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Research Article

Genetic variability and stability of *Desi* chickpea (*Cicer arietinum* L.) genotypes under late sown terminal heat stress conditions

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Abstract
Given the global climate change and frequent episodes of high temperature, globally legume crops including chickpea are receiving serious challenge of yield loss across the globe. Therefore, to sustain chickpea production breeders exploiting existing germplasm resources which can withstand drastically happening and fluctuating abiotic stresses like terminal heat and draught. A wide range of genetic variability for various phenological traits and yield related traits were recorded in 71 chickpea genotypes during normal and late or terminal heat stress sown conditions. The analysis of variance for all the environments revealed highly significant differences among the mean square due to genotypes for all the characters. The range of variation was comparatively wider in late sown condition than in normal sown conditions. The differences between phenotypic and genotypic coefficient of variation (PCV and GCV) were not substantial. High heritability coupled with high/moderate genetic advance expressed as percentage of mean were exhibited by hundred seed weight, seed yield/plant, number of pods/plants, plant height, reproductive phase duration, number of primary branches/plant and days to 50 % flowering under normal as well as late planting. So, these traits can be used as selection indices to improve seed yield in high temperature sown condition as well as timely sown condition. The pooled analysis of variance over dates of sowing (environments) were computed following Eberhart and Russell (1966) model. Genotype x environment interactions was highly significant for most of the characters except no. of primary branches/plant when tested against error mean square. G x E (linear) component was significant and higher than non-linear component for days to 50 % flowering, days to maturity, number of pods/plants, hundred seed weight and seed yield per plant. From the present study, five genotypes *viz*., ICC 14778, GJG 6, ICC 6579, ICC 8950 and ICC 10945 were highly stable for seed yield across the environments.

Keywords: Chickpea, Terminal heat stress, Dates of sowing, Stability, Variability

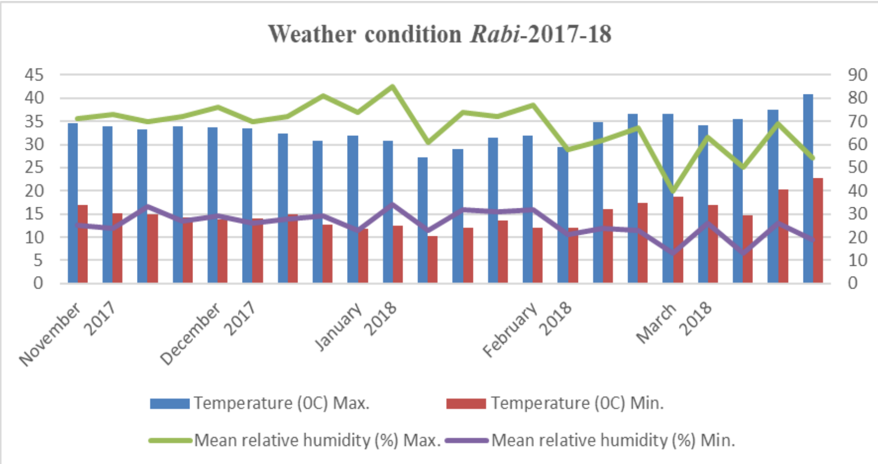
INTRODUCTION

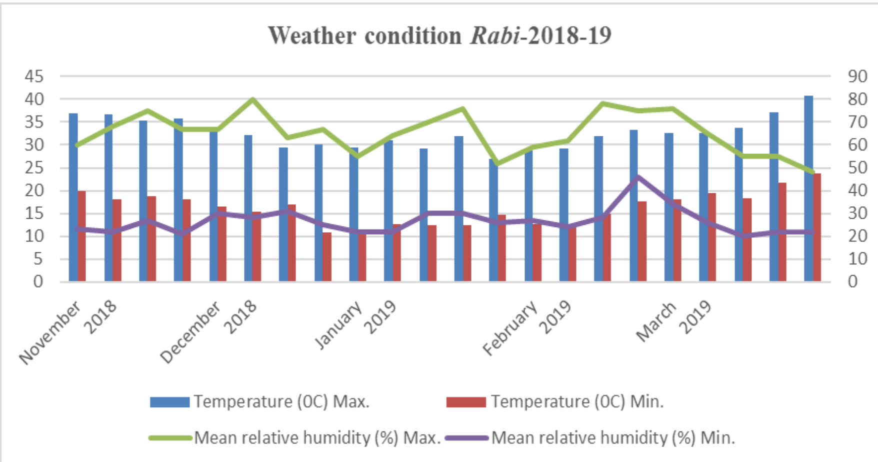
The grain legumes or pulses constitute the backbone of Indian Agriculture because of their unique ability to grow well under low fertility and low moisture conditions and low requirement of costly inputs as compared to cereals. Pulses are considered as soil ameliorant in view of their unique ability of fixing atmospheric nitrogen through activities of *Rhizobia*. Being nutritionally complementary to cereals in their pattern and profile of amino acids, legumes play an important role in human diet. They supply valuable sources of vegetable proteins to supplement the cereals based diet of the people of the developing countries. Chickpea is the third most important pulse crop in the world, after dry beans and field peas. It is grown mainly in the arid and semi-arid regions of the world.

According to ICAR-IIPR (2022), During 2021-22, India cultivated chickpea on 10. 91 million ha. and produced 13.75 million tonnes. Even after self-sufficiency in pulses and a global production share of 73.46%, the country imported 12.51% and ranked second. While in export ranked fifth that led global chickpeas market grew from $13.93 billion in 2022 to $14.9 billion in 2023 at a compound annual growth rate (CAGR) of 7.0%. The low yields have been attributed to several factors among which include low genetic diversity of cultivated chickpea and several biotic and abiotic stresses (Gaur *et al*., 2012). The chickpea area under late-sown conditions is increasing where prevailing temperature remains high at reproductive and grain filling stages of the crop, particularly in northern and central India, due to inclusion of chickpea in new cropping systems and intense sequential cropping practices. Therefore, to sustain the global chickpea productivity under high temperature (HT), a comprehensive assessment of existing genetic variability under HT for selecting superior HT tolerant chickpea genotype with higher yield potential under prevailing HT condition is urgently needed. Hence, to select stable heat tolerant chickpea genotype, we assessed the genetic variability and stability of seed yield and its eight component traits aiming at selection of superior chickpea genotypes under terminal heat stress/ late sown conditions.

MATERIALS AND METHODS

Experimental conditions and plant materials: The experimental materials consisted of total 71 genotypes (65 genotypes + 5 locally/nationally released varieties) obtained from ICRISAT, Hyderabad, Telangana and Pulses Research Station (PRS), J.A.U, Junagadh, Gujarat. These cultivars were evaluated in *Rabi*-2017-18 and 2018-19 under two dates of sowing, normal (5th and 1st November) and late sown (3rd and 2nd December) terminal heat stress conditions at PRS, J.A.U., Junagadh using field experimental design RBD with three replications. Late sowing was delayed in field to force genotypes to go through heat stress, where temperature was >30 ℃ at reproductive stage and grain filling the important growth stage of the crop **(Fig. 1&2)**.





Observations recorded: The genotypes were sown in single row of 4 m per replication following the recommended spacing of 45 cm x 10 cm. The observations were recorded on total nine plant characters for the randomly selected five plants per replication per date of sowing. The phenological characters (days to 50%flowering, days to maturity and reproductive phase duration) were observed on plot basis and morphological traits (plant height, no. of primary branches/plant, no. of pods/plants, hundred seed weight, seed yield/plant and SPAD value) were recorded by following the PPV&FRA, (2007) guidelines.

