

## Variations of NDVI Scores among Chickpea Varieties under Late Sown Conditions

A.K. Srivastava, G.P. Dixit, P.S. Basu, Mohammad Nisar and Shalini Srivastava<sup>1</sup>

ICAR-Indian Institute of Pulses Research, Kanpur

<sup>1</sup>Department of Botany, Institute of Science, Banaras Hindu University, Varanasi-221005, India

### Abstract

Normalized Difference Vegetation Index (NDVI) is commonly used to measure plant health and vigor. NDVI was estimated among 142 chickpea varieties (108 *desi* and 34 *kabuli*) using GreenSeeker™ Handheld Optical Sensor Unit (NTech Industries, Inc., USA) at pod development stage under late sown condition. Among *desi* types, the NDVI score ranged from 0.29 to 0.75 with mean value of 0.56. Among *kabuli* types, the NDVI scores ranged from 0.23 to 0.62 with mean value of 0.41. Thus, in general NDVI scores were less in *kabuli* chickpea. The genotypes having higher NDVI values are expected to have higher photosynthetic rate at pod development stage which might give them an edge over other varieties in terms of source capacity. Thus, among *desi* varieties JG 218, CSJ 515, Avrodhi and RSG 44 and among *Kabuli* type varieties GNG 1499, L 550, Pusa 267 and PKC 1, having higher NDVI values, are expected to give higher yield under heat stress.

**Key words:** Chickpea, NDVI, heat stress.

### Introduction

Chickpea has played a major role in realization of Pulses Revolution in India, making the country near self-sufficient in Pulses (Dixit et al. 2020; Singh et al. 2020). There is a quantum jump of 5.79 million tonnes in chickpea production during 2021-22 (13.12 million tonnes) as compared to that during 2014-15 (7.33 million tonnes). This is accompanied with more than 28% increase in chickpea productivity during 2021-22 (1142

kg/ha) as compared to productivity in 2014-15 (889 kg/ha) (Anonymous 2022). During past four decades, there is a large shift in chickpea area from northern India to Southern India. Chickpea crop is exposed to terminal heat and drought stress at flowering and maturity in Central and Southern States accompanied with severe fluctuations and increase in temperatures due to climate change (Dixit et al. 2019). Due to increased area under late sown conditions, terminal heat stress tolerance in chickpea has assumed paramount importance (Arriagada et al. 2022). Field screening for heat tolerance based on yield reduction under heat stress is cumbersome. Plant health and vigour under heat stress can provide insight to its heat tolerance. Normalized Difference Vegetation Index (NDVI) is commonly used to measure plant health and vigor ([https://phenology.cr.usgs.gov/ndvi\\_foundation.php](https://phenology.cr.usgs.gov/ndvi_foundation.php)). In the present study an attempt has been made to assess the heat tolerance capacity of chickpea varieties based on NDVI scores.

### Materials and Methods

The material under study included 142 chickpea varieties among which 108 were *desi* types and 34 were *kabuli* types (Table 1). NDVI was estimated using Green Seeker™ Handheld Optical Sensor Unit (NTech Industries, Inc., USA) at pod development stage under late sown condition. Mean and Range of NDVI scores among *desi* and *kabuli* varieties were estimated.

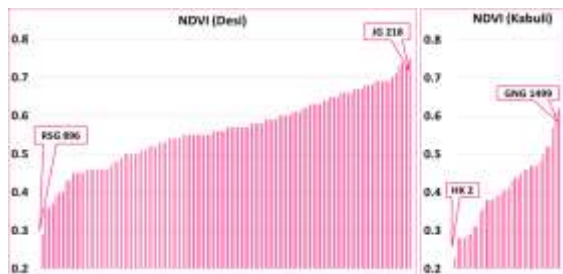
**Table 1. Description of Chickpea varieties used in study.**

Desi Chickpea			Kabuli Chickpea
RSG 10	H 82-2	Pusa 547	HK 2
RSG 896	RSG 959	Chaffa	ICCV 2
RVG 202	Annegiri 1	ICCV 10	Pusa 1108
BG 3043	KWR 108	PBG 5	RVKG 101
HC 3	Radhey	RAU 52	JGK 1
JG 412	Gulak 1	Anuradha	Pusa 1088
RVG 203	JG 74	BG 261	BG 1053
JG 130	KPG 59	Dahod Yellow	Kripa
RSG 963	Rajas	RSG 931	Virat
Bidisha	Digvijay	CSJD 884	GLK 28127
CSG 8962	GNG 1488	JG 12	CSJK 21
JG 6	JG 322	Pusa 212	KAK 2
Phule G 0405	K 850	GG 5	Vihar
GNG 469	Mahamaya 1	PUSA 72	HK 4
JG 14	NBeG 3	GNG 1958	Pusa 1105
Pusa 1103	RSG 2	ICCC 37	CSJK 6
RSG 895	RSG 902	JG 315	JGK 3
RSG 945	Vishwas	PDG 3	RSGK 6
Vijay	C 235	AKG 9303-12	HK 1

