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PERFORMANCE OF CHICKPEA (*Cicer arietinum* L.) VARIETIES TO IRRIGATION AND PHOSPHOROUS LEVELS IN VERTISOLS UNDER RAINFED CONDITION

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ABSTRACT

Field investigation was undertaken for two consecutive years (2017-18 and 2018 -19) at Regional Agricultural Research Station, Nandyal, Andhra Pradesh during *rabi* on vertisols to estimate growth parameters, yield attributes and yield of chickpea varieties relative to irrigation and phosphorus levels under rainfed condition. The experiment was carried out in split split plot design with two irrigation levels (without irrigation and with irrigation) as main plots, two varieties (*Desi* -NBeG 49 and *Kabuli* - NBeG 119) as sub plots and four phosphorus levels (0, 25, 50, 75 kg ha^{-1}) as sub sub plots with three replications. Significantly higher number of pods (30.2 plant^{-1}), seed yield (1628 kg ha^{-1}) and net returns (Rs 46,768 ha^{-1}) were recorded with application of irrigation when compared to without irrigation (24.8 plant^{-1}, 1256 kg ha^{-1} and Rs 30,795 ha^{-1}). NBeG 49 recorded higher number of pods (32.2 plant^{-1}) and seed yield (1580 kg ha^{-1}) when compared to NBeG 119 (22.7 plant^{-1} and 1305 kg ha^{-1}). Phosphorus levels did not exert any significant influence on growth parameters, yield attributes and seed yield of chickpea.

KEYWORDS: Chickpea, irrigation, varieties, phosphorus, seed yield

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important legume crop cultivated and consumed across the world. Among the different countries in the world, India is the largest producer and consumer of chickpea. It is grown in an area of about 9.85 Mha with a production of 10.32 Mt and productivity of 1048 kg ha^{-1} (http: //www.agricoop.nic.in). In Andhra Pradesh it is grown in an area of 0.58 Mha with a production of 0.72 Mt and productivity of 1241 kg ha^{-1}. Chickpea is *rabi* crop generally cultivated under conditions of residual soil moisture and often subjected to deficit moisture after sowing. In chickpea, branching (pre flowering) and pod development stages are moisture sensitive stages. Water stress adversely affects many aspects of plant growth, which ultimately reduce dry matter production and seed yield. Reduction in seed yield depends on stage of crop growth, intensity and duration of stress. Phosphorus is important plant nutrient involved in wide range of plant processes from permitting cell division to the development of a good root system. Legumes generally have a higher phosphorus requirement as lot of energy is consumed during the process of symbiotic nitrogen fixation. Farmers are applying higher doses of complex fertilizers to chickpea. Vertisols have medium to high range of phosphorus. Under the above circumstances, the present work was undertaken to study the effect of irrigation levels and different phosphorus doses on performance of chickpea varieties under rainfed conditions.

MATERIAL AND METHODS

The present experiment was carried out during *rabi* for two consecutive years (2017-18 and 2018-19) at Regional Agricultural Research Station, Nandyal (ANGRAU), Andhra Pradesh. The investigation was carried out in split-split plot design with two irrigation levels (without irrigation and with irrigation) as main plots, two varieties (NBeG 49 and NBeG 119) as sub plots and four phosphorus levels (0, 25, 50, 75 kg ha^{-1}) as sub sub plots sown at 30 cm × 10 cm spacing with three replications. The soil of the experimental soil is moderately alkaline (pH-8.3), non saline (EC-0.15 dSm^{-1}), low in available nitrogen (113 kg ha^{-1}), medium in available phosphorus (48.5 kg ha^{-1}) and high in available potassium (366 kg ha^{-1}). All the recommended package of practices was adopted to raise chickpea. One light irrigation (30 mm) was given at branching stage (pre flowering). Soil samples were collected and soil moisture at different intervals was calculated by gravimetric method. Observations were recorded from five randomly

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Table 1. Rainfall during the crop growth period

