Plant Archives Vol. 25, No. 2, 2025 pp. 77-84 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.2.014

STABILITY ASSESSMENT FOR READY TO ROAST TRAITS IN ADVANCE BREEDING LINES OF CHICKPEA (*CICER ARIETINUM* L.)

Rajkumar[1], Laxuman[2]*, Sidramappa[3], G.Y. Lokesh[1], P.F. Mathad[4], K. Shivkumar[5] and Archana Joshi[6]

[1]Department of Genetics and Plant Breeding, University of Agricultural Sciences, Raichur - 584 104, Karnataka, India.
[2]Zonal Agricultural Research Station, Kalaburagi - 585 104, Karnataka, India.
[3]Agricultural Research Station, Bidar - 585 401, Karnataka, India.
[4]Department of Processing and Food Engineering, College of Agriculture Engineering, Raichur - 584 104, Karnataka, India.
[5]AICRP on Linseed, MARS, UAS, Raichur - 584 101, Karnataka, India.
[6]Nuclear Agriculture and Biotechnology Division, Bhabha Atomic Research Centre, Mumbai - 400 085, Maharashtra, India.
*Corresponding author E-mail : laxumanc@uasraichur.edu.in
(Date of Receiving-22-05-2025; Date of Acceptance-29-07-2025)

ABSTRACT

A-1 variety is commonly used for roasting in Karnataka but has become susceptible to *Fusarium* wilt, which affects seed quality and yield. The improved version, SA-1 is not suitable for roasting due to its wrinkleless of seed. Therefore, it is imperative to identify a variety that offers both high yield and suitability for roasting in Karnataka. A set of 12 ready to roast genotypes and four commercial checks *viz.*, JG 11, A-1, SA-1 and GULAK were evaluated for seed yield and stability for ready to roast traits during *Rabi* 2023-24 in three locations (Bidar, Kalaburagi and Raichur). An experiment was conducted during *Rabi* 2023-24 in three locations (Bidar, Kalaburagi and Raichur) to identify high yielding and stable chickpea genotypes for ready to roast traits. At each of the locations, the stability of 12 ready to roast genotypes and four commercial checks *viz.*, A-1, SA-1, JG-11and GULAK were tested in Randomized Block Design with three replications. Eberhart and Russel (1966) model was followed for Stability analysis. Results revealed highly significant genotype × environment interaction for days to 50 per cent flowering, plant height (cm), number of branches per plant, number of pods per plant, seed yield per plant (g), test weight (g) and iron content (ppm). Among three locations, Bidar was found most favourable environment for expression of the traits. The study revealed that none of the genotypes exhibited stability across all three locations. However, the genotypes *viz.*, RG-2016-134, ICCV-191151, ICCV-191251, ICCV-191161, ICCV-191126, JG-11 and SA-1 were found suitable for favourable environments.

Key words : Chickpea, G x E interaction, Stability, Genotype, Roasting.

Introduction

Chickpea is an ancient crop of modern times that occupied cultivable lands for nearly 57 countries around the world and accounts for over 20 per cent of world pulse production, moreover, much of the world's chickpea supply (80-90 per cent) comes from India (Yadav *et al*., 2023). India holds the top rank in terms of area (9.59 million hectares) and production (11.04 million tonnes) of chickpea in the world, with a productivity of 1151 kg per hectare. In India, Karnataka ranks fourth in chickpea cultivation, covering an area of 0.638 million hectares, an annual production of 0.386 million tonnes and a productivity was 605 kg per hectare (Anonymous, 2023-24). Chickpea is an excellent source of both carbohydrates and protein, which account for 80 per cent of the total dry mass of chickpea (Zhang *et al*., 2024).

Chickpea seeds are processed through methods like soaking, sprouting and roasting to enhance digestibility and remove anti-nutritional factors (Yadav and Bhatnagar, 2017). Roasted chickpeas, often coated with jaggery or spices, are a popular snack in India. Roasting improves texture, colour and flavor by converting carbohydrates into dextrins, which react with amino acids. It also makes the seeds more digestible, destroys harmful microorganisms and prevents spoilage. Puffed chickpeas, high in protein and low in fat, are a growing healthy snack option. In the market, seeds that are bold with thin coats are preferred due to their better expansion during roasting (Kaur and Prasad, 2021). Chickpea, being particularly used for parching, getting higher premium in the market for the parched grains, is mainly dependent upon the expansion of volume of the grains during the process. Thus, this trait should be leveraged, as bold seed with a thin seed coat is of prime importance in chickpea.

