

Studies on crop phenology and physiological attributes in prerelease cultures of chickpea (*Cicer arietinum* L.) under rainfed and irrigated conditions

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ABSTRACT

The study was carried out at Regional Agricultural Research Station, Nandyal to study the performance of advance chickpea breeding lines under rainfed and irrigated conditions during Rabi 2020-21 and 2021-22 in black cotton soils. The experiment was conducted in Factorial Randomized Block Design with eight chickpea genotypes (four Desi : NBeG 49, NBeG 776, NBeG 779, NBeG 857 and four Kabuli : NBeG 440, NBeG 789, NBeG 833, NBeG 844) under rainfed and irrigated condition with gross plot size 7.2 m². Significantly higher seed yield was recorded in desi genotypes, i.e NBeG-857 (2592 kg/ha) followed by NBeG- 779 (2526 kg/ha) and in kabuli genotype NBeG-440 (2055 kg/ha) followed by NBeG- 833 (1874 kg/ha). The seed yield in irrigated conditions (2326 kg/ha) was significantly higher compared to rainfed conditions (1992 kg/ha). The interactions between genotypes and irrigation was not significant. In desi genotypes hundred seed weight was higher in NBeG -779 (28.7g) and in kabuli NBeG-833 had higher seed size (44.5g). Chickpea genotypes responded to irrigation and an yield advantage of 442 kg/ha was realized due to improvement in biomass and source sink relationship.

Key words: Chickpea, Rainfed, Irrigated, Yield, Yield attributes.

Introduction

Chickpea (*Cicer arietinum* L.) is the second most important pulse crop globally, grown in an area of about 12.6 million ha across 55 countries (FAOSTAT, 2016). India contributes 70% of total global production with 116.2 lakh tones grown on 112 lakh hectares with a productivity of 1036 Kg/ha ([www. agricoop. nic.in](http://www.agricoop.nic.in)). India is the world's

largest producer of gram, followed by Turkey, Pakistan, Myanmar and Ethiopia. Chickpea ranks first in total pulse production in India, followed by redgram. Andhra Pradesh is sixth important chickpea growing state in India and produces 5.66 lakh hectares with a productivity of 1218 kg/ha (Annual Report, All India Co-ordinated Research Project on chickpea, 2020-21). Chickpea is an economically beneficial protein rich food, legume car-

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bohydrate, dietary fibers, polyunsaturated fatty acids, minerals and vitamins (Jukanti, *et al.*, 2012). Chickpea is preferred to food legumes in some regions because of its multiple uses. Mostly in India chickpea grown under rainfed and receding soil moisture condition as a post rainy season crop during *Rabi*. In Andhra Pradesh chickpea crop is grown in most parts of Kurnool, Prakasam, Anantapur and Kadapa districts. Changes in cropping system that necessitate late planting, scope for expansion in rice fallows and the global warming are pushing chickpeas to relatively warmer growing environment. Therefore screening of chickpea germplasm for drought and high temperature is priority. Gaur *et al.*, 2008 reported that varieties with drought avoidance (dehydration postponement) or drought tolerance (dehydration resistance) abilities are needed for improving grain yield of chickpea under drought stress. A study of physiology of crop in different varieties helps in identification of tolerant and resistant varieties for which the various phenological stages, i.e sowing to emergence, flowering to podding, podding to physiological maturity and physiological maturity to harvest maturity of the crop will be evaluated and helps in increasing the yield. In chickpea it was difficult to select directly for resistance to dryness because genetic control of this quantitative trait was very complex. The current approach consists in selecting for several parameters related to resistance to drought. The present investigation carried out to identify chickpea lines for cultivation in rainfed areas through some of physiological characteristics and yield components.

