52	44.6	1.1	0.53	50.1	0.5	5.79	111.0	1.0	-1.02
PG 95311	35.5	1.1	0.99	40.7	1.0	0.91	46.2	0.5	7.22	109.4	1.1	-0.79
PKV 4	36.4	1.2	0.18	41.8	1.3	7.69	48.0	0.8	8.89	114.2	1.1	-0.98
IPCK 2002-29	38.5	0.8	1.45	43.5	0.8	2.96	50.2	0.6	-0.73	115.3	1.0	-1.02
Phule G 0517	35.6	1.1	1.13	40.3	0.9	0.77	47.0	0.7	-0.23	110.8	1.0	-0.89
IPCK 2004-29-1	37.0	1.0	0.74	42.3	0.8	-0.53	49.4	1.1	1.81	110.6	1.0	-1.02
ICCV13301	35.6	0.9	0.10	40.1	0.6	1.48	45.8	0.3	-0.45	111.0	1.0	-1.02
ICCV13310	40.2	1.0	-0.21	45.1	1.0	0.67	50.7	0.9	-0.65	110.3	1.0	-1.02
ICCV13306	40.1	0.8	-0.69	45.4	0.8	0.44	52.6	1.1	0.40	108.7	1.1	-0.92
ICCV13313	39.5	1.2	0.67	44.7	1.1	-0.69	51.7	1.4	-0.55	110.3	1.0	-1.02
ICCV13302	36.5	1.2	0.27	41.7	1.0	-0.56	49.0	1.2	1.91	110.3	1.0	-0.34
ICCV13303	39.5	1.1	-0.40	45.2	1.2	-0.68	50.6	0.9	3.63	111.6	1.0	-1.02
ICCV13311	37.1	1.0	-0.08	43	0.8	-0.53	49.2	0.9	-0.64	109.3	1.0	-0.21
ICCV13307	41.5	1.2	-0.20	46.3	1.2	-0.65	52.7	0.9	-0.31	108.5	1.0	-1.00

Table 2: Continue...

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ICCV13312	38.7	1.4	0.16	44.4	1.5	-0.30	51.0	1.2	2.37	109.0	1.0	-0.81
ICCV13314	38.8	1.3	-0.54	44.2	1.3	-0.53	50.7	1.2	-0.29	114.3	1.0	-1.02
ICCV13308	37.8	1.0	6.55	43.4	1.0	5.61	49.4	0.5	5.79	109.3	1.0	-1.02
ICCV13318	41.5	1.2	1.41	46.7	1.0	3.63	52.8	0.8	1.79	109.3	1.0	-1.02
ICCV13309	43.3	1.2	-0.70	48.6	1.0	0.12	55.1	1.2	0.09	109.0	1.0	-1.02
ICCV13304	40.6	1.0	2.08	45.8	0.7	-0.57	51.4	0.5	2.36	107.1	1.0	-0.62
ICCV13316	40.3	0.9	-0.70	46.3	0.8	-0.06	53.2	1.4	5.82	107.0	1.1	-1.02
ICCV13305	56.3	0.6	2.65	61.8	0.4	1.02	68.7	0.8	3.53	107.2	1.0	-0.76
ICCV13315	38.8	1.2	0.27	43.8	1.1	4.09	50.8	1.0	-0.52	106.7	1.0	-0.99
ICCV13317	36.3	1.2	-0.17	42.2	1.6	3.03	47.7	0.7	21.5	106.6	1.0	-1.02
FLIP-07-9C	69.2	0.7	4.28	75.1	1.1	0.80	80.1	0.8	2.05	113.6	1.0	-1.02
FLIP-07-236C	70.7	0.6	-0.36	77.0	0.8	2.06	82.5	0.7	-0.11	111.7	1.0	-1.01
FLIP-07-257C	72.0	0.9	5.53	77.7	1.0	7.39	82.6	0.9	-0.03	111.4	1.0	-0.65
FLIP-07-259C	70.8	0.8	0.63	76.6	1.0	2.23	82.3	0.9	0.94	108.6	1.0	-0.88
FLIP-07-283C	72.7	0.7	-0.15	79.0	1.0	2.23	84.0	0.7	-0.23	112.3	0.9	-0.72
FLIP-07-286C	68.2	0.6	-0.55	74.3	0.8	-0.06	79.5	0.6	-0.43	114.1	1.0	0.98
FLIP-07-306C	65.8	0.7	0.29	72.2	1.1	-0.23	79.0	1.3	0.14	111.0	1.1	-0.14
FLIP-07-312C	71.8	0.5	0.66	77.0	0.6	0.18	83.0	0.3	3.95	111.0	1.1	-0.28
FLIP-08-105C	69.3	0.7	-0.08	74.8	1.0	-0.31	80.1	0.7	9.08	110.4	1.0	-1.00
JGK4	38.2	1.3	-0.54	43.2	1.3	-0.69	50.2	1.3	-0.74	102.3	1.0	-1.02
JGK18	36.2	0.4	-0.57	41.2	0.1	2.68	47.2	0.6	12.4	100.0	1.0	-1.02
JGK 24	37.8	1.1	-0.56	42.4	1.1	2.02	49.5	1.0	-0.52	98.1	0.9	-1.02
JGK 25	38.7	1.3	-0.60	43.7	1.3	1.69	50.4	1.1	1.06	104.4	0.9	-0.84
JGK 26	39.0	0.8	1.76	43.6	0.7	0.69	50.3	1.2	5.13	99.0	1.0	-1.02
JGK 27	34.8	0.8	-0.41	39.7	0.6	-0.67	46.7	0.8	5.60	102.6	1.0	-1.02
KRIPA	37.6	1.0	0.21	42.5	1.1	-0.67	48.7	1.0	-0.44	107.6	1.0	-1.02
JGK12	39.6	0.6	0.42	44.6	0.5	0.28	51.6	0.8	4.69	97.0	1.0	-1.02
JGK14	38.8	1.1	2.48	43.7	1.2	0.93	50.5	1.3	-0.58	96.6	0.7	-1.00
FLIP-01-29C	64.6	1.1	-0.36	70.6	0.9	5.66	77.4	1.3	4.90	107.3	1.0	-1.02
JGK 23	37.1	0.8	-0.51	42.8	0.9	0.32	49.5	1.2	1.33	99.8	0.9	-0.95
JGK1	37.1	0.9	-0.62	42.8	1.4	1.87	49.5	0.9	4.45	102.7	0.7	-0.84
JGK 2	37.6	0.8	-0.29	43.0	0.8	0.00	49.7	1.1	0.83	106.2	1.0	-0.76
JGK 3	36.8	0.8	0.30	42.8	0.6	-0.51	49.5	1.0	3.78	104.3	1.0	-0.81
KAK 2	33.2	0.5	-0.21	40.4	1	-0.48	47.5	1.3	0.71	102.2	0.8	-0.30
Population mean	**43.7**			**49**			**55.5**			**108.4**		