G×E interactions are indeed critical because they provide important insights into how different varieties (genotypes) respond to varying environmental conditions, such as soil, climate and agricultural practices. This is particularly relevant in crop breeding programs aiming to improve yield stability, especially for crops with inherently lower yields. These interactions play an essential role in assessing the homeostasis of breeding materials. Furthermore, the complex interactions between different yield components and environmental factors make seed yield a composite character influenced by multiple variables (Hamma-Umin, 2019). The present study aims to identify chickpea varieties superior in both yield and roasting quality. It examines genotype by environment interaction on seed yield and other key traits, as well as the stability and adaptability of ready-to-roast chickpea genotypes.

Materials and Methods

In this study, 16 chickpea genotypes (Table 1) were sown during *Rabi* 2023-24 across three locations *viz.*, Zonal Agricultural Research Station (ZARS), Kalaburagi, MARS, PG research block, UAS Raichur and Agriculture Research Station, Janawada, Bidar. The experiment was laid out using a Randomized Block Design (RBD) with three replications. Each genotype was sown in four rows of four meters in length with a spacing of 30 cm between rows and 10 cm between plants. Data were recorded on phenological traits *viz.*, days to 50 per cent flowering, days to maturity; yield attributing traits namely number of branches per plant, plant height, number of pods per plant, test weight, seed yield and quality traits *viz.*, crude protein content, carbohydrate content, crude fat content,

Table 1 : List of 16 chickpea genotypes used for study.

S. no.	Genotype	Pedigree
1	ICCV-191256	ICC-4958/ICCV-00108//ICCV-93954/ICCV-94954///ICCV10/ICCV-97105//ICCV-93952/ICCV-96970
2	ICCV-191156	ICC-4958/ICCV-93954//ICCV-96970/ICCV-97105///ICCV-10/ICCV-93952//ICCV-94954/ICCV-00108
3	RG-2016-134	ICCV 03112 x ICCV10
4	ICCV-191151	ICC-4958/ICCV-10//ICCV-93952/ICCV-93954
5	ICCV-191251	ICC-4958/ICCV-10//ICCV 93952/ICCV 93954
6	ICCV-191255	ICC-4958/ICCV-10//ICCV-93952/ICCV-93954
7	ICCV-191161	ICC-4958/ICCV-10//ICCV-93952/ICCV-93954///ICCV-94954/ICCV-96970//ICCV-97105/ICCV-00108
8	ICCV-191253	ICC-4958/ICCV-97105//ICCV-10/ICCV-00108
9	ICCV-88202	PRR-1///H-208/T-3//26-2-B-BP-BP-BP-4P-1P-1P-1P-BP
10	ICCV-191159	ICC-4958/ICCV-97105//ICCV-10/ICCV-00108///ICCV- 93952/ICCV-94954//ICCV-93954/ICCV-96970
11	ICCV-191126	JG 11///JG 11//Harigantars/JG 11
12	ICCV-191155	ICC-4958/ICCV-00108//ICCV-93954/ICCV-94954///ICCV-10/ICCV-97105//ICCV-93952/ICCV-96970
13	JG-11 (NC for yield)	ICCV-93954
14	SA-1 (RC for yield)	Annigeri-1 × WR-315
15	A-1 (LC for ready to roast/Parching)	Selection from land race
16	Gulak (Check Parching/ ready to roast)	(N-59 × D-8) 1-88-88A

zinc content and iron content; roasting traits like expansion index and puffing index. Observations were taken from five randomly chosen plants for each entry in every replication for all the characters being studied except for test weight, expansion index, puffing index, crude protein content, zinc content, iron content, carbohydrate content and crude fat content which were recorded on a whole plot basis. The average values of the random sample of the respective character used for analysis. The statistical analysis was executed based on stability analysis by Eberhart and Russell (1966).

Results and Discussion

Collected data on phenological traits, yield attributing traits, roasting traits and quality characters on 16 chickpea genotypes over three locations were subjected to pooled analysis (Table 2). The G × E interactions against pooled error were significant for days to 50 per cent flowering, plant height (cm), number of branches per plant, number of pods per plant, seed yield per plant (g), test weight (g) and iron content (ppm). Significant G × E interactions in chickpea for important traits were indicated by Jayalakshmi *et al*. (2024), Chetariya *et al*. (2023) and Thapa *et al*. (2023). Thus, the performance of genotypes across three locations was affected by the environment. Therefore, the performance of the genotypes was subjected to regression analysis to arrive at the extent of the genotype and environment interaction.