Statistical procedure adopted: The analysis of variance for different characters was carried out by following Panse and Sukhatme (1985). Heritability in the broad sense was derived based on the formula given by Allard (1960). Genetic advance expressed as per cent of mean (GAM) was obtained by the formula prescribed by Johnson *et al*. (1955). The method adopted by Burton and De Vane (1953) was used to calculate phenotypic (PCV) and genotypic coefficient of variation (GCV). Mean data obtained was statistically analyzed and the cultivars were assessed for their stability of performance across environments following the method described by Eberhart and Russell (1966).

RESULTS AND DISCUSSION

Analysis of variance (ANOVA): **(Table 1A & 1B)** There were highly significant differences in the mean square values of all the characters studied in normal and late sown conditions **(Table 1A & 1B)** indicating presence of high genetic variability among the genetic material tested in the experiment suggesting ample scope of exploiting such variability through selection. These findings were supported by many workers like Paneliya *et al*. (2017&2018), Chetariya *et al*. (2019), Kushwah *et al*. (2021) and Hemareddy *et al*. (2023).

Genetic variability parameters **(Table 2A & 2B):** Coefficient of Range: The high coefficient of range indicated wide range of variation in the material under studied. Comparatively the stress sown conditions showed wide range of variation which is indication of existence of stress tolerant genotypes in the material under study.

Table 1A. Analysis of variance showing mean squares for various characters in 71 genotypes of chickpea under normal (E_1) and high temperature/late sown (E_2) conditions during *Rabi*-2017-18 (Y-I).

		Mean squares								
Source	**d. f.**	**DFF**	**DM**	**RPFD**	**PH**	**NPBP**	**NPP**	**HSW**	**SYP**	**SPAD**
					Normal sown (E_1)					
Replications	2	26.2019	17.7605	12.0751	19.9207	0.0154	0.3640	0.7028	0.0051	6.7318
Genotypes	70	64.5121**	69.1388**	88.0272**	88.6913**	0.3273**	171.4931**	52.8848**	5.6979**	17.3926**
Error	40	5.3161	7.3605	11.8608	7.6093	0.0841	8.8812	0.9577	0.4023	3.8521
					Late sown (E_2)					
Replications	2	12.0610	1.1409	12.5681	124.0473**	0.6280**	2.9566	1.1453	0.1831	41.1237**
Genotypes	70	43.6238**	53.5139**	46.0684**	82.3876**	0.3821**	153.7469**	48.1852**	7.5573**	23.3359**
Error	40	6.0944	8.0980	11.7443	5.1491	0.0781	7.8121	0.7929	0.2872	6.1090

Table 1B. Analysis of variance showing mean squares for various characters in 71 genotypes of chickpea under normal (E_3) and high temperature/late sown (E_4) conditions during *Rabi*-2018-19 (Y-II).

Source	**d. f.**	**DFF**	**DM**	**RPFD**	**PH**	**NPBP**	**NPP**	**HSW**	**SYP**	**SPAD**
					Normal sown (E_3)					
Replications	2	45.9765**	6.4836	86.3709**	53.9619**	0.2627	2.0982	0.6051*	0.0868	8.0652*
Genotypes	70	163.4771**	43.8622**	108.0708**	88.3554**	0.2904**	346.4148**	59.6531**	14.9581**	36.3962**
Error	140	9.0765	7.8550	14.7185	8.7914	0.0943	10.1559	0.1508	0.5546	2.3006
					Late sown (E_4)					
Replications	2	2.7606	9.8920	5.1596	0.6361	0.1087	2.6777	0.6194	0.8584	59.6973**
Genotypes	70	30.5034**	17.9321**	76.5140**	93.0110**	0.2877**	241.1434**	58.2636**	15.2470**	31.7707**
Error	140	2.4463	2.7301	4.6549	10.2780	0.1007	10.1181	0.2433	0.4232	2.9721

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

DFF= Days to 50 % flowering, DM=Days to maturity, RPFD=Reproductive phase duration, PH=Plant Height(cm), NPBP=No. of primary branches per plant, NPP-No. of pods per plant, HSW= Hundred seeds weight (g), SYP= Seed yield per plant, SPAD=SPAD value.

Table 2A. Range of variation, coefficient of range, mean ± S.Em and different genetic parameters for various characters in 71 genotypes of chickpea under normal sown (E_1) and high temperature (E_2)/ late sown conditions during *Rabi*-2017-18

Character	Date of sowing	Range	Coefficient of range (%)	Mean ± S.Em	Genotypic coefficient of variation (%)	Phenotypic coefficient of variation (%)	Heritability (Broad Sense) (%)	Genetic advance	Genetic advance expressed as percent of mean
Days to 50 per cent flowering	E_1	43.67-63.00	18.12	52.89 ± 1.33	8.40	8.80	91.76	8.77	16.57
	E_2	42.33-61.00	18.07	52.67 ± 1.43	6.71	7.24	86.03	6.76	12.83
Days to maturity	E_1	94.67-115.00	9.70	103.72 ± 1.57	4.38	4.63	89.35	8.84	8.52
	E_2	77.00-95.00	10.47	87.58 ± 1.64	4.44	4.82	84.87	7.38	8.43
Reproductive phase duration	E_1	39.33-64.00	23.87	50.83 ± 1.99	9.91	10.66	86.53	9.66	19.00
	E_2	24.00-46.67	32.08	34.91 ± 1.98	9.69	11.23	74.51	6.01	17.23
Plant height (cm)	E_1	33.20-59.40	28.29	45.47 ± 1.59	11.43	11.96	91.42	10.24	22.52
	E_2	28.87-57.00	32.76	38.69 ± 1.31	13.12	13.55	93.75	10.12	26.16
No. of primary branches per plant	E_1	1.67-3.27	32.39	2.52 ± 0.17	11.28	13.09	74.31	0.51	20.03
	E_2	1.33-2.80	35.59	2.05 ± 0.16	15.51	17.39	79.57	0.58	28.50
No. of pods per plant	E_1	32.87-69.30	35.66	48.43 ± 1.72	15.20	15.61	94.82	14.77	30.50
	E_2	22.47-59.00	44.84	35.56 ± 1.61	19.61	20.13	94.92	14.00	39.36
Hundred seed weight (g)	E_1	11.39-35.37	51.28	17.15 ± 0.57	24.26	24.49	98.19	8.49	49.53
	E_2	10.07-32.83	53.05	15.52 ± 0.51	25.61	25.82	98.35	8.12	52.32
Seed yield per plant (g)	E_1	4.87-12.29	43.24	7.92 ± 0.37	16.77	17.40	92.94	2.64	33.30
	E_2	3.15-11.29	56.37	5.45 ± 0.31	28.59	29.15	96.20	3.15	57.77
SPAD value	E_1	55.83-68.17	9.95	63.38 ± 1.13	3.35	3.80	77.85	3.86	6.09
	E_2	52.10-69.10	14.03	61.28 ± 1.43	3.91	4.55	73.82	4.24	6.92

Table 2B. Range of variation, coefficient of range, mean ± S.Em and different genetic parameters for various characters in 71 genotypes of chickpea under normal sown (E_3) and high temperature (E_4)/ late sown conditions during *Rabi*-2018-19