except DM however, environment linear was observed significant for all the characters**.** (Table 1) G×E (linear) showed the significant differences for DM,DF 50%, BY and SY suggested that prediction for these attributes would be perfect, these results supporting the earlier findings of Tilihun *et al*. (2015), Kanouni *et al*. (2015) and Tilihun *et al*. (2015). However, pooled deviation was found to be significant for DI, TP and SY.

Through comprehensive observations; genotypes *viz*., PhuleG 0517 (DM and TP), ICCV13312 (SY), FLIP-07-236C (DFI and DPI), FLIP-07-283C (DFI, DPI and DM), FLIP-07-286C (DFI, DF50%, DPI and DM), JGK25 (TP) and JGK26 (SY) exhibited stable performance for these traits (Table 2 and 3). Hence, these promising genotypes may be grown under wide range of environments particularly in tolerance to terminal heat.

SY was found high innormal, late and very late planting in genotypes ICCV13312, ICCV13314, JGK 26, JGK 27, JGK12, JGK14, JGK 23, JGK1, JGK2, JGK3 and KAK 2.

Twenty two genotypes *viz*; JGK12, JGK 1, ICCV13312, ICCV 13317, ICCV13314, JGK 26, JGK2, JGK25, JGK3, KAK2, ICCV13316, NBeG 402, NBeG 176, JGK14, ICCV 13310, JGK 23, JGK 27, HK 10-124, FLIP-01-29C, IPCK 2004-29-1, CSJK 46 and ICCV13301 were identified on better seed yield under late planting. (Table 3).

Similarly, 23 genotypes KAK2, ICCV13309, ICCV13311, ICCV13312, ICCV13304, JGK12, ICCV13314, CSJK 46, ICCV13302, ICCV13307, JGK18, JGK 23, JGK2, JGK14, JGK1, ICCV13317, ICCV13318, HK10-103, JGK26, JGK3, CSJK77, JGK27 and Phule G051 were high yielding lines in very late planting conditions.