The traits which exhibited significant G × E interaction were further subjected to stability analysis as per the model proposed by Eberhart and Rusell (1966). The study revealed that Bidar location was

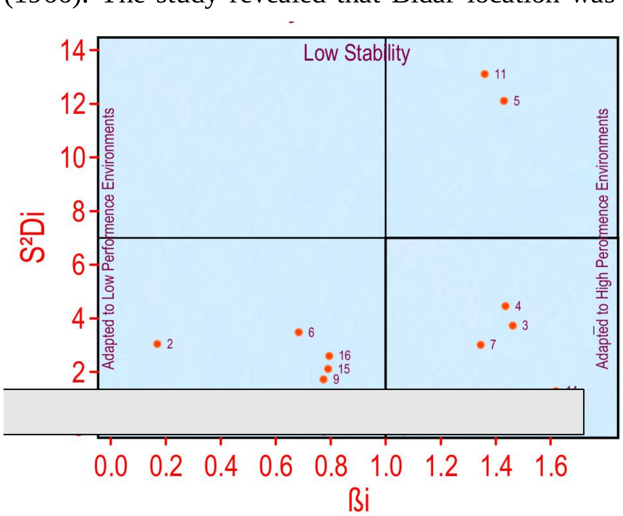

Fig. 1 : Stability of genotypes based on S^2Di for seed yield per plant.

Table 2 : Pooled analysis of variance for stability in 16 chickpea genotypes.

Characters	Genotypes	Gen.* Env.	Env. + (Gen.* Env.)	Environments	Environments (Linear)	Gen.* Env. (Linear)	Pooled Deviation	Pooled Error
Degrees of freedom	15	30	32	2	1	15	16	90
Days to 50 per cent flowering	21.20**	4.09**	10.99*	114.44**	228.89**	3.194**	4.68**	0.11
Days to maturity	5.46	4.85	32.88**	453.40**	906.79**	0.804	8.34**	0.16
Plant height(cm)	36.55**	4.99**	38.24**	537.08**	1074.16**	5.64**	4.06**	4.24
Number of branches per plant	0.18	0.13**	0.21*	1.35**	2.70**	0.17**	0.10**	0.01
Number of pods per plant	26.13	35.76**	74.83	660.93**	1321.86**	25.47**	43.17**	2.83
Seed yield per plant (g)	3.39**	2.50**	5.22**	45.99**	91.99**	1.25**	3.51**	0.21
Test weight(g)	48.09**	0.65*	1.021**	6.527**	13.05**	1.31**	0.00*	0.17
Expansion index (%)	1213.07**	162.62	154.77	37.02	74.04	118.26	194.04**	6.01
Puffing index (%)	1433.02**	167.67	162.43	83.80	167.62	206.65	120.66**	5.26
Crude protein content (%)	3.79**	0.06	0.07	0.10	0.20*	0.088	0.04	0.11
Crude fat content (%)	0.78**	0.04	0.05	0.16*	0.31*	0.04	0.04**	0.006
Carbohydrate content (%)	5.21**	0.12	0.13	0.23	0.46**	0.06	0.17	0.25
Iron content(ppm)	1548.90**	81.81**	97.92	339.58*	679.16*	74.70**	83.36**	10.71
Zinc content (ppm)	45.60	24.93	30.75	118.08*	236.16**	25.64	22.70**	0.24

**, * Significant at 1% level and 5% level, respectively.

Table 3 : Estimation of environmental index (Ij) under three locations in chickpea.

Environmental Index	E1	E2	E3
Days to 50 per cent flowering	-2.79	0.24	2.55
Plant height (cm)	-3.37	-3.33	6.69
Number of branches per plant	-0.26	0.31	-0.05
Number of pods per plant	2.09	-7.21	5.12
Seed yield per plant (g)	0.94	-1.96	1.02
Test weight (g)	0.65	-0.88	0.23
Iron content (ppm)	3.54	-5.21	1.67

favourable for most of the characters *viz.*, days to 50 per cent flowering, number of pods per plant, plant height, seed yield per plant, test weight and iron content. Raichur location was found favourable for characters *viz.*, days to 50 per cent flowering, seed yield, iron content whereas, Kalaburagi location was favourable for days to 50 per cent flowering and number of branches per plant (Table 3). Environmental index for seed yield per plant shown in Fig. 2.

