Plant Archives Vol. 26, Supplement 1, 2026 pp. 2120-2123 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-1.285

STUDIES ON IRRIGATION MANAGEMENT AT DIFFERENT GROWTH STAGES IN CHICKPEA (*CICER ARIETINUM* L.)

M. Pooja Reddy[1]*, B. Kiruthiga[1], G. Adi Lakshmi[1], P. Varalakshmi[2] and K. Avil Kumar[1]

[1]Department of Agronomy, School of Agricultural Sciences, Malla Reddy University, Hyderabad, Telangana (500100), India

[2]Department of Soil Science and Agricultural Chemistry, School of Agricultural Sciences, Malla Reddy University, Hyderabad, Telangana (500100), India

*Corresponding author E-mail: marthalapoojareddypooja@gmail.com

(Date of Receiving : 24-10-2025; Date of Acceptance : 27-12-2025)

ABSTRACT

A field experiment was conducted during the *rabi* season 2024–25 at the Research Farm, School of Agricultural Sciences, Malla Reddy University, Hyderabad, to study the effect of irrigation management at different growth stages in chickpea (*Cicer arietinum* L.). The soil of the experimental site was sandy loam in texture, moderately alkaline in reaction, non-saline in electrical conductivity, low in organic carbon and available phosphorus medium in available nitrogen and potassium. The experiment was laid out in a randomized block design with seven irrigation treatments replicated thrice, consisting of irrigation at different growth stages: T_1-irrigation at pre-flowering stage, T_2 - irrigation at pod development stage, T_3 - irrigation at seed filling stage, T_4 - irrigation at pre-flowering + pod development stages, T_5 - irrigation at pre-flowering + seed filling stages, T_6- irrigation at pod development + seed filling stages and T_7 - irrigation at pre-flowering + pod development + seed filling stages. A recommended fertilizer dose of 20:50:0 kg $N:P_2O_5:K_2O$ ha^{-1} was applied as basal and the chickpea variety JG 11 was sown in November at a spacing of 30 cm × 10 cm. Irrigation scheduling for all treatments was done using the graduated bucket method, with water drawn from a bore well. The data generated were analyzed using standard statistical procedures. The results revealed that T_7 (irrigation at pre-flowering + pod development + seed filling stages) recorded the highest seed yield (1949 kg ha^{-1}) and maximum total water used (194 mm), while T_3 (irrigation at seed filling stage) recorded the lowest seed yield. In terms of water use efficiency (WUE), T_1 (irrigation at pre-flowering stage) recorded the highest WUE (13.2 kg ha^{-1} mm^{-1}), which was significantly superior to all other irrigation schedules, indicating that while frequent irrigation (T_7) enhanced yield, a single irrigation at the pre-flowering stage (T_1) ensured the most efficient use of water.

***Keywords*:** Chickpea, seed yield, water applied and water use efficiency.

Introduction

Chickpea (*Cicer arietinum* L.) is an important *rabi* (winter) legume crop, mainly grown under rainfed conditions by utilizing residual soil moisture after kharif crops. Although drought-tolerant and suited for semi-arid tropical and warm temperate regions, chickpea shows a significant increase in yield when supplemental irrigation is applied. It does not favor high humidity and is sensitive to both moisture deficit and excess soil moisture. Globally, chickpea is the third most important food legume after French beans and field peas. It can fulfill up to 80% of its nitrogen requirement through symbiotic nitrogen fixation, which reduces dependence on synthetic fertilizers. In the year 2022–2023 period, chickpea was cultivated over an area of 10.4 million hectares in India, yielding a total production of 12.267 million tonnes and an average productivity of 1,222 kg ha^{-1} (Indiastat, 2023). Major chickpea-producing states in India include Madhya Pradesh, Rajasthan, Maharashtra, Telangana, Andhra Pradesh, Karnataka, and Uttar Pradesh. In Telangana, chickpea was grown on 0.148 million

hectares with production of 0.232 million tonnes and productivity of 1,568 kg ha^{-1}. In Andhra Pradesh, it was cultivated on 0.329 million hectares, producing 0.457 million tonnes with a productivity of 1,388 kg ha^{-1} (DES, GOI, Ministry of Agriculture & Farmers Welfare, DA & FW 2010–11 to 2022–23). Globally, India, Turkey and Australia are the top producers of chickpea.