Character	Date of sowing	Range	Coefficient of range (%)	Mean ± S.Em	Genotypic coefficient of variation (%)	Phenotypic coefficient of variation (%)	Heritability (Broad Sense) (%)	Genetic advance	Genetic advance expressed as percent of mean
Days to 50 per cent flowering	E_3	43.67-77.67	28.02	54.22 ± 1.74	13.23	13.62	94.45	14.36	26.49
	E_4	40.00-73.33	29.41	56.49 ± 0.90	11.57	11.68	98.13	13.33	23.60
Days to maturity	E_3	97.67-116.33	8.72	109.87 ± 1.62	3.15	3.48	82.09	6.47	5.88
	E_4	92.33-104.00	5.94	98.84 ± 0.95	2.28	2.47	84.78	4.27	4.32
Reproductive phase duration	E_3	37.33-67.00	28.44	55.65 ± 2.22	10.02	10.79	86.38	10.68	19.19
	E_4	28.00-53.00	30.86	42.34 ± 1.25	11.56	11.93	93.92	9.77	23.08
Plant height (cm)	E_3	36.47-62.73	26.47	45.60 ± 1.71	11.29	11.90	90.05	10.07	22.08
	E_4	33.33-58.60	27.49	43.21 ± 1.85	12.15	12.88	88.95	10.20	23.61
No. of primary branches per plant	E_3	2.07-3.47	25.27	2.66 ± 0.18	9.62	11.71	67.51	0.43	16.28
	E_4	2.00-3.60	28.57	2.64 ± 0.18	9.45	11.72	64.99	0.42	15.69
No. of pods per plant	E_3	38.80-87.47	38.54	67.70 ± 1.84	15.62	15.86	97.07	21.49	31.71
	E_4	33.13-77.07	39.87	52.29 ± 1.84	16.78	17.15	95.80	17.69	33.84
Hundred seed weight (g)	E_3	10.09-35.20	55.44	15.70 ± 0.22	28.37	28.40	99.75	9.16	58.36
	E_4	8.17-33.02	60.33	14.14 ± 0.28	31.09	31.16	99.58	9.04	63.91
Seed yield per plant (g)	E_3	6.65-16.60	42.80	11.11 ± 0.43	19.72	20.09	96.29	4.43	39.86
	E_4	4.11-15.16	57.34	8.16 ± 0.38	27.24	27.62	97.22	4.52	55.32
SPAD value	E_3	54.69-70.25	12.45	62.26 ± 0.86	5.41	5.59	93.68	6.72	10.80
	E_4	54.73-71.16	13.05	64.03 ± 0.99	4.84	5.08	90.65	6.08	9.49

Note: GCV, PCV, GAM ; 0-10 - Low; 10-20 - Medium; > 20 - High; h^2 ; 0-30 - Low; 30-60 - Medium; > 60 – High

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Similar findings were also reported by Barad *et al*. (2018), Paul *et al*. (2018), Chetariya *et al*. (2019), Kushwah *et al*. (2021) and Thapa *et al*. (2022). Wide range of variation was registered by 100-seed weight, seed yield per plant and number of pods per plant, while characters *viz*., reproductive phase duration, plant height and number of primary branches per plant also showed moderate phenotypic range under both the sowing conditions. Characters with the wider range of variation had better scope for selection

Mean and range: All the characters particularly seed yield and its components were found to be affected in late sowing due to prevailing high temperatures. The population mean value in E_1 and E_3 (normal) and E_2 and E_4 (terminal heat/late) indicated tremendous decrease in seed yield and its components in late sowing **(Table 2A & 2B)**. In comparison of means values of phenological and morphological characters studied under normal and late sown condition, none of the trait had higher mean values in stress sown condition. However, duration of maturity noticed was less under late sown due to prevailing high temperature which induced forced maturity. It indicates that genotypes complete their reproductive phase at a faster speed in late sown. and higher temperature forces the genotypes to complete their life cycle early (Yucel,2018).

Genotypic and phenotypic coefficient of variation (GCV&PCV): The values of PCV were higher for all the traits studied in all the environments which indicates the influence of environment **(Table 2A & 2B)**. Nevertheless, the differences between PCV and GCV were not substantial. When these differences were narrow, it indicates the characters were comparatively stable to the environment. Similar results in chickpea were obtained by Tiwari *et al*. (2022), Desai *et al*. (2017) and Chetariya *et al*. (2019). This also suggested that genetic factor was predominantly responsible for the expression of these attributes and selection could be effectively made on the basis of phenotypic performance.

Under normal sown conditions (E_1 and E_3), high/moderate estimates of PCV and GCV were observed for hundred seed weight, seed yield/plant, no. of pods/plants, plant height and no. of primary branches/plants. Days to 50 % flowering and reproductive phase duration were also had moderate magnitude under second year of normal sowing (E_3). These results were similar to earlier findings for seed yield/plant (Mathew *et al*., 2017; Mohammed *et al*., 2019), seed weight (Bhavani *et al*., 2009 and Bapurao *et al*., 2019), plant height (Nizama *et al*., 2013), no. of pods/plant and no. of primary branches/plant (Sonwani *et al*., 2017).

Under late sown conditions (E_2 and E_4), hundred seed weight, seed yield/plant, no. of pods/plant, plant height, no. primary branches/plant and reproductive phase duration had high magnitude of PCV and GCV. Days to 50 % flowering had moderate magnitude under late sown condition of second year (E_4). While remaining all the characters were low in magnitude of PCV and GCV under all the environments. High to moderate estimates of phenotypic and genotypic coefficient of variation in chickpea grown under late sown (stress/high temperature) condition have been reported for hundred seed weight and seed yield/plant (Kuldeep *et al*., 2014; Babbar *et al*., 2015; Kumar *et al*., 2017a and Kumar *et al*., 2017b); no. of pods/plants, plant height and no. of primary branches/plant (Tiwari *et al*., 2016) and reproductive phase duration (Alemayehu, 2017).

In general, hundred seed weight, seed yield/plant, number of pods/plants, plant height, no. of primary branches/plant and reproductive phase duration possessed high to moderate magnitude of PCV and GCV under both the normal and late sown conditions.

Heritability: Under both the sowing conditions, high estimates of heritability were observed for all the characters studied. Particularly, two important yield components of chickpea, hundred seed weight and number of pods/plants had highest heritability values in all environments. These results were in agreement with those of Desai *et al*. (2017), Paul *et al*. (2018) and Chetariya *et al*. (2019). It was notable that heritability of all the traits under study was stable under both the sowing condition. This magnitude of heritability indicated true expression of phenotypes is due to their respective genotypes only irrespective of environment and stress.

Genetic Advance: High values of genetic advance expressed as per cent of mean was exhibited by seed yield/plant, hundred seed weight, no. of pods/plant and plant height under normal planting (E_1 and E_3). It was also found to be high for no. of primary branches/plant in E_1, while it was moderate in case of E_3. Days to 50 % flowering in E_3 had high magnitude, while it was found moderate in E_1. While under late planting, high estimate for this parameter was found for seed yield/plant, hundred seed weight, no. of pods/plants and plant height. It was also estimated high for no. of primary branches/plant in E_2, while it was moderate in E_4.