Month	2017-18			2018-19		
	Rainfall (mm)	Rainy days	Deviation (%)	Rainfall (mm)	Rainy days	Deviation (%)
October	124.8	7	66.2	4.0	1.0	-95.2
November	3.2	1	-91.9	8.2	1.0	-78.2
December	0	0	-100.0	3.0	1.0	11.1
January	0	0	-100.0	18.0	2.0	1185.7
Total	128.0	8.0	8.2	33.2	5.0	-73.5

selected plants from each treatment in each replication to estimate the growth and yield parameters. The data recorded on soil moisture, plant height (cm), number of branches, days to 50% flowering, number of pods per plant, test weight (g), seed yield (kg ha^{-1}) and harvest index (%) were subjected to statistical analysis by adopting Fisher's method of analysis of variance at 5% level of significance as outlined by Gomez & Gomez (1984).

RESULTS AND DISCUSSION

Rainfall during the crop growth period

During the experimentation period chickpea was sown during the second fortnight of October and harvested in the second fortnight of January. During 2017-18, 128.0 mm rainfall (8.2% higher than normal) in 8 rainy days was received during crop growth period whereas during 2018-19, 33.2 mm rainfall (73.5% lower than normal) in 5 rainy days was received during crop growth period (Table 1). During 2017-18, except 3.2 mm rain in November there was no rainfall further affects the growth and yield of chickpea. During 2018-19, chickpea was sown during October with pre-sowing irrigation due to non receipt of sufficient rainfall. There was deficit rainfall during crop growth period which affected the growth and yield of the chickpea.

Available soil moisture

The analysis of variance was significant for quantitative traits due to irrigation levels and varieties. The data in table 2 showed that irrigation levels did not influence the available soil moisture at 25 and 75 days after sowing (DAS) but significantly higher soil moisture (18.6%) was recorded at 50 DAS with one irrigation at pre flowering stage/branching stage when compared to without irrigation (15.8%). Different varieties and phosphorus doses did not influenced the available soil moisture at different intervals.

Growth parameters and seed yield

Significantly higher plant height (38.0 cm), days to 50% flowering (42.7 days), pods $plant^{-1}$ (30.2), test weight (35.8 gm), seed yield (1628 kg ha^{-1}), net returns (Rs 46,768 ha^{-1}) and BCR (2.42) was recorded with irrigation when compared to without irrigation (35.3 cm, 40.4 days, 24.8, 34.0 gm, 1256 kg ha^{-1}, Rs 30,795 ha^{-1} and BCR of 2.00 respectively). Irrigation influenced the crop growth and increased the seed yield of chickpea by 29.6 per cent. The result is in confirmation with Palled *et al.* (1995), where they reported that the number of branches $plant^{-1}$ increased due to irrigation in blackgram. Significantly higher number of pods $plant^{-1}$ and 100 seed weight with irrigation at pod development stage over irrigation at flowering and no irrigation might be due to better translocation of absorbed nutrients coupled with supply of soil moisture which coincided with peak pod and seed development stages (Fallah *et al.,* 2005). The results indicated that number of branches $plant^{-1}$ increased with increasing soil moisture content. Reduced number of branches $plant^{-1}$ might be due to inhibition of cell division and cell enlargement under water stress (Mariam *et al.,* 2014). Significantly lower plant height (34.7 cm), higher number of days to 50% flowering (43.0 days), pods $plant^{-1}$ (32.2), lower test weight (29.7 gm), higher seed yield (1580 kg ha^{-1}), net returns (Rs 39,173 ha^{-1}) and BCR of 2.29 was observed with *Desi* variety NBeG 49. Significantly higher plant height (38.6 cm), lower days

Table 2. Soil moisture, growth, seed yield and economics of chickpea as influenced by different treatments

