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Influence of Moisture Regimes on Yield and Water Use Efficiency of Chickpea Cultivars (*Cicer arietinium* L.)

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ABSTRACT

A field experiment was conducted at College farm, Acharya N.G. Ranga Agricultural University, Hyderabad during rabi, 2013-14 to study the yield and water use efficiency of gram influenced by irrigation levels. Irrigation levels has shown significant influence on yield and water use efficiency. Among four irrigation schedules, Irrigation scheduled at 0.6 IW:CPE (I_3) produced significantly higher grain and haulm yields of chickpea but it was on par with 0.9 IW:CPE (I_4). The JG-11 variety has produced higher grain yield than Annegiri. Water use efficiency decreased with increase in irrigation level from I_1 (Rainfed), to I_4 (0.9 IW:CPE) treatments. Moisture regimes at higher level i.e. 0.9 IW:CPE ratio requires more water compared to other lower levels. The lowest water use was recorded under I_4 (0.9 IW:CPE) treatment.

Key words: *Chickpea, Yield, Irrigation scheduling, IW/CPE ratio, WUE.*

INTRODUCTION

Chickpea (*Cicer arietinium* L.) is a *rabi* pulse crop and largest produced food legume in South Asia and the third largest produced food legume globally. It is predominantly grown on residual soil moisture as is evident from the fact that of the total area in the country, only 1.96 million ha (28.3%) is irrigated[5]. Experimental results of Bhaskara Reddy[1] revealed that keeping the total quantity of irrigation water constant, increasing the frequency of irrigation would maximize the yields in several crops. Because of high productivity under assured irrigation, a climatological approach based on IW/CPE ratio in irrigation scheduling has been found most appropriate as it integrates most of the weather parameters which determine the water requirement of a crop and increase production by at least 15 to 20 per cent[4]. Since many years farmers were following the same irrigation schedule irrespective of the varieties cultivated without knowing its feasibility under today's climatic conditions. Hence, today's limited water resources along with changing cropping patterns calls for urgent need for application of water at an appropriate intervals or ensuring better water use efficiency. Keeping this in view, this study was undertaken to investigate the influence of moisture regimes on yield and water use efficiency of chickpea cultivars.

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MATERIALS AND METHODS

A field experiment was conducted to during *rabi*, 2013-2014. The research work was carried out at College Farm, College of Agriculture, Rajendranagar, Hyderabad. The soil of the experimental field was sandy loam in texture with pH of 7.8. The soil was low in available nitrogen (226 kg ha^{-1}), available phosphorus (18.5 kg ha^{-1}) and medium in available potassium (235 kg ha^{-1}) contents.

The experiment was laid out in a randomized block design (two factors) with one factor I: treatments of four moisture regimes *viz.*, I_1 (Rainfed), I_2 (0.3 IW:CPE), I_3 (0.6 IW:CPE), I_4 (0.9 IW:CPE) and factor II : varieties JG-11 and Annegiri and replicated thrice. Chickpea was sown after treating the seed with Rhizobium and were hand dibbled @ 2 seeds $hill^{-1}$ at a depth of 6 cm and sowing was carried out in N-S direction leaving 10 cm space between two hills with a row to row gap of 30 cm. Immediately after sowing basal application of N-20, P_2O_5-50, K_2O-40 kg ha^{-1} was applied. The mean daily maximum temperature during the crop period ranged from 27.4^0C to 32.8^0C with an average of 28.9^0C, while the daily mean minimum temperature ranged from 7.51^0C to 18.53^0C with an average of 13.9^0C. The mean pan evaporation (USWB- class A pan) recorded during the crop period ranged from 1.73 to 4.51 mm day^{-1} with an average of 3.19 mm day^{-1}. In general, the weather was congenial for the cultivation of chickpea during *rabi*, 2013-2014. Yield were recorded at harvest and water use efficiency is The weight of economic yield per unit of water used is referred to as water use efficiency and was calculated by using the formula given by Viets[14].

$$\text{WUE (kg ha}^{-1}\text{ mm}^{-1}\text{)} = \frac{\text{Economic yield (kg ha}^{-1}\text{)}}{\text{Water used (mm)}}$$

Water use (mm) = Soil moisture depletion (mm) + effective rainfall (mm)

Statistical analysis was done to all the recorded data as per Panse and Sukhatme[8]

RESULTS AND DISCUSSION

The results of the investigation, regarding the chickpea on yield and water use efficiency content have been presented in Table 1 & 2.