Overall, moderate to high value of heritability accompanied by moderate /high genetic advance as per cent of mean was expressed by no. of pods/plant, hundred seed weight, seed yield/plant, plant height and days to 50 % flowering. Moderate to high estimates of heritability with low genetic advance as percentage of mean were observed for SPAD value and days to maturity for all the environments. These moderate to high estimates ascribed expression of characters by additive and fixable gene action, which is advisable for phenotypic selection of these traits for further improvement. Similar results were also reported by Barad *et al*. (2018) and Hotti and Sadhukhan, (2018). Stability Parameters: The interaction between genotype and environment is the major reason for plants ability to show phenotypic stability and adaptability. In search of stable yield under stress environment, breeders always try to investigate and identify genotypes with different stable and adaptable component characters. Phenotypically stable varieties are usually sought for commercial production of crop plants, which could perform more or less uniformly under different environmental conditions.

Analysis of variance: The pooled analyses of variance showed that mean sum of squares due to genotypes were significant for all the characters **(Table 3A & 3B)**. The mean squares due to environments (E) were found significant for all the characters when tested against pooled deviation as well as pooled error. G x E interactions were found significant for all the characters except no. of primary branches/plant when tested against error mean square. This indicates presence of variability among the genotypes and environments. On partitioning the genotype x environment interaction into linear and non-linear components, it was found that both the components, *i.e.* linear as well as non-linear were significant for all the traits when tested against pooled error and pooled deviation. G x E (linear) component was significant for all the traits, when tested against pooled error, while the same variance *i.e.* G x E (linear) was significant for days to 50 % flowering, days to maturity, no. of pods/plant, hundred seed weight and seed yield/plant when tested against pooled deviation. The mean squares due to environments (linear) was also noted significant difference for all the characters against pooled error and pooled deviation. Mean squares due to pooled deviation was significant for all the characters studied. These results are in agreement with those reported by Sharma and Johnson (2017), Tomar and Singh, (2017), Tiwari *et al*. (2023), Tare *et al*. (2023), Karimizadeh *et al*. (2023).

Stability parameters **(Table 4A to 4C):** In the present investigation for seed yield per plant, five genotypes *viz*., ICC 14778, GJG 6, ICC 6579, ICC 8950 and ICC 10945 have high seed yield/plant, near unit regression coefficient and non-significant deviation from regression indicated that these genotypes were highly stable across the environments. These stable genotypes possessed stability for certain component characters. ICC 6579 showed stability for four characters (no. of pods/plant, hundred seed weight, no. of primary branches/plant and days to 50 % flowering). The genotypes, ICC 14778 (hundred seed weight and SPAD value) and ICC 8950 (SPAD value and plant height) registered stability in performance for two components. While remaining genotypes GJG 6 and ICC 10945 found stable for no. of primary branches/plant and SPAD value, respectively.

Genotype ICC 14799 recorded higher seed yield per plant, b_i value more than unity and non-significant S^2di value. This genotype was also found highly heat susceptible hence it can give good yield only under timely sowing. Contrary to this, genotypes ICCV 92944, GG 5 and GG 4 exhibited high mean value, less than unit regression coefficients and non-significant deviation from regression. This shows adaptability of these genotypes to late sown conditions. Above said genotypes were observed to be high yielding under high temperature and this may be the reason for their stability under late sowing.

Out of the above said five stable genotypes, most promising genotypes were ICC 14778 (11.12 g/plant), GJG 6 (11.02 g/plant) and ICC 6579 (9.12 g/plant) because they produced more yield with stability. The seed yield of ICC 14778 (11.12 g/plant) and GJG 6 (11.02 g/plant) was also comparable with seed yield of the highest seed yield producing genotype ICC 4958 (13.44 g/plant).

The present experiment may provide genetic variability background information for high temperature tolerance in the given genotypes during terminal heat stress/late sowing, thereby assisting in designing new stress tolerant genotypes *via* selecting suitable donors in hybridization programme. Additionally, the contrasting genotypes from this study can be used to map the concerned HT tolerance QTL in future. Further, the important traits *viz*. high seed yield/plant, no. of pods/plant, hundred seed weight and no. of primary branches/plant with early maturity and short reproductive cycle can be used as selection criteria for HT. Genotypes namely ICC 14778, GJG 6, ICC 6579, ICC 8950 and ICC 10945 were found stable across the environments. These genotypes were also stable for some of the supporting characters like no. of pods/plant, hundred seed weight, no. of primary branches/plant and

Table 3A. Analysis of variance showing mean sum of squares for nine characters over four environments in 71 genotypes of chickpea

Source	d. f.	DFF	DM	RPFD	PH	NPBP	NPP	HSW	SYP	SPAD
Environment	3	18.582**	6316.374**	5985.232**	740.453**	5.734**	12493.304**	107.038**	381.826**	104.74**
Genotypes	70	97.781**	29.507**	44.169**	86.216**	0.137*	197.28**	69.857**	10.677**	16.807**
G x E	210	12.086**	10.656**	20.686**	10.422*	0.097	35.662**	1.046**	1.27**	6.497**
Pooled error	420	5.733	6.511	10.745	7.957	0.089	9.242	0.536	0.417	3.808

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

DFF= Days to 50 % flowering, DM=Days to maturity, RPFD=Reproductive phase duration, PH=Plant Height(cm), NPBP=No. of primary branches per plant, NPP-No. of pods per plant, HSW= Hundred seeds weight (g), SYP= Seed yield per plant, SPAD=SPAD value.

Table 3B. Analysis of variance for stability over four environments in chickpea as per Eberhart and Russel (1966) model

Source of variation	d. f.	DFF	DM	RPFD	PH	NPBP	NPP	HSW	SYP	SPAD
Environments (E)	3	218.582**++	6316.374**++	5985.232**++	740.453**++	5.734**++	12493.304**++	107.038**++	381.826**++	104.74**++
Genotypes	70	97.781**++	29.507**++	44.169**++	86.216**++	0.137**+	197.28**++	69.857**++	10.677**++	16.807**++
G x E	210	12.086**	10.656**	20.686**	10.422*	0.097	35.662**	1.046**	1.27**	6.497**
Environment + (G x E)	213	14.994**++	99.469**++	104.694**++	20.704**++	0.177**++	211.122**++	2.539**++	6.63**++	7.881**
Environment (linear)	1	655.745**++	18949.121**++	17955.695**++	2221.358**++	17.202**++	37479.911**++	321.113**++	1145.479**++	314.221**++
G x E (linear)	70	17.883**++	14.908**++	19.323**	8.422**	0.115**	49.844**++	1.363**+	1.765**++	4.999**
Pooled deviation	142	9.058**	8.41**	21.066**	11.261**	0.087**	28.169**	0.875**	1.008**	7.144**
Pooled error	560	1.9111	2.1703	3.5815	2.6523	0.0298	3.0806	0.1787	0.1390	1.2695

*, ** Significant at 5 and 1 levels, respectively when tested against pooled error
+, ++ Significant at 5 and 1 levels, respectively when tested against pooled deviation
Note: Mean squares due to environments and genotypes found non-significant when tested against G x E interaction mean square

Table 4A. Mean over the environment, regression coefficient (b_i) and deviation from regression (S^2di) for Seed yield and its component characters