The timing of flowering and days to maturity is accelerated under heat stress, thus shortening the duration of crop development and reducing seed yield. The entries

Table 3: Stability parameters for total number of pods per plant, biological yield per plant and seed yield per plant.

Genotypes	TP			BY			SY		
	μ	βi	σ²di	μ	βi	σ²di	μ	βi	σ²di
HK 10-124	34.0	0.6	565.6	27.0	0.2	5.7	9.5	0.9	17.8
HK 10-109	31.9	0.8	42.9	29.0	0.1	10.3	8.4	1.3	-0.9
NBeG 177	28.5	1.1	34.0	36.8	0.4	0.7	8.9	0.9	8.0
IPCK 2004-29	58.0	1.4	-0.2	48.9	1.4	1.5	11.8	1.4	1.8
IPCK 09-79	33.5	1.1	51.5	34.4	0.9	-6.2	8.3	1.0	8.7
CSJK 46	38.9	0.3	41.1	40.0	0.2	5.6	11.9	0.2	2.7
PG 071	30.6	0.4	131.7	31.3	1.1	-4.8	10	1.2	3.9
GNG 2228	32.3	1.2	112.2	32.1	0.9	-6.2	8.2	1.0	-0.6
IPCK 2010-92	37.0	1.1	13.7	30.1	1.2	-3.8	10.2	0.8	1.7
GNG 2237	30.2	0.9	2.5	32.6	0.7	-5.4	7.1	1.0	-0.9
NBeG 402	34.6	0.2	95.4	37.8	1.6	9.1	8.7	0.3	18.8
IPCK 2009-145	37.9	1.6	324.9	32.2	1.0	-6.1	10.5	2.2	-0.8
Phule G 0625-6	26.3	0.4	184.3	28.2	0.8	-5.8	6.1	0.6	12.9
BGD 128	28.2	1.1	-0.7	27.3	0.2	6.7	8.0	1.0	5.5
Phule G 0625-9	23.3	0.1	152.5	32.5	0.1	10.8	5.2	-0.2	10.3
BDNGK 807	23.2	0.3	136.9	26.1	0.3	1.3	7.8	0.6	7.4
CSJK 4	50.1	1.6	11.6	44.5	1.7	-3.9	12.4	1.8	-0.7
NBeG 176	41.4	1.8	410.5	41.2	1.6	6.9	11.8	1.7	19.1
CSJK 77	52.2	2.0	262.9	41.1	1.2	-2.8	10.8	1.1	10.9
HK 10-103	47.3	1.2	322.9	41.9	0.6	-4.6	11.4	1.2	22.4
HK 09-211	37.1	1.2	-3.9	31.8	0.6	-3.6	8.3	1.1	0.6
PG 95311	35.9	1.1	63.9	29.1	0.9	-6.1	7.8	1.0	1.6
PKV 4	32.7	1.2	-5.8	33.6	0.9	-6.2	10.4	2.1	0.1
IPCK 2002-29	50.4	1.6	1.6	37.4	1.8	14.8	12.3	1.6	1.0
Phule G 0517	40.9	0.4	-3.3	27.7	0.6	-3.8	9.0	0.1	1.0
IPCK 2004-29-1	48.3	1.6	16.2	40.5	0.9	-6.2	12.9	1.6	2.1
ICCV13301	36.0	0.5	10.2	32.9	0.4	0.9	11.0	0.9	1.4
ICCV13310	45.9	0.7	27.1	36.1	0.9	10.2	12.6	1.1	0.4
ICCV13306	40.9	1.5	133	35.2	1.1	-5.2	12.0	1.7	0.6
ICCV13313	36.8	0.8	11.5	30.8	0.5	7.4	10.6	1.0	-0.9
ICCV13302	49.2	1.2	80.2	36.6	1.1	-4.5	14.1	1.5	16.0
ICCV13303	39.5	1.5	35.0	34.3	1.1	-5.9	10.7	1.8	3.4
ICCV13311	41.6	1.1	224.3	33.7	0.9	-6.2	13.7	1.0	31.3
ICCV13307	48.3	1.1	379.3	32.1	1.0	-5.9	11.4	0.7	19.8
ICCV13312	53.7	0.6	16.5	33	0.8	-2.6	15.8	0.5	-0.9
ICCV13314	55.8	0.8	7.5	40.8	1.3	-1.9	16.5	1.2	-0.9
ICCV13308	32.9	0.2	16.1	24	0.2	10.5	9.7	0.9	3.5
ICCV13318	52.8	1.7	203.7	45.2	1.8	-2.9	13.8	1.5	7.3
ICCV13309	49.8	1.1	170.8	41.8	1.6	9.4	13.6	0.9	43.4
ICCV13304	37.7	1.0	255	28.4	0.6	-4.8	14.6	1.2	19.6
ICCV13316	39.0	0.8	234.9	35.9	1.2	-3.4	11.6	0.9	5.2
ICCV13305	23.9	0.5	18.7	24.8	0.4	-4.7	6.4	-0.1	5.2
ICCV13315	36.4	0.3	-4.6	29.5	0.6	-3.5	9.8	0.1	5.6
ICCV13317	45.3	1.3	90.4	29.7	0.9	-5.8	12.7	0.1	1.7
FLIP-07-9C	24.7	1.5	54.3	48.8	1.3	-0.2	4.6	0.6	-0.2
FLIP-07-236C	27.1	1.5	81.9	29.2	0.8	-6.2	7.0	1.1	0.4
FLIP-07-257C	31.6	2.0	110.1	47.7	1.7	-3.4	5.8	0.9	-0.9
FLIP-07-259C	17.4	0.5	-1.5	38.1	1.2	-6.2	5.4	0.3	-0.6
FLIP-07-283C	18.2	0.6	-4.7	28.9	0.7	-2.8	4.5	0.4	0.1