Grain Yield

The highest grain yield was obtained when irrigation was scheduled at an IW:CPE ratio of 0.6 (I_3) (1882 kg ha^{-1} and 1655 kg ha^{-1} for JG-11 and Annegiri, respectively), but it was on par with I_4 (IW:CPE-0.9) (1722 kg ha^{-1} and 1542 kg ha^{-1} for JG-11 and Annegiri, respectively) treatment. The higher grain yield with more frequent irrigation might be accounted for their favourable influence on the growth characters (plant height and number of branches respectively) and yield attributing characters (no. of pods $plant^{-1}$ and test weight, respectively). In case of I_4 treatment which provide maximum frequency of irrigation (four irrigations), the decrease in grain yield as compared to I_3 treatment might be due to frequent irrigations leading to relatively lesser seed filling. Similar findings were reported by Palled *et al.*[7], Chandrasekhar and Saraf[2]. The JG-11 variety recorded significantly higher grain yield (1882 kg ha^{-1} at 0.6 IW:CPE ratio) as compared to Annegiri (1655 kg ha^{-1} at 0.6 IW:CPE ratio). These results were in conformity with Naik *et al.*[6], Rao *et al*[10].

Interaction effect between irrigation levels and varieties was non significant with regard to the grain yield.

Haulm yield

Irrigation level I_3 recorded the maximum haulm yield (893 kg ha^{-1} and 794 kg ha^{-1} for JG-11 and Annegiri, respectively), but was on par with I_4 treatment (822 kg ha^{-1} and 657 kg ha^{-1} for JG-11 and Annegiri, respectively). The increase in haulm yield with increased in

irrigation frequency of irrigation might be accounted for high vegetative growth and dry matter production. Similar findings were reported by Dabhi *et al.*[3] and Singh *et al*[11]. The varieties significantly differ among themselves higher haulm yield was obtained with JG-11 variety (893 kg ha^{-1}) when compared with Annegiri (794 kg ha^{-1}). Similar findings were reported by Rao *et al*[10]. Interaction effect of irrigation schedules and varieties has shown inconsistence which resulted in non significant.

Water use efficiency (kg $ha^{-1}mm^{-1}$)

The data (table 2) reveals that the highest irrigation level I_4 recorded the lowest water use efficiency of 7.83 kg $ha^{-1}mm^{-1}$ and 4.66 kg $ha^{-1}mm^{-1}$ for JG-11 and Annegiri respectively. With the increase in irrigation level, the water use efficiency decreases. The I_1 (control) recorded the highest water use efficiency of 9.41kg $ha^{-1}mm^{-1}$ and 6.68 kg $ha^{-1}mm^{-1}$ for JG-11 and Annegiri respectively, compared to the other higher levels of moisture regimes. This finding is in conformity with Srivastava and Srivastava[13], Singh *et al.*[12], Pramanik *et al*[9].

Table 1: Yield of chickpea varieties influenced by varied moisture regime

TREATMENTS	Grain yield (kg ha^{-1})			Haulm yield (kg ha^{-1})		
	V1	V2	Mean	V1	V2	Mean
T1-CONTROL	1245	1008	1127	618	451	535
T2-0.3IW:CPE	1567	1323	1445	750	583	667
T3-0.6 IW:CPE	1882	1655	1769	893	794	844
T4-0.9 IW:CPE	1722	1542	1632	822	657	740
Mean	1604	1382	1493	771	621	696
	SE(m)	CD		SE(m)	CD	
Factor A	72.05	218.55		29.93	90.81	
Factor B	101.90	309.07		42.33	128.42	
Factor (A x B)	144.10	NS		59.87	NS	