Materials and Methods

The field experiment was conducted during consecutive *Rabi* seasons of 2020-21 and 2021-22 at Regional Agricultural Research Station, Nandyal, Andhra Pradesh located at 18° 29' N latitude, 78° 29' E longitude, and at an altitude of 202 m above mean sea level with an average rainfall 772 mm. The experimental plot was black cotton soil with P^H 8.3 and E.C 0.26 dsm⁻¹, having low available nitrogen (196 Kg ha⁻¹), medium in available P₂O₅ (48 kg ha⁻¹) and high available K₂O (346 Kg ha⁻¹). The experiment design was Factorial Randomized Block design with eight chickpea genotypes (four Desi : NBeG 49, NBeG 776, NBeG 779, NBeG 857 and four Kabuli : NBeG 440, NBeG 789, NBeG 833, NBeG 844) under rainfed and irrigated condition with

gross plot size 7.2 m² and replicated thrice. The total rainfall and rainy days received during crop growth period 2020-21 & 2021-22 were 65.2 mm and 140.5mm with 4 & 12 days respectively. Only one irrigation (50 mm) was given at 55 days after sowing to irrigated crop. The observation on morpho-Phenological traits and yield attributes *viz.*, plant height (cm), root length (cm), Days to first flowering, Days to 50% flowering, leaf area index, Specific leaf area (cm²/gm), SPAD chlorophyll meter reading, Chlorophyll stability index and number of pods per plant, 100 seed weight, seed yield (kg /ha) were recorded under field conditions. Statistical analysis of the data was analyzed (Panse and Sukhatme, 1978).

Results and Discussion

Physiological traits

The data recorded during two seasons on physiological and yield attributes were analyzed as per standard statistical procedures. Significantly higher plant height was recorded in desi genotypes was NBeG- 776 (40.59cm) and in kabuli genotypes NBeG- 789 had tall plants (46.3 cm). Under rainfed conditions plant height was 41.5 cm and under irrigated conditions (43.2 cm). Significantly higher root length was recorded in desi genotype NBeG 857 (12.9 cm) and NBeG -833 kabuli genotype (15.8 cm). Desi genotype was early to flowering NBeG - 49 (31.5) and where as NBeG -440 is early in kabuli genotypes (35.5). Significantly lower days to 50% flowering was recorded in NBeG -49 (35.6) and in kabuli NBeG -440(40.7). Berger *et al* (2006) reported that warm Southern locations favour early flowering than compared to Northern conditions.

Under desi genotypes higher leaf area index was recorded in NBeG-779 and NBeG-857 (2.0) while in kabuli genotypes NBeG-440, NBeG-833 and NBeG 844 had high Leaf Area Index (2.1). Under rainfed conditions leaf area index was 1.8 and in irrigated conditions is was 2.1. Significantly higher specific leaf area (cm²/gm) in desi genotypes was recorded NBeG- 49 (174 cm²/gm) while in kabuli NBeG-844 (179 cm²/gm). Among desi genotypes higher SPAD chlorophyll meter reading was in NBeG 779 (46.1) and in kabuli NBeG- (44.6). Under rainfed conditions SPAD chlorophyll meter reading was (43.4) and in irrigated conditions was (44.3). The interactions between genotypes and irrigation was non significant. In desi genotypes higher chlorophyll stability index

was recorded in NBeG 776 (56.5) and in kabuli NBeG 844 (56.9). Under rainfed conditions chlorophyll stability index was (49.7) and in irrigated conditions (54.2) (Table 1) Berger *et al.* (2006) reported that phenology, time to flowering, podding to matu-

rity play critical role in adoption of chickpea cultivars to different environments. Early phenology is a key trait for adoption of chickpea to short season environments as it helps crop to escape from end of the stress.

Table 1. Morpho-Phenological traits of chickpea genotypes under rainfed and irrigated conditions 2020-21 & 2021-22 (pooled analysis)