S.No.	Genotypes	Days to 50% flowering			Days to maturity			Reproductive phase duration		
		Mean	b_i	S^2di	Mean	b_i	S^2di	Mean	b_i	S^2di
1.	Annegiri 1	56.42	3.22**	10.93**	101.33	1.26**++	-0.78	44.92	0.92**	6.59*
2.	GG 1	51.25	-0.28*++	-1.79	97.67	0.81**	6.78**	46.42	0.78*	24.05**
3.	GG 4	53.17	-1.36**++	-0.66	100.17	0.62**++	2.52*	47.00	0.56	22.85**
4.	GG 5	48.92	-1.45++	6.11**	96.42	0.55**++	1.19	47.50	0.71*	24.49**
5.	GJG 3	42.75	-0.96**++	-1.15	93.83	1.12*	75.01**	51.08	1.11	88.01**
6.	GJG 6	48.33	-0.41	5.08**	98.50	0.55	27.09**	50.17	0.71**	10.60**
7.	ICC 10018	52.33	0.03	21.42**	100.08	1.31**++	-1.01	47.75	1.68**+	16.61**
8.	ICC 10393	50.42	3.19**+	6.78**	98.17	1.27**	5.83**	47.75	1.44**++	1.23
9.	ICC 10685	55.08	0.67	2.40*	100.83	0.65**++	-2.05	45.75	0.66**++	-0.47
10.	ICC 1083	49.75	1.52*	2.17*	97.17	1.18**++	-2.12	47.42	1.32**++	-1.12
11.	ICC 10945	51.33	1.25	6.19**	97.92	1.10**	6.99**	46.58	1.29**	8.19*
12.	ICC 11121	57.17	1.48**++	-1.75	101.25	1.36**++	-0.79	44.08	1.38**++	-0.91
13.	ICC 11198	61.42	1.37	59.87**	104.58	1.01**	-0.23	43.17	0.44	21.65**
14.	ICC 11944	57.17	1.45	6.27**	103.25	0.79**++	-2.03	46.08	0.89**	4.51*
15.	ICC 1205	56.92	0.74	0.18	98.75	0.74**	16.93**	41.83	0.75*	25.58**
16.	ICC 12155	55.33	1.39	3.54*	99.67	0.81**	0.63	44.33	0.66**++	-1.88
17.	ICC 13124	50.17	0.84	8.79**	97.75	1.33**+	2.81*	47.58	1.25**	27.59**
18.	ICC 13524	57.58	0.89	4.59**	104.25	0.96**	0.56	46.67	0.87**	10.49**
19.	ICC 1356	56.50	1.50**	-0.71	100.42	1.26**	6.93**	43.92	1.18**	0.45
20.	ICC 14402	50.83	1.15	7.59**	96.17	0.98**	6.16**	45.33	1.09**	18.28**
21.	ICC 14595	44.92	0.48**++	-1.61	93.75	1.14**	1.21	48.83	1.14**	6.26*
22.	ICC 14669	48.67	0.02	11.75**	96.08	1.09**	8.59**	47.42	1.15*	51.29**
23.	ICC 14778	60.17	2.25**++	-1.11	101.08	0.81**	12.53**	40.92	0.78**	6.89*
24.	ICC 14799	62.17	3.33**+	8.93**	101.08	0.99**	6.37**	38.92	0.72**	6.40*
25.	ICC 14815	55.75	1.10**	-1.60	102.33	1.16**	3.42*	46.58	1.24**	1.19

S.No.	Genotypes	Days to 50% flowering			Days to maturity			Reproductive phase duration		
		Mean	b_i	S^2di	Mean	b_i	S^2di	Mean	b_i	S^2di
26.	ICC 14831	56.33	0.48	-0.84	102.67	1.14**	4.81*	46.33	1.10**	6.39*
27.	ICC 15510	58.58	0.84	0.63	101.92	0.80**+	0.49	43.33	0.95**	-0.05
28.	ICC 15606	60.92	1.96**	1.68	101.08	0.78**+	-0.25	40.17	0.78**	13.97**
29.	ICC 15612	52.17	1.88**++	-0.99	97.08	0.86**	-0.003	44.92	0.78**	7.17*
30.	ICC 15614	53.25	2.98*	12.62**	97.58	1.21**++	-1.14	44.33	0.92**	17.83**
31.	ICC 15618	46.50	1.41	2.91*	96.33	0.66**++	0.77	49.83	0.51*+	9.16**
32.	ICC 15868	51.75	-0.32	9.11**	98.00	0.82**	5.17**	46.25	0.90*	39.48**
33.	ICC 16374	46.83	0.67	-0.28	103.00	0.84**++	-1.50	56.17	0.97**	-3.38
34.	ICC 1882	51.25	-0.13	6.83**	100.25	1.27**	17.16**	49.00	1.52**++	4.69*
35.	ICC 2072	52.83	0.41	4.48*	99.00	0.98**	0.81	46.17	1.18**	6.31*
36.	ICC 2263	55.17	1.53**	-0.38	101.33	0.86**+	-1.33	46.17	0.75**+	-1.18
37.	ICC 2507	54.75	0.58	-0.64	101.67	1.23**++	-0.53	46.92	1.16**++	-3.50
38.	ICC 2629	66.42	4.28	73.78**	102.83	1.61**+	15.82**	36.42	0.98	110.03**
39.	ICC 2884	54.17	1.11**	-0.37	98.67	1.48**++	4.57*	44.50	1.36**	9.66**
40.	ICC 2969	62.83	5.44*+	41.92**	104.75	0.82**	5.42**	41.92	0.612	201.33**
41.	ICC 3325	60.75	1.91	41.03**	102.50	0.92**	-1.51	41.75	0.53	29.67**
42.	ICC 3362	57.00	0.81	-0.25	102.42	0.89*	32.51**	45.42	0.97**	20.89**
43.	ICC 3631	60.67	2.05	20.61**	104.08	0.97**	3.01*	43.42	0.58*	12.37**
44.	ICC 3761	55.42	0.11	0.41	102.92	0.98**	6.09**	47.50	1.09**	-2.26
45.	ICC 4182	56.33	1.15**	-1.53	102.92	1.34**++	-1.46	46.58	1.41**++	-3.38
46.	ICC 4363	46.92	0.14++	-1.29	98.58	1.16**	13.28**	51.67	1.14**	18.29**
47.	ICC 4418	56.17	0.62	-0.95	100.50	1.18**++	-1.27	44.33	1.12**++	-3.09
48.	ICC 4495	54.92	1.11	3.15*	104.17	1.06**	32.39**	49.25	1.28**	20.71**
49.	ICC 4657	57.92	-0.53	22.06**	102.42	0.77**	3.33*	44.50	0.88**	24.29**
50.	ICC 4958	45.33	-0.15+	0.88	99.00	1.28**	3.33*	53.67	1.47**++	-1.09
51.	ICC 4991	55.67	0.85	0.09	98.17	1.06**	38.22**	42.50	1.12**	42.62**
52.	ICC 506	54.58	2.26**++	-1.73	100.08	1.08**	6.68**	45.50	1.01**	2.25
53.	ICC 5383	50.58	1.29	6.29**	97.58	0.92**	-1.41	47.00	1.16**	-0.39
54.	ICC 5613	56.33	2.28**++	-0.66	98.58	1.09**	4.69*	42.25	1.00**	12.93**
55.	ICC 5878	53.75	1.48**	-0.84	99.17	1.03**	5.15**	45.42	1.03**	-0.72
56.	ICC 6279	48.25	0.02	8.57**	96.42	0.78**	16.83**	48.17	1.01**	14.25**
57.	ICC 6293	57.33	0.12	2.13*	102.42	0.96**	5.49**	45.08	1.00**	21.72**
58.	ICC 637	56.17	0.57**++	-1.82	97.83	0.89**	-1.22	41.67	0.91**	-1.71
59.	ICC 6537	65.75	1.84	19.63**	106.00	0.96**	4.73*	40.25	0.65	32.59**
60.	ICC 6579	56.25	1.59**	-0.35	101.50	0.70**++	-2.10	45.25	0.74**+	0.73
61.	ICC 67	53.25	0.11	16.08**	98.42	0.76**+	1.52	45.17	0.93*	31.41**
62.	ICC 6816	54.00	1.89**	1.52	101.58	1.31**++	1.28	47.58	1.32**	11.89**
63.	ICC 6874	54.75	-1.46**++	-1.33	103.08	0.92**	7.08**	48.33	0.92**	8.78**
64.	ICC 708	54.08	0.91	24.09**	98.67	1.04**	11.35**	44.58	1.32**++	-2.89
65.	ICC 8318	47.17	1.48**	0.44	98.42	1.07**	2.26*	51.25	1.21**	7.14*
66.	ICC 8522	47.50	-0.02	7.48**	98.08	1.01**	-0.10	50.58	1.28**	6.06*
67.	ICC 8950	59.17	2.86**+	3.60*	102.58	1.13**	9.52**	43.42	0.94*	36.97**
68.	ICC 9002	51.17	-3.48+	28.08**	98.33	0.75**+	1.03	47.17	1.19*	67.71**
69.	ICC 9895	54.42	2.98**++	2.45*	101.33	1.22**	4.18*	46.92	1.06**	26.73**
70.	ICCV 92944	44.08	-1.30**++	-1.78	94.17	0.37**++	-0.51	50.08	0.39*++	4.72*
71.	JG 16	54.92	1.00**	-1.32	99.42	1.19**	5.88**	44.50	1.12**	5.46*
	G.M.	54.05	1.00	-	100.00	1.00	-	45.93	1.00	-
	S.Em ±	1.38	-	-	1.47	-	-	1.89	-	-