Treatments	Soil moisture (%)			Plant height (cm)	No. of branches plant^{-1}	Days to 50% flowering	Pods Plant^{-1}	Test weight (g)	Seed yield (kg ha^{-1})	Net returns (Rs.)	BCR
	25 DAS	50 DAS	75 DAS								
Irrigation levels											
Without irrigation	23.0	15.8	13.7	35.3	10.1	40.4	24.8	34.0	1256	30795	2.00
With irrigation	22.5	18.6	15.3	38.0	12.0	42.7	30.2	35.8	1628	46768	2.42
SEm±	0.35	0.27	0.46	0.16	0.24	0.17	0.49	0.28	19.4		
CD (P=0.05)	NS	1.7	NS	1.0	1.5	1.1	3.0	1.7	125		
Varieties											
NBeG 49 (Desi)	22.4	16.6	14.4	34.7	11.5	43.0	32.2	29.7	1580	39173	2.29
NBeG 119 (Kabuli)	23.2	17.9	14.5	38.6	10.5	40.0	22.7	40.2	1305	38423	2.15
SEm±	0.33	0.48	0.08	0.69	0.53	0.28	0.82	0.3	44.1		
CD (P=0.05)	NS	NS	NS	2.7	NS	1.0	3.2	1.2	172		
P_2O_5 levels (kg ha^{-1})											
P 0	22.0	16.5	14.2	36.1	10.6	41.8	27.1	35.0	1414	39627	2.33
P 25	23.0	17.2	14.4	36.7	10.8	41.4	27.2	34.6	1454	40154	2.29
P 50	22.9	17.2	14.4	36.7	11.5	41.6	27.8	35.1	1458	38728	2.19
P 75	23.3	18.0	14.9	37.2	11.2	41.3	27.9	35.0	1442	36625	2.08
SEm±	0.65	0.65	0.34	0.85	0.52	0.31	0.83	0.46	58.9		
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS		
Interactions											
SEm±	1.29	1.30	0.67	1.69	1.05	0.61	1.66	0.93	117.8		
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS		

Table 3. Interaction effect of different treatments on seed yield (kg ha^{-1}) of chickpea

Treatments		P_2O_5 levels (kg ha^{-1})				
Irrigation levels	**Varieties**	**P 0**	**P 25**	**P 50**	**P 75**	**Mean**
Without irrigation	NBeG 49	1219	1291	1399	1465	1256
	NBeG 119	1202	1185	1157	1137	
With irrigation	NBeG 49	1819	1848	1864	1734	1628
	NBeG 119	1419	1494	1414	1433	
Mean	Varieties	1580		1305		
	P levels	1414	1454	1458	1442	

	SEm±	CD (P=0.05)
Irrigation levels (I)	19.4	125
Varieties (V)	44.1	172
P_2O_5 levels (P)	58.9	NS
Interactions	117.8	NS

to 50% flowering (40.0 days), pods plant^{-1} (22.7), higher test weight (40.2 gm), lower seed yield (1305 kg ha^{-1}), net returns (Rs 38,423 ha^{-1}) and BCR of 2.15 was observed with *Kabuli* variety NBeG 119. A wide range of variation was observed for all traits under study suggesting variability among the genotypes for these traits. Results of the present investigation are in conformity with Ramanappa *et al.* (2013). The estimates of variability revealed that genetic variability was significant among the genotypes under study. The present findings were in accordance with Parameswarappa *et al.*(2012) for plant height and days to 50% flowering. Similar result was reported by Alkadev *et al.* (2017) for 100 seed weight. The variation for different qualitative and quantative traits in chickpea could help breeders to release better and superior lines and varieties (Malik *et al.* 2010; Rozina and Hamayoon, 2011). Different phosphorus levels did not influence growth, yield parameters and seed yield. This could be due to productive soil status for supply of phosphorus. Similar results were also reported by Nawange *et al.* (2011), Yadav *et al.* (2016) and Basha *et al.,* (2018). The genotype NBeG 49 cultivated with application of 50 kg P ha^{-1} and with one irrigation at pre flowering/branching recorded higher seed yield (1864 kg ha^{-1}) compared to NBeG 119 cultivated without application of phosphorus and irrigation (1202 kg ha^{-1}) (Table 3).

It can be concluded that, most of the morphological and yield attributes such as plant height, pods plant^{-1}, test weight, seed yield were enhanced significantly due to application of irrigation. Cultivation of desi variety NBeG 49 with application of 50 kg P_2O_5 ha^{-1} with one light irrigation (30 mm) at branching stage/pre flowering enhanced the productivity of chickpea under moisture deficit condition in vertisols.

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