Vishal	Pant Gram 5	GNG 663	BG 2085
GNG 146	Phule	BG	GLK
	G 12	372	26155
GNG 2171	Pusa 329	Pusa 391	IPCK 02-29
Pratap Chana 1	BGM 413	Vikas	GNG 1491
JG 11	Birsa Chana 3	GL 769	GNG 1969
DCP 92-3	GG 3	JG 63	BGD 128
GCP 105	GPF 2	Mahamaya 2	GNG 1292
GNG 1581	JG 16	RSG 807	HK 98-155
JAKI 9218	JG 226	GG 2	PKV 4
RVG 201	Pusa 362	Pusa 209	IPCK 04-29
PBG 1	AKGS -1	RSG 11	L 552
RSG 973	CSJ 140	BGM 408	PKC 1
GNG 2144	Pusa 244	HC 5	Pusa 267
RSG 974	Vaibhav	CSJ 515	L 550
Himanchal Chana 1	Pant G 114	JG 218	GNG 1499
Phule Vikram	PDG 4		
RSG 888	RSG 44		
Sadabahar	Avrodhi		

**Findings**

Among *desi* types, the NDVI score ranged from 0.29 to 0.75 with mean value of 0.56. Maximum reading was observed in JG 218 (0.75) followed by CSJ 515 and Avrodhi (0.74 each) (Fig. 1).

**Fig 1. NDVI range among *desi* and *kabuli* varieties.**

Minimum reading was observed in RSG 896 (0.29) followed by RVG 202 and BG 3043 (0.36 each). Among *kabuli* types, the NDVI scores ranged from 0.23 to 0.62 with mean value of 0.41. Among *kabuli* chickpea, maximum reading was observed in GNG 1499 (0.62) followed by L 550 (0.61) and Pusa 267 (0.57). Minimum reading was observed in Haryana *Kabuli* Chana-2 (0.23) followed by ICCV 2 and Pusa 1108 (0.28 each). Thus, in general NDVI scores were less in *kabuli* types as compared to *desi* types (Table 1).

**Table 1. Descriptive Statistics for NDVI scores in chickpea varieties**

Parameters	<i>Desi</i>	<i>Kabuli</i>
Mean	0.56	0.41
Range	0.46	0.39
Minimum	0.29	0.23
Maximum	0.75	0.62

The top ten *desi* chickpea varieties with high NDVI scores included JG 218, CSJ 515, Avrodhi, RSG 44, PDG 4, Pant G 114, Vaibhav, Sadabahar, RSG 888 and Phule Vikram (Table 2). *Kabuli* type chickpea varieties with high NDVI scores included GNG 1499, L 550, Pusa 267, PKC 1, L 552, IPCK 04-29, PKV 4, HK 98-155, GNG 1292 and BGD 128.

**Table 2. *Desi* and *Kabuli* chickpea varieties with best NDVI scores under late sown condition**

<i>Desi</i> Chickpea	NDVI (Best)	<i>Kabuli</i> Chickpea	NDVI (Best)
Phule Vikram	0.69	BGD 128	0.47

RSG 888	0.69	GNG 1292	0.47
Sadabahar	0.69	HK 98-155	0.47
Vaibhav	0.69	PKV 4	0.48
Pant G 114	0.70	IPCK 04-29	0.50
PDG 4	0.71	L 552	0.52
RSG 44	0.73	PKC 1	0.52
Avrodhi	0.74	Pusa 267	0.57
CSJ 515	0.74	L 550	0.61
JG 218	0.75	GNG 1499	0.62

### Conclusion

The NDVI successfully predicts photosynthetic activity determined by chlorophyll content and activity which is a manifestation of chosen agricultural management system within the boundaries of the agro-ecological environment. Under late sown condition, proper canopy growth at pod development stage is a limiting factor due to reduced growing period. The genotypes having higher NDVI values are expected to have higher photosynthetic rate at pod development stage which might give them an edge over other varieties in terms of source capacity. Among *desi* varieties JG 218, CSJ 515, Avrodhi and RSG 44 are having higher NDVI values. These are expected to have higher photosynthetic rate at pod development stage leading to higher yield under heat stress. *Kabuli* type varieties GNG 1499, L 550, Pusa 267 and PKC 1 are having higher NDVI values. These lines can be used as donor for developing chickpea varieties with higher heat tolerance.

### References

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