*, ** Significant at 5 and 1 percent levels, respectively as tested as bi/SE(bi)
+, ++ Significant deviation of bi from unity at 5 and 1 percent levels, respectively as tested as 1-bi/SE(bi)

Table 4B. Mean over the environment, regression coefficient (b_i) and deviation from regression (S^2di) for Seed yield and its component characters

S.N.	Genotypes	Plant height (cm)			No. of primary branches per plant			Number of pods per plant		
		Mean	b_i	S^2di	Mean	b_i	S^2di	Mean	b_i	S^2di
1.	Annegiri 1	41.92	-0.30	32.31**	2.48	-0.66++	0.01	41.17	0.79*	62.42**
2.	GG 1	45.50	1.97**++	0.61	2.48	0.92	0.06*	44.53	1.09**	3.23*
3.	GG 4	43.63	1.43**	1.46	2.43	0.85**	-0.02	46.91	0.38**++	3.76*
4.	GG 5	43.67	1.81**	6.66**	2.80	1.22**	-0.00	46.12	0.51**++	12.36**
5.	GJG 3	40.29	0.92	9.41**	2.25	0.98**	-0.01	36.97	0.22+	65.26**
6.	GJG 6	43.03	1.36**	2.47*	2.32	0.42	0.02	48.40	0.61**++	2.37
7.	ICC 10018	40.60	1.75**++	-1.00	2.43	-0.85**++	-0.03	44.53	0.49*+	22.57**
8.	ICC 10393	41.52	1.89**	8.09**	2.22	2.13**++	0.00	45.24	1.30**++	3.41*
9.	ICC 10685	52.77	0.59	8.91**	2.46	0.51	-0.00	44.48	1.46**++	5.05*
10.	ICC 1083	39.17	1.06	6.69**	2.43	1.96**	0.06*	53.08	0.79**	14.89**
11.	ICC 10945	39.57	0.67**++	-2.16	2.74	1.75*	0.10**	50.90	1.13**	16.98**
12.	ICC 11121	43.35	1.53**	0.43	2.20	0.09++	-0.01	48.48	1.17**	16.79**
13.	ICC 11198	37.53	1.10**	2.52*	2.47	0.93	0.07*	58.20	0.89	172.31**
14.	ICC 11944	37.63	0.45	5.46*	2.62	-0.07	0.09**	43.68	0.93**	9.54**
15.	ICC 1205	44.53	1.39**	4.53*	2.55	0.72	0.08**	62.12	0.70**	17.17**
16.	ICC 12155	41.75	1.26**	-1.79	2.60	1.14	0.08**	66.07	0.54**++	10.38**
17.	ICC 13124	42.50	0.48	9.58**	2.43	0.68*	-0.01	52.37	1.57**	109.79**
18.	ICC 13524	52.28	1.34*	10.66**	2.63	1.00*	0.03*	39.20	0.84**	9.28**
19.	ICC 1356	42.67	1.02**	0.34	2.37	0.97**	0.00	62.68	1.41**	24.91**
20.	ICC 14402	41.38	1.25	21.17**	2.50	0.56**++	-0.03	51.40	1.22**+	1.21
21.	ICC 14595	41.47	0.75**+	-2.29	2.37	1.96*	0.17**	49.37	0.71**	31.38**
22.	ICC 14669	42.82	0.97**	1.24	2.35	2.66**+	0.09**	51.25	1.51**	46.38**
23.	ICC 14778	42.57	1.42**	4.92*	2.28	0.52	0.07**	69.71	0.81**+	0.57
24.	ICC 14799	42.33	1.38**	-0.69	2.47	1.16	0.11**	64.45	1.24**++	1.53
25.	ICC 14815	45.07	1.88**++	-0.44	2.38	0.41++	-0.02	55.22	1.14**	20.66**
26.	ICC 14831	41.62	0.94	22.79**	2.46	1.75**+	0.01	46.43	1.11**	2.37
27.	ICC 15510	48.75	0.57*	-1.01	2.75	0.52	0.09**	39.33	0.71**	17.17**
28.	ICC 15606	40.57	1.00**	-0.02	2.58	0.28	0.07**	53.83	1.09**	5.62*
29.	ICC 15612	42.90	1.33	22.39**	2.52	2.03**+	0.03*	61.60	1.13*	105.23**
30.	ICC 15614	42.75	1.68	22.84**	2.44	1.37**	0.01	50.68	0.94	170.98**
31.	ICC 15618	41.48	0.34	3.82*	2.25	0.69*	-0.00	48.73	1.02**	-2.68
32.	ICC 15868	43.40	0.39	26.02**	2.52	0.79	0.07**	54.52	1.34**	83.32**
33.	ICC 16374	46.97	0.58**++	-1.97	2.35	1.42**	0.01	49.00	1.33**	17.54**
34.	ICC 1882	37.89	0.23*++	-2.28	2.47	0.78**	-0.02	56.90	1.38**	37.43**
35.	ICC 2072	38.67	0.08++	0.43	2.26	1.75**	0.02	57.82	1.12**	16.44**
36.	ICC 2263	40.45	1.09	10.50**	2.75	0.18	0.09**	54.83	1.32**+	7.61**
37.	ICC 2507	51.07	1.56*	11.14**	2.37	1.65*	0.09**	45.65	0.80**++	-2.90
38.	ICC 2629	39.63	0.89**	0.76	2.43	1.19**	-0.02	53.97	1.15**	7.62**
39.	ICC 2884	49.23	0.21+	2.40	2.60	0.42	0.06*	46.28	0.76**++	-1.63
40.	ICC 2969	38.17	0.96*	4.04*	2.59	0.76	0.15**	40.88	0.66*	39.94**
41.	ICC 3325	40.63	0.96**	-2.62	2.94	1.63*	0.09**	44.87	1.01**	-0.30
42.	ICC 3362	41.85	1.22	12.54**	2.53	1.09	0.13**	52.70	1.25**	19.03**
43.	ICC 3631	55.58	1.02*	3.26*	2.65	0.53	0.11**	60.40	1.60**++	-0.64
44.	ICC 3761	48.08	1.72	67.41**	2.45	0.03+	0.01	46.13	0.69**+	6.95*
45.	ICC 4182	48.41	1.08**	-1.52	2.90	1.43**	0.02	51.23	1.24**++	-0.87
46.	ICC 4363	48.83	1.15**	-1.39	2.13	1.07	0.16**	56.21	1.05**	18.26**
47.	ICC 4418	51.23	0.87**	-1.74	2.63	-0.03	0.05*	52.77	1.25**	9.86**
48.	ICC 4495	42.93	1.30**	0.99	2.58	0.55	-0.01	49.95	1.34**++	-1.88