Regression coefficients and mean square deviation from regression respectively ranged from -0.11 to 1.70

Table 4 : Stability parameters of chickpea genotypes for phenological traits, seed yield and yield attributing traits.

Genotypes	Days to 50 per cent flowering			Plant height (cm)			Number of branches per plant		
	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
ICCV-191256	42.67	1.12	0.00	43.85	0.97	-2.89	2.220	1.58	0.05
ICCV-191156	39.33	1.51	6.07	39.56	0.77	6.00	2.66	2.47	0.05
RG-2016-134	39.89	1.36	0.34	47.99	1.60	10.34	2.80	1.37	0.04
ICCV-191151	43.33	0.79	18.58	42.89	0.83	-3.80	2.39	0.48	0.02
ICCV-191251	40.56	1.43	-0.03	46.60	1.02	-4.20	2.20	0.37	0.00
ICCV-191255	42.56	1.17	0.94	45.67	1.08	1.04	2.31	0.61	0.11
ICCV-191161	45.44	0.85	4.19	43.07	0.90	-0.13	2.69	3.00	-0.01
ICCV-191253	46.56	0.52	1.37	46.33	0.60	-4.54	2.38	0.93	0.01
ICCV-88202	40.56	1.34	2.09	40.48	1.26	-1.61	2.54	1.07	-0.01
ICCV-191159	39.44	1.70	7.05	39.56	0.55	-3.32	2.48	2.05	0.10
ICCV-191126	38.56	0.83	0.41	42.52	1.33	-4.70	1.84	0.61	0.25
ICCV-191155	41.33	1.08	0.73	37.63	1.05	-4.74	2.54	1.16	0.04
JG-11	38.89	1.04	0.87	41.74	1.03	12.83	2.21	-0.03	0.32
SA-1	44.33	0.26	12.92	37.52	0.90	-2.89	2.46	-0.33	0.09
A-1	44.67	-0.11	13.72	38.41	1.40	-4.18	2.20	-0.73	-0.01
GULAK	45.78	1.10	3.90	37.37	0.71	-4.15	2.64	1.39	0.31
Mean	**42.12**			**41.95**			**2.42**		

Genotypes	Number of pods per plant			Seed yield per plant (g)			Test weight (g)		
	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
ICCV-191256	32.00	0.71	12.55	7.47	0.93	0.74	23.18	-0.57	-0.05
ICCV-191156	25.59	0.03	20.22	6.97	0.17	3.04	24.93	0.00	0.68
RG-2016-134	30.33	1.27	76.84	7.26	1.46	3.72	23.07	3.42	0.20
ICCV-191151	29.52	1.02	102.15	7.50	1.44	4.45	23.20	1.91	0.60
ICCV-191251	32.93	1.01	151.54	10.0	1.43	12.10	28.40	2.26	-0.12
ICCV-191255	26.78	0.46	30.60	7.34	0.68	3.47	29.20	1.98	0.19
ICCV-191161	30.41	1.96	33.56	7.06	1.35	3.01	19.56	0.82	-0.15
ICCV-191253	28.22	0.67	0.92	6.86	0.69	0.12	25.24	1.02	5.46
ICCV-88202	29.04	0.84	34.05	6.29	0.77	1.72	21.49	0.30	-0.14
ICCV-191159	27.56	0.21	-2.70	6.04	0.25	0.70	19.62	1.64	0.84
ICCV-191126	29.04	1.73	128.80	5.85	1.36	13.10	19.84	-1.32	3.22
ICCV-191155	30.81	1.01	-1.02	6.23	0.67	0.16	17.50	0.08	0.02
JG-11	37.11	1.46	23.95	7.68	1.59	0.47	19.76	2.17	0.81
SA-1	32.63	1.84	27.53	6.66	1.62	1.28	17.68	1.51	0.51
A-1	29.54	1.09	9.62	6.37	0.79	2.11	18.82	-0.62	0.99
GULAK	34.55	0.69	-2.27	5.25	0.80	2.59	13.82	1.41	1.46
Mean	**30.38**			**6.93**			**21.58**		

Table 5 : Stability parameters of chickpea genotypes for quality traits.