Table 3: Continue...

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FLIP-07-286C	19.9	0.9	60.8	32.5	0.7	-5.8	5.1	0.6	2.4
FLIP-07-306C	34.2	1.9	272.6	35.2	1.3	-1.7	3.9	0.2	0.3
FLIP-07-312C	31.7	1.5	205.8	44.4	1.8	-3.3	6.5	0.9	-0.9
FLIP-08-105C	19.6	0.4	134.6	38.2	1.3	-0.2	5.5	0.4	7.6
JGK4	23.9	0.5	-1.5	30.0	0.8	-5.9	6.1	0.6	-0.8
JGK18	36.8	0.8	206.8	37.7	1.2	-4.0	12.3	1.1	20.3
JGK 24	44.6	1.5	0.1	40.8	1.8	-1.1	14.2	1.9	-0.9
JGK 25	50.5	0.6	-4.6	36.0	1.3	-0.7	12.4	0.9	4.1
JGK 26	56.1	0.8	11.2	27.6	0.9	-6.2	14.2	0.8	0.5
JGK 27	58.3	1.3	-5.6	46.4	1.7	-4.2	17.4	2.6	-0.6
KRIPA	27.7	0.3	76.8	41.9	1.2	-3.1	9.5	-0.1	2.3
JGK12	59.8	1.3	15.9	47.3	1.9	5.7	17.5	1.3	-0.7
JGK14	44.4	0.9	209.4	50.2	1.5	-3.7	14.3	1.1	0.3
FLIP-01-29C	38.0	0.7	13.3	39.6	1.1	10.2	10.6	0.6	0.9
JGK 23	53.0	2.1	95.4	49.6	2.3	48.2	16.4	1.9	1.6
JGK1	52.0	0.3	5.2	29.6	0.5	-2.9	16.7	1.3	1.2
JGK 2	47.6	0.7	39.5	40.3	1.1	1.6	16.0	1.4	-0.9
JGK 3	48.5	1.3	203.3	37.3	1.2	-5.0	16.0	1.7	-0.9
KAK 2	59.0	1.7	244.8	28.3	0.6	-6.1	17.5	1.4	11.1
Population mean	**39.1**			**35.7**			**10.8**		

HK10-109, IPCK2009-145,CSJK4, PKV4, ICCV13306, ICCV13303, JGK 24, JGK 23, JGK3 were found most promising lines in case of minimum yield reduction in all normal, late and very late planting dates.

CONCLUSION

Promising lines *viz*., CSJK46, PhuleG 0517, ICCV13310, ICCV13312, FLIP-07-236C, FLIP-07-283C, FLIP-07-286C, JGK1, JGK 25 and JGK26 found stable for most of the characters. Hence, these genotypes may be grown under wide range of environments including high temperature condition in late planting dates. Lines ICCV13312 and JGK26 found highly stable with mean values greater than grand mean and regression coefficient lesser than one with deviation from regression minimum. The entries HK 10-109, IPCK 2009-145, CSJK 4, PKV 4, ICCV13306, ICCV13303, JGK24, JGK23 and JGK3 found most promising lines in case of minimum yield reduction in all planting dates.These promising lines should be evaluated over years and locations to obtain the clear cut picture of yield and its contributing traits under heat stress environment for sustained chickpea production.

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