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S.N.	Genotypes	Plant height (cm)			No. of primary branches per plant			Number of pods per plant		
		Mean	b_i	S^2di	Mean	b_i	S^2di	Mean	b_i	S^2di
49.	ICC 4657	40.12	0.97**	-2.42	2.36	0.81**	-0.02	45.20	1.22**	67.89**
50.	ICC 4958	47.13	1.00**	-0.79	2.32	1.05	0.04*	47.90	0.47**++	7.59**
51.	ICC 4991	41.63	0.75	22.61**	2.20	1.82**	0.04*	51.00	0.97**	27.83**
52.	ICC 506	42.88	0.32++	-1.73	2.53	0.05	0.09**	49.27	1.38**+	10.30**
53.	ICC 5383	35.42	1.19	18.99**	2.20	1.05**	-0.01	50.57	1.26**	70.31**
54.	ICC 5613	39.82	1.02*	3.58*	2.38	1.11	0.19**	49.45	0.97**	7.74**
55.	ICC 5878	41.92	1.65*	12.04**	2.33	1.65**+	-0.01	46.11	0.75**	26.28**
56.	ICC 6279	44.63	0.89*	2.67*	2.67	1.84*	0.15**	50.20	1.08**	56.80**
57.	ICC 6293	59.43	0.60	0.44	2.43	1.54	0.32**	40.08	0.76**+	3.67*
58.	ICC 637	40.25	0.11	16.55**	2.48	0.05	0.05*	44.92	0.81**+	0.05
59.	ICC 6537	45.75	0.16++	-0.59	2.73	0.60	0.05*	43.55	0.78**	16.88**
60.	ICC 6579	42.81	1.52**	7.21**	2.73	1.70**	0.03	57.31	1.01**	2.04
61.	ICC 67	42.75	1.26*	4.79*	2.69	2.48**+	0.05*	53.12	1.29**	23.05**
62.	ICC 6816	48.20	2.03	45.79**	2.18	1.19	0.06*	54.30	0.83**	17.29**
63.	ICC 6874	38.32	1.28	31.88**	2.78	0.16	0.03	50.13	0.94**	-0.15
64.	ICC 708	42.99	1.45**	-0.42	2.65	0.80	0.44**	41.65	0.41**++	6.79*
65.	ICC 8318	36.47	0.16+	2.88*	2.28	1.66**++	-0.03	66.22	1.15**	64.82**
66.	ICC 8522	39.84	1.18	40.32**	2.28	1.29	0.09**	63.40	1.30**	68.51**
67.	ICC 8950	36.18	0.48	1.09	2.43	1.83**	0.05*	56.82	0.94**	17.19**
68.	ICC 9002	36.87	0.47**++	-2.54	2.40	1.34*	0.08**	49.58	1.19**	3.47*
69.	ICC 9895	43.35	0.91	60.69**	2.20	1.07	0.09**	52.30	1.08**	46.11**
70.	ICCV 92944	51.12	0.18	19.65**	2.10	0.88	0.04*	48.83	0.57**++	-0.69
71.	JG 16	41.83	0.91**	0.68	2.53	1.17	0.13**	58.70	1.09**	-1.16
	G.M.	43.24	1.00	-	2.47	1.00	-	51.01	1.00	-
	S.Em ±	1.63	-	-	0.17	-	-	1.76	-	-

*, ** Significant at 5 and 1 percent levels, respectively as tested as bi/SE(bi)
+, ++ Significant deviation of bi from unity at 5 and 1 percent levels, respectively as tested as 1-bi/SE(bi)

Table 4C. Mean over the environment, regression coefficient (b_i) and deviation from regression (S^2di) for Seed yield and its component characters

S.N.	Genotypes	Hundred seed weight (g)			Seed yield per plant (g)			SPAD-value		
		Mean	b_i	S^2di	Mean	b_i	S^2di	Mean	b_i	S^2di
1.	Annegiri 1	10.44	0.60**++	-0.11	6.35	0.83	4.21**	60.91	1.38	26.70**
2.	GG 1	19.89	0.77**	-0.01	8.21	1.45**	0.76**	65.31	-1.10	12.62**
3.	GG 4	19.20	0.44+	0.08	8.82	0.51**++	-0.03	64.23	0.22	6.85**
4.	GG 5	19.47	0.53	0.98**	9.68	0.88**++	-0.13	67.41	-0.21	17.09**
5.	GJG 3	21.42	0.32	6.65**	9.80	1.42**+	0.47**	64.71	-0.26++	-1.01
6.	GJG 6	25.52	1.52**	0.33*	11.02	1.05**	-0.05	66.03	1.50	3.73**
7.	ICC 10018	13.10	0.94**	-0.02	6.37	0.23++	0.45**	62.84	-1.05+	2.19*
8.	ICC 10393	13.44	0.68	0.41*	6.59	0.89**	0.88**	64.54	1.99	5.91**
9.	ICC 10685	10.52	0.96**	0.19*	5.62	0.88**	-0.06	64.80	1.43	3.34**
10.	ICC 1083	14.05	0.37*++	-0.05	7.71	0.59*	0.96**	64.11	1.45	6.23**
11.	ICC 10945	17.48	1.48**+	0.08	8.42	1.04**	0.04	63.51	0.70**	-0.95
12.	ICC 11121	12.34	0.23++	0.01	6.91	1.03**	0.04	63.72	2.55**++	0.02
13.	ICC 11198	11.58	1.24**	0.45**	7.44	0.31	4.88**	61.22	0.37	32.29**
14.	ICC 11944	13.65	1.68**	1.59**	6.31	0.99**	1.24**	62.92	0.89*	-0.66
15.	ICC 1205	15.80	0.68**++	-0.12	9.68	0.40*++	0.43**	64.79	3.36	40.39**
16.	ICC 12155	11.61	0.68**	0.01	8.97	0.80**	0.32*	62.42	1.59	2.79*
17.	ICC 13124	13.06	0.04++	0.31*	8.14	1.51**	3.98**	63.99	0.64	1.34*
18.	ICC 13524	11.02	0.34**++	-0.18	5.63	0.79**+	-0.02	62.37	1.84**+	-0.58