Genotypes	Iron content (ppm)		
	Mean	bi	S^2di
ICCV-191256	216.66	-0.39	49.84
ICCV-191156	216.67	2.85	112.41
RG-2016-134	196.67	1.23	-7.52
ICCV-191151	143.33	-1.23	-7.52
ICCV-191251	156.67	1.13	-7.52
ICCV-191255	150.00	0.00	-10.28
ICCV-191161	180.00	0.00	-10.28
ICCV-191253	190.00	-0.44	181.43
ICCV-88202	163.33	2.90	100.45
ICCV-191159	180.00	1.62	78.37
ICCV-191126	153.33	1.18	387.26
ICCV-191155	193.33	-0.79	230.21
JG-11	193.33	2.45	0.76
SA-1	196.67	1.13	-7.52
A-1	193.33	2.45	0.76
GULAK	170.00	1.62	78.37
Mean	**180.83**		

and -0.03 to 18.58 for days to 50 per cent flowering; 0.55 to 1.60 and -4.74 to 12.83 for plant height; -0.73 to 3.00 and -0.01 to 0.32 for number of branches per plant; 0.03 to 1.96 and -2.70 to 151.54 for number of pods per plant; 0.17 to 1.62 and 0.12 to 13.10 for seed yield per plant; -1.32 to 3.42 and -0.14 to 5.46 for test weight; -1.23 to 2.90 and -10.28 to 387.26 for iron content (Tables 4 and 5).

Considering three stability parameters; the genotypes with average stability for days to 50 per cent flowering was JG-11, for plant height ICCV-191256, ICCV-191251, ICCV-191155 and JG-11, for number of pods per plant ICCV-191151, ICCV-191251 and ICCV-191155 and for test weight ICCV-191253 displayed average stability. These genotypes had mean values more than population mean and regression coefficient around unity and non-significant deviation from the regression coefficient. They fall under category of average stability.

The following genotypes have showed specific suitability for different traits. The genotypes *viz*., ICCV-191256, ICCV-191255, ICCV-191156, GULAK, RG-2016-134, ICCV-191251, ICCV-88202, ICCV-191155 and ICCV-191159 for days to 50 per cent flowering; ICCV-191255, RG-2016-134, ICCV-88202, ICCV-191126 and A-1 for plant height; ICCV-191256, ICCV-191156, ICCV-88202, RG-2016-134, ICCV-191161, ICCV-191159, ICCV-191155 and GULAK for number of branches per plant; RG-2016-134, ICCV-191161,

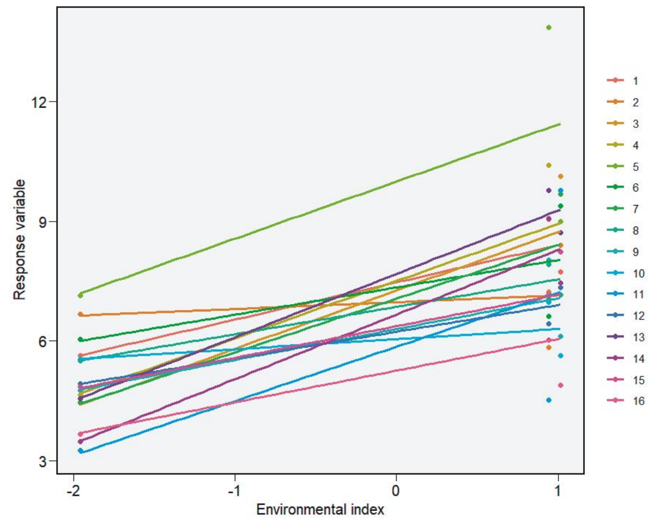

Fig. 2 : Environmental index for seed yield per plant.

ICCV-191126, JG-11, A-1 and SA-1 for number of pods per plant; RG-2016-134, ICCV-191151, ICCV-191251, ICCV-191161, ICCV-191126, JG-11 and SA-1 for seed yield per plant; RG-2016-134, ICCV-191151, ICCV-191251, ICCV-191159, ICCV-191255, JG-11, SA-1 and GULAK for test weight; ICCV-191156, ICCV-191251, ICCV-191126, SA-1, RG-2016-134, ICCV-88202, ICCV-191159, JG-11, A-1 and GULAK for iron content showed specific suitability since they had regression coefficient (b_i) greater than one and mean value more than their population mean. Therefore, these genotypes may be utilized under optimal favourable environmental conditions.