IW:CPE- Irrigation Water:Cumulative Pan Evaporation+

V1- JG-11, V2-Annegiri, Factor A-Varieties, Factor B- Irrigation levels

Table 2: Total water use and water use efficiency (WUE) of chickpea varieties under varied moisture regime

Treatments	Total Et_c		Etc (mm day^{-1})		WUE (kg ha^{-1} mm^{-1})	
	V1	V2	V1	V2	V1	V2
T_1-Control	155	148	1.55	1.48	9.41	6.68
T_2-0.3IW:CPE	193	170	1.93	1.70	8.12	6.27
T_3-0.6IW:CPE	200	182	2.00	1.82	8.03	6.11
T_4-0.9IW:CPE	220	204	2.2	2.04	7.83	4.66

IW:CPE- Irrigation Water:Cumulative Pan Evaporation

V1- JG-11, V2-Annegiri

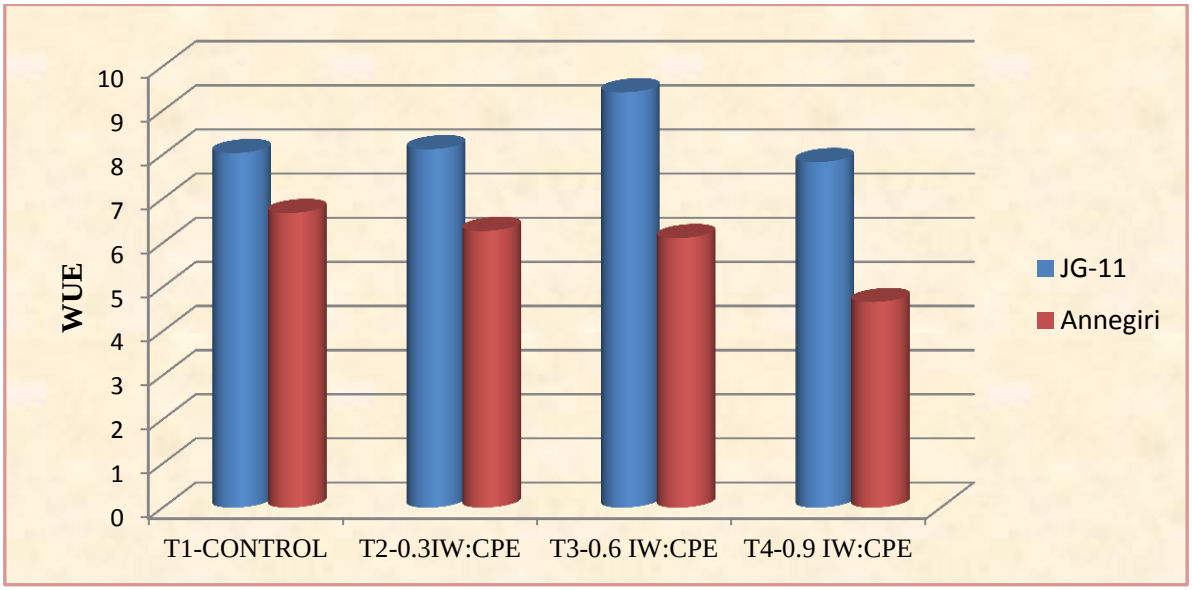

Fig. 1: Water use efficiency (WUE) of chickpea under varied moisture regime

CONCLUSION

Form for going discussion, it can be concluded that, irrigation scheduled at 0.6 IW:CPE (I_3) produced significantly grain and haulm yields of chickpea but it was on par with 0.9 IW:CPE (I_4). The JG-11 variety has produced higher grain yield than Annegiri. The water use efficiency decreased with an increase in irrigation regime. The highest and lowest water use efficiency were recorded under I_1 (rainfed) and I_4 (IW:CPE ratio-0.9) treatments respectively.

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