S.N.	Genotypes	Hundred seed weight (g)			Seed yield per plant (g)			SPAD-value		
		Mean	b_i	S^2di	Mean	b_i	S^2di	Mean	b_i	S^2di
19.	ICC 1356	13.03	0.51**++	-0.13	8.08	1.13**+	-0.09	64.70	0.02	3.59**
20.	ICC 14402	15.92	1.73**++	0.09	7.79	1.35**	0.45**	60.01	0.52	-0.39
21.	ICC 14595	21.97	0.76**	0.15	9.63	0.76**	1.06**	60.58	-2.12**++	-0.93
22.	ICC 14669	17.96	0.82*	0.57**	9.50	1.35**	1.20**	64.02	3.37**++	0.31
23.	ICC 14778	12.18	0.90**	-0.11	11.12	0.99**	-0.01	63.40	0.23	-0.41
24.	ICC 14799	13.76	1.69**	0.54**	9.89	1.49**++	-0.07	61.32	0.79*	-0.84
25.	ICC 14815	14.41	1.07**	-0.05	7.82	1.06**	0.53**	64.11	1.15	33.68**
26.	ICC 14831	14.77	0.85	0.73**	7.43	1.21**++	-0.04	60.59	2.08**	0.59
27.	ICC 15510	23.20	1.12**	0.41*	7.52	0.79**	0.49**	63.97	2.68	7.96**
28.	ICC 15606	12.78	0.88**	0.05	7.17	1.05**	0.96**	60.34	2.04	3.98**
29.	ICC 15612	16.38	2.19**	2.29**	9.63	1.13**	1.64**	62.00	0.24	1.72*
30.	ICC 15614	13.28	0.90**	-0.07	7.02	0.82	2.67**	60.62	1.39	13.29**
31.	ICC 15618	11.73	0.56	1.05**	6.86	1.04**	0.20*	60.75	1.07**	-0.82
32.	ICC 15868	12.74	0.65*	0.19*	7.24	1.19**	1.01**	65.56	2.43*	3.78**
33.	ICC 16374	16.43	2.43**	2.54**	7.58	1.51**	5.01**	65.73	1.03	46.71**
34.	ICC 1882	18.04	0.85**	0.24*	8.95	1.12**	0.16*	64.07	0.89**	-0.76
35.	ICC 2072	14.16	0.24+	0.44**	8.73	0.97**	0.21*	63.20	0.39	1.06
36.	ICC 2263	12.61	0.88**	-0.06	7.79	1.27**++	-0.05	62.32	1.25	2.82*
37.	ICC 2507	14.14	1.25	2.97**	6.50	0.59**	0.57**	62.57	0.72	0.72
38.	ICC 2629	13.44	1.58**+	0.13	7.49	0.75**++	-0.10	55.60	1.95**	0.48
39.	ICC 2884	13.82	0.94**	0.19*	6.85	0.82**++	-0.10	63.34	0.42	2.07*
40.	ICC 2969	10.50	1.24**	0.01	5.69	0.46	1.12**	59.34	-0.92	22.74**
41.	ICC 3325	14.52	1.95**+	0.54**	6.58	0.92**	-0.02	61.75	1.35	13.97**
42.	ICC 3362	20.82	0.69	1.33**	9.86	1.22**	0.61**	62.17	0.42	-0.64
43.	ICC 3631	11.43	1.94**++	0.37*	8.91	1.63**++	0.25*	61.19	2.22**++	-0.74
44.	ICC 3761	12.83	1.34**+	-0.06	7.04	0.68**++	-0.09	61.77	1.41	1.23*
45.	ICC 4182	12.36	1.58**++	-0.18	7.74	1.22**++	-0.07	61.81	0.50	3.26**
46.	ICC 4363	11.54	1.12**	0.09	8.14	0.93**	0.29*	64.31	0.20	0.75
47.	ICC 4418	11.72	0.54**++	-0.09	7.75	1.06**	0.79**	61.13	-0.08	1.24*
48.	ICC 4495	14.91	1.64**	1.57**	7.95	1.31**++	-0.07	65.76	1.52**	-0.25
49.	ICC 4657	15.69	0.78**	-0.03	7.58	1.11**	0.56**	61.12	1.47**	-0.78
50.	ICC 4958	34.11	0.83	1.07**	13.44	0.81**	0.77**	64.94	1.85	4.75**
51.	ICC 4991	13.74	1.44**	1.18**	7.22	0.83**	0.44**	64.82	0.89**	-1.07
52.	ICC 506	15.50	1.21**+	-0.13	7.68	1.51**+	0.94**	62.49	4.10*	10.62**
53.	ICC 5383	19.89	1.99**++	-0.01	8.40	1.44**	4.41**	63.51	0.54	2.42*
54.	ICC 5613	16.27	1.18*	0.86**	7.21	1.12**	0.73**	58.69	1.25*	0.23
55.	ICC 5878	15.87	0.38	0.52**	7.03	0.72**	0.45**	61.28	1.15**	-0.89
56.	ICC 6279	16.37	1.40**	0.29*	7.99	1.28*	4.81**	64.98	0.01	5.05**
57.	ICC 6293	12.90	1.29*	1.25**	5.74	0.84**	0.18*	61.21	0.45	0.21
58.	ICC 637	15.32	0.43	2.49**	6.56	0.61**++	0.07	61.38	1.42	8.35**
59.	ICC 6537	12.19	1.31**	0.73**	6.10	0.59**++	0.16*	60.89	0.93	12.82**
60.	ICC 6579	13.48	0.95**	0.13	9.12	0.97**	-0.11	58.48	1.89	3.23**
61.	ICC 67	17.33	0.34	0.53**	8.93	1.59**+	1.28**	63.19	1.76	17.02**
62.	ICC 6816	12.02	0.71	0.69**	7.80	0.62**++	-0.08	65.37	1.09*	-0.32
63.	ICC 6874	14.13	1.69*	2.34**	7.93	0.78**++	-0.04	64.03	0.92**	-1.19
64.	ICC 708	18.78	0.79**	-0.09	6.84	0.68**	0.31*	62.09	-0.21+	-0.15
65.	ICC 8318	22.90	1.62**	0.67**	12.76	1.38*	4.57**	62.21	-0.29	7.16**
66.	ICC 8522	19.94	0.21	0.72**	12.30	1.49**	3.41**	62.75	0.69	3.14**
67.	ICC 8950	14.19	1.87*	2.32**	8.52	0.91**	0.06	62.84	0.23	0.98
68.	ICC 9002	19.70	-0.03	6.68**	9.29	1.51**+	0.70**	63.70	1.67*	1.02
69.	ICC 9895	17.01	1.36**	0.62**	8.04	0.71**	0.26*	59.79	-0.28	2.99**
70.	ICCV 92944	24.18	0.47*+	0.06	11.05	0.68**++	0.02	63.36	1.81	12.38**
71.	JG 16	17.14	0.44	0.23*	9.91	1.39**	0.93**	63.49	1.23	10.65**
	G.M.	15.63	1.00	-	8.16	1.00	-	62.74	1.00	-
	S.Em ±	0.42	-	-	0.37	-	-	1.13	-	-

*, ** Significant at 5 and 1 percent levels, respectively as tested as bi/SE(bi)

+, ++ Significant deviation of bi from unity at 5 and 1 percent levels, respectively as tested as 1-bi/SE(bi)

SAPD value. These genotypes and characters identified can be utilized respectively by farmers and breeders for growing and breeding sustainable chickpea production under terminal heat stress/late sowing.

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