The genotypes which showing specific adaption to low-performing environments for different traits are ICCV-191161, ICCV-191253, ICCV-191151, SA-1, ICCV-191126 and A-1 for days to 50 per cent flowering; ICCV-191161, ICCV-191151, ICCV-191156, ICCV-191253, ICCV-191159, SA-1 and GULAK for plant height; ICCV-191253, ICCV-191151, ICCV-191251, ICCV-191255, ICCV-191126, JG-11, SA-1 and A-1 for number of branches per plant; ICCV-191256, ICCV-191156, ICCV-1911255, ICCV-88202, ICCV-191253, ICCV-191159 and GULAK for number of pods per plant; ICCV-191256, A-1, GULAK, ICCV-191156, ICCV-191255, ICCV-191253, ICCV-88202, ICCV-191159 and ICCV-191155 for seed yield per plant; ICCV-191256, ICCV-191156, ICCV-88202, ICCV-191126, ICCV-191155, ICCV-191161 and A-1 for test weight; ICCV-191256, ICCV-191151, ICCV-191255, ICCV-191161, ICCV-191253 and ICCV-191155 for iron content. All these genotypes had regression coefficient lower than unity, non-significant deviation from the regression coefficient and also had the high mean. Laxuman *et al.* (2022), Laxuman *et al.* (2024), Gebeyaw *et al.* (2024) and Rao *et al.* (2023) had done stability analysis for seed