Genotypes	Plant height (cm)	Root length (cm)	Days to first flowering	Days to 50% flowering	Leaf area index	Specific leaf area (cm ² /gm)	SPAD chlorophyll meter	Chlorophyll reading stability index
NBeG 49 (D)	41.2	12.0	31.5	35.6	1.9	174	37.6	49.5
NBeG 776 (D)	40.9	11.4	32.0	36.4	2.0	170	45.5	56.5
NBeG 779 (D)	40.7	12.6	32.0	35.7	1.9	163	46.1	55.5
NBeG 857 (D)	37.1	12.9	31.8	37.5	2.0	166	42.4	47.1
NBeG 440 (K)	42.2	14.2	35.5	40.7	2.1	170	40.0	56.9
NBeG 789 (K)	46.3	10.5	37.8	42.2	1.8	163	43.1	46.8
NBeG 833 (K)	44.9	15.8	41.7	46.8	2.1	173	44.5	47.2
NBeG 844 (K)	45.3	15	42.0	46.7	2.1	179	43.5	56.1
SEm±	0.9	0.006	0.6	0.6	0.59	2.5	1.2	0.8
CD (P=0.05)	2.6	0.02	1.7	1.7	0.17	7.4	3.53	2.4
Irrigation Levels								
I1	41.5	13.1	34.7	39.4	1.8	161	43.4	49.7
I2	43.2	13.0	36.4	41.0	2.1	178	44.3	54.2
SEm±	0.44	0.003	0.3	0.28	0.03	1.3	0.61	0.4
CD (P=0.05)	1.27	0.009	0.9	0.83	0.09	3.7	1.76	1.9
Interactions : Vx I								
SEm±	1.24	0.01	0.85	0.81	0.08	3.7	1.73	1.15
CD (P=0.05)	NS	0.03	NS	NS	NS	NS	NS	NS

Table 2. Physiological traits and yield attributes of chickpea genotypes under rainfed and irrigated conditions 2020-21 & 2021-22 (pooled analysis)

Genotypes	No. of pods/Plant	100 seed weight (gm)	Yield (kg/ha)		
			2020-21	2021-22	Pooled
NBeG 49 (D)	23.0	26.1	1590	2343	1967
NBeG 776 (D)	26.2	28.5	1851	2997	2425
NBeG 779 (D)	28.8	28.7	1952	3099	2526
NBeG 857 (D)	29.4	28.1	1879	3304	2592
NBeG 440 (K)	21.3	31.9	1674	2437	2055
NBeG 789 (K)	23.2	38.9	1665	2292	1979
NBeG 833 (K)	17.6	44.5	1445	2302	1874
NBeG 844 (K)	17.5	43.5	1314	2328	1857
SEm±	0.50	0.52	83	91	54.62
CD (P=0.05)	1.45	1.5	240	265	157.8
Irrigation Levels					
I1	21.35	33.4	1488	2498	1992
I2	25.4	34.2	1853	2778	2326
SEm±	0.25	0.26	41	45	27.3
CD (P=0.05)	0.72	0.75	120	133	78.9
Interactions: Vx I					
SEm±	0.71	0.73	117	129	77.2
CD (P=0.05)	2.0	2.12	NS	NS	NS

I1: Rainfed; I2: Irrigated (Irrigated at 55 DAYS with 50 mm)

Yield and yield attributes

Significantly higher number of pods per plant in desi genotypes were recorded in NBeG-857 (29.4) and in kabuli NBeG-789 (23.2). Under rainfed conditions number of pods per plant was (21.3) and in irrigated conditions it was 25.4. The interaction between genotypes and irrigation was significant. In desi genotypes test weight was higher in NBeG-779 (28.7g) and in kabuli NBeG-833(44.5g). Under rainfed conditions test weight was 33.4g and in irrigated conditions it was 34.2g. The interaction between genotypes and irrigation was significant. Among desi genotypes significantly higher seed yield was recorded in NBeG-857 (2592 kg/ha) and on par with NBeG-779 (2526 kg/ha) while in kabuli genotype NBeG-440 was top yielder (2055 kg/ha). Under rainfed conditions seed yield was (1992 kg/ha) and in irrigated conditions (2326 kg/ha). The interactions between genotypes and irrigation was non significant. Increasing rainfall, annual plants delay their phenology, giving them more time to capture resources, accumulate biomass. Source sink relationship will be improved which in turn maximizes their yield potential (Grime, 1977). Devasirvatham *et al* (2012) reported that terminal drought can reduce chickpea yields by 70%. By giving 50 mm irrigation at 55 days after sowing to chickpea 442 kg/ha seed yield was increased (Table 2).

Moisture availability during crop season is critical in realizing higher crop yields. All the chickpea genotypes tested in the study have shown good response to one irrigation and an yield advantage of 442 kg/ha was realized due to improvement in the biomass and other physiological parameters.

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