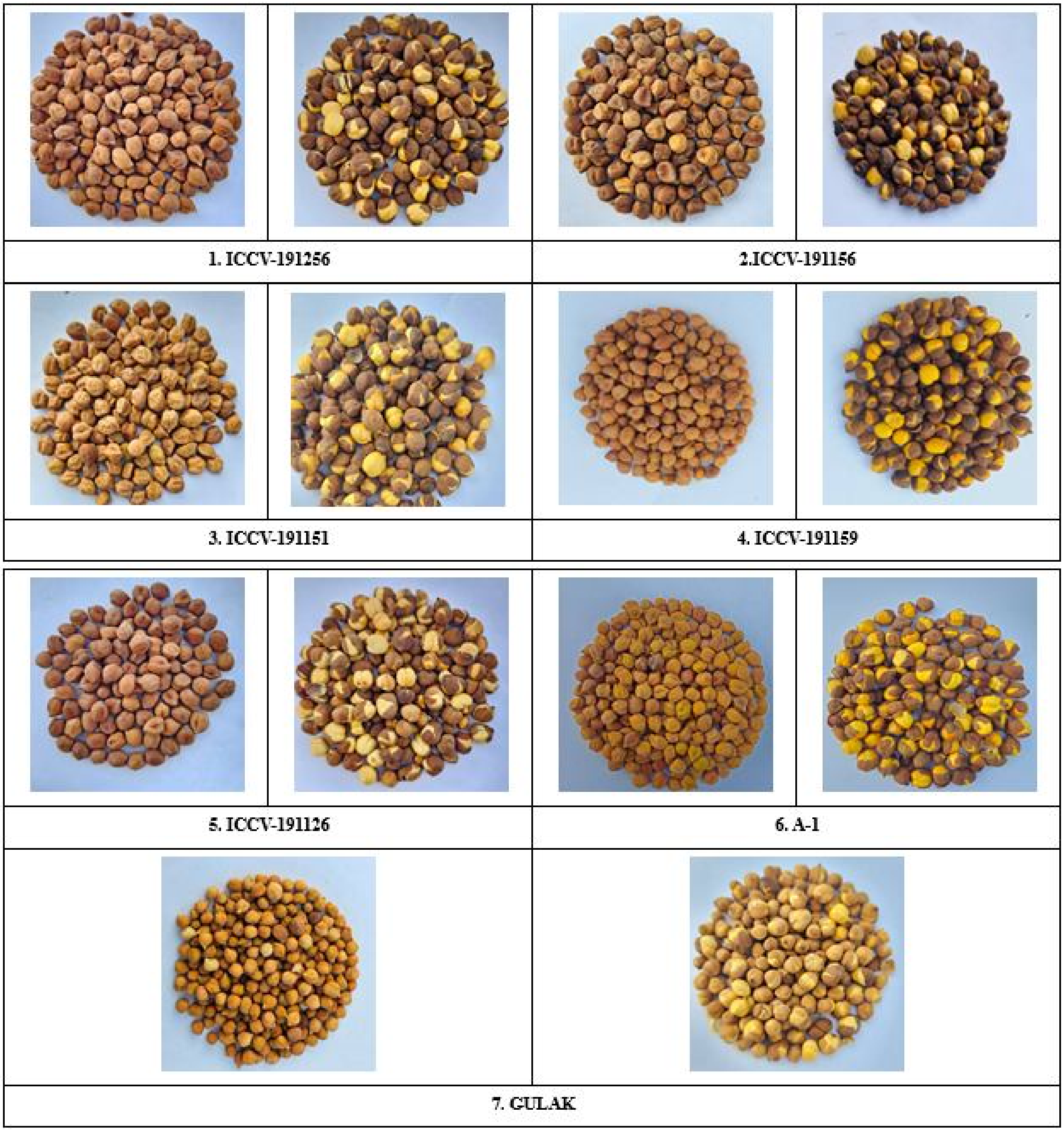

Fig. 3 : Appearance of top five ready to roast genotypes along with checks before and after roasting.

yield and identified stable genotypes. Based on stability parameters genotypes are classified and presented in Table 6 and stability of genotypes based on deviation from the regression coefficient for seed yield per plant shown in Fig. 1.

The genotype ICCV-191156 was identified as the best among all the genotypes including checks for puffing index and expansion index whereas, genotypes *viz.*, ICCV-191256, ICCV-191151, ICCV-191159 and ICCV-191126 were found on par with the checks *viz.*, A-1 and GULAK for roasting traits. Appearance of these top five ready to roast genotypes along with checks before and after roasting shown in Fig. 3. The genotypes, ICCV-191256, ICCV-191156, ICCV-191151 and ICCV-191159 were found high yielding with better roasting trait.

Conclusion

The stability analysis revealed that the Bidar location offers a favourable environment for most traits studied, with genotypes such as RG-2016-134, ICCV-191151, ICCV-191251, ICCV-191161, ICCV-191126, JG-11 and SA-1 demonstrating stable performance for seed yield.

Table 6 : Nature of stability and suitability of chickpea genotypes for three locations in chickpea.

Characters	Genotypes showing stability		
	Well, adapted to all environments bi = 1 Average Stability	**Specifically adapted to favorable environments bi > 1 Below average Stability**	**Specifically adapted to unfavorable environments bi < 1 Above average Stability**
Days to 50 per cent flowering	JG-11	ICCV-191256, ICCV-191255, ICCV-191156, GULAK, RG-2016-134, ICCV-191251, ICCV-88202, ICCV-191155 and ICCV-191159	ICCV-191161, ICCV-191253, ICCV-191151, SA-1, ICCV-191126 and A-1
Plant height (cm)	ICCV-191256, ICCV-191251, ICCV-191155 and JG-11	ICCV-191161, ICCV-191151, ICCV-191255, RG-2016-134, ICCV-88202, ICCV-191126 and A-1	ICCV-191156, ICCV-191253, ICCV-191159, SA-1 and GULAK
Number of branches per plant	-	ICCV-191256, ICCV-191156, ICCV-88202, RG-2016-134, ICCV-191161, ICCV-191159, ICCV-191155 and GULAK	ICCV-191253, ICCV-191151, ICCV-191251, ICCV-191255, ICCV-191126, JG-11, SA-1 and A-1
Number of pods per plant	ICCV-191151, ICCV-191251 and ICCV-191155	RG-2016-134, ICCV-191161, ICCV-191126, JG-11, A-1 and SA-1	ICCV-191256, ICCV-191156, ICCV-1911255, ICCV-88202, ICCV-191253, ICCV-191159 and GULAK
Seed yield per plant (g)	-	RG-2016-134, ICCV-191151, ICCV-191251, ICCV-191161, ICCV-191126, JG-11 and SA-1	ICCV-191256, A-1, GULAK, ICCV-191156, ICCV-191255, ICCV-191253, ICCV-88202, ICCV-191159 and ICCV-191155
Test weight (g)	ICCV-191253	RG-2016-134, ICCV-191151, ICCV-191251, ICCV-191159, ICCV-191255, JG-11, SA-1 and GULAK	ICCV-191256, ICCV-191156, ICCV-88202, ICCV-191126, ICCV-191155, ICCV-191161 and A-1
Iron content (ppm)	-	ICCV-191156, ICCV-191251, ICCV-191126, SA-1, RG-2016-134, ICCV-88202, ICCV-191159, JG-11, A-1 and GULAK	ICCV-191256, ICCV-191151, ICCV-191255, ICCV-191161, ICCV-191253 and ICCV-191155

Genotypes *viz*., ICCV-191256, A-1, GULAK, ICCV-191156, ICCV-191255, ICCV-191253, ICCV-88202, ICCV-191159 and ICCV-191155 were well suited for unfavourable environment. Furthermore, ICCV-191256, ICCV-191156, ICCV-191151 and ICCV-191159 emerged as high-yielding genotypes with enhanced roasting traits. These findings underscore the importance of tailoring genotype selection to specific environmental conditions. Introducing these genotypes into farmers' fields for demonstration trials could validate their yield superiority over widely cultivated or local varieties, offering practical benefits to growers.

References

Anonymous (2023–24). Area, yield and production for the year 2023–24. *Indiastat*. Retrieved from https://www.indiastat.com.

Chetariya, C.P., Pithia M.S., Pheirim R., Mehandi S., Pampaniya A.G. and Barad S.H. (2023). Genetic variability and stability of Desi chickpea (*Cicer arietinum* L.) genotypes under late sown terminal heat stress conditions. *Elect. J. Plant Breed.*, **14(4)**, 1433–1445.

Eberhart, S.T. and Russell W.A. (1966). Stability parameters for comparing varieties. *Crop Sci.*, **6(1)**, 36–40.

Gebeyaw, M., Fikre A., Abate A., Alemu Setotaw T., Bekele N., Zeleke B. and Gebremariam T. (2024). Genotype by Environment (G×E) Interaction and Yield Stability of Chickpea (*Cicer arietinum* L.) varieties Across Agroecological Regions of Ethiopia. *Leg. Sci.*, **6(2)**, 227–235.

Hamma-Umin, B.O. (2019). Stability and yielding performance of seven chickpea (*Cicer arietinum* L.) genotypes over a range of environments in Sulaimani, Iraq. *J. Zankoy Sulaimani - Part A (JZS-A)*, **21(2)**, 165–172.

Jayalakshmi, V., Laxuman C., Patil M.D., Ramadevi S. and Reddy A.L. (2024). Stability analysis for yield and yield-related traits in advanced breeding lines of chickpea (*Cicer arietinum* L.). *Elect. J. Plant Breed.*, **15(1)**, 132–137.

Kaur, R. and Prasad K. (2021). Nutritional characteristics and value-added products of chickpea (*Cicer arietinum*) – A review. *J. Post Harvest Technol.*, **9(2)**, 1–13.

Laxuman, H., Sidramappa P.H., Kumar K.S. and Kumar G.A. (2022). Seed yield stability assessment of chickpea genotypes through AMMI and Biplot analysis. *Leg. Res.*, DOI: 10.18805/LR-4911.

Laxuman, Kumar B.P., Reddy B.S., Sidramappa Kuchanur P.H., Nidgundi J.M. and Yogeesh L.N. (2024). Genotype × Environment Interaction and Stability analysis for Seed Yield in Desi Chickpea (*Cicer arietinum* L.) under irrigated conditions. *Leg. Res.*, DOI: 10.18805/LR-5020.

Rao, P., Sandhyakishore N., Srinivasan S., Sandeep S., Praveen G., Neelima G. and Kumar G.A. (2023). AMMI and GGE stability analysis of drought-tolerant chickpea (*Cicer arietinum* L.) genotypes for target environments. *Leg. Res.*, **46(9)**, 1105–1116.

Thapa, R.S., Singh T., Kumar A., Khan A.A., Kumar S. and Pratap D. (2023). Genotype × Environment (G×E) interaction and stability analysis for seed yield and its component traits in chickpea (*Cicer arietinum* L.). *Agricult. Res.*, **60(5)**, 54–62.

Yadav, L. and Bhatnagar V. (2017). Effect of soaking and roasting on nutritional and anti-nutritional components of chickpea (Pratap-14). *Bioscan*, **12(5)**, 771–774.

Yadav, R.K., Tripathi M.K., Tiwari S., Tripathi N., Asati R., Patel V., Sikarwar R.S. and Payasi D.K. (2023). Breeding and genomic approaches towards the development of Fusarium wilt resistance in chickpea. *Life*, **13(4)**, 988–999.

Zhang, J., Wang J., Zhu C., Singh R.P. and Chen W. (2024). Chickpea: Its origin, distribution, nutrition, benefits, breeding and symbiotic relationship with *Mesorhizobium* species. *Plants*, **13(3)**, 429.