Agronomically, chickpea plays a dual role by providing food (grains and green pods) and fodder for livestock while improving soil health. Its deep taproot system enhances soil structure, and nitrogen-fixing nodules restore soil fertility, contributing to sustainable agriculture. Under optimal conditions, chickpea can fix up to 141 kg of nitrogen kg ha^{-1}, reducing the need for synthetic fertilizers. (Ahlawat *et al.,* 2010, Gaur *et al.,* 2010 and Doughton *et al.,* 1993).

Water management is crucial in chickpea cultivation. While the crop tolerates drought, both insufficient and excessive irrigation can harm growth and yield. Traditional flood check basin irrigation is commonly used, but irrigation scheduling at critical growth stages like branching, flowering, and pod development is essential to avoid terminal drought and maximize productivity (Yolcu, 2008). Excess moisture, however, may cause diseases, pod drop, seed rot, and revert growth to vegetative phases. (Rahman *et al.,* 2000, Singh *et al.,* 2016).

Climate change has disrupted rainfall patterns, increasing the risk of moisture stress during germination, emergence and pod filling, which severely impacts yields. Maintaining soil moisture close to field capacity is vital for optimal growth (Lende and Patil 2017, Pang *et al.* 2017, Kumar *et al.* 2021). Research highlights the need for timely irrigation scheduling to combat erratic rainfall and water stress. Therefore, a study is proposed to evaluate the impact of different irrigation regimes applied at various chickpea growth stages. The aim is to identify optimal irrigation practices that maximize yield potential while ensuring efficient water use and sustainable crop production.

Materials and Methods

The experiment was carried out during the *rabi* season of 2024–25 at the A2 plot of the Research Farm, School of Agricultural Sciences, Malla Reddy University, located in Dulapally, Hyderabad, Telangana. The experimental site is geographically positioned at 17°19'16" N latitude and 78°24'43" E longitude, with an elevation of 542.3 meters above mean sea level. The study was carried out using the chickpea variety JG-11 and was laid out in a Randomized Block Design (RBD) comprising seven treatments**,** each replicated three times**.** The details of the treatments used in the experiment are listed below

T_1	Irrigation at pre-flowering stage
T_2	Irrigation at pod-development stage
T_3	Irrigation at seed filling stage
T_4	Irrigation at pre-flowering + pod-development stages
T_5	Irrigation at pre-flowering + seed filling stages
T_6	Irrigation at pod-development + seed filling stages
T_7	Irrigation at pre-flowering + pod-development + seed filling stages

The data on seed yield (kg ha^{-1}), total water used (mm) and water use efficiency (kg ha^{-1} mm^{-1}) recorded during the field experiment were statistically analyzed using analysis of variance appropriate for a randomized block design. The significance of treatment effects was tested using the F-test at the 5% probability level and treatment means were compared using the critical difference to determine statistically significant differences among treatments.

Data Collection

Seed yield per hectare

The seed yield was individually measured for each treatment net plot area and then converted to per hectare yield. Measurements were after the seed was sun-dried to achieve a moisture content of 12 percent, followed by cleaning, weighing and expressed the yield in kilograms per hectare (kg ha^{-1}).

Total water used (mm)

Total water used in each irrigation treatment was calculated as detailed below.

Total water used (mm) = water applied irrigation wise (mm) + effective rainfall (mm) + pre-sowing irrigation (mm).

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

It is the ratio of crop yield (kg ha^{-1}) to the amount of water used in water applied. It has calculated by the following equation.

$$\text{Water use efficiency (kg ha}^{-1}\text{ mm}^{-1}\text{)} = \frac{\text{Total yield (kg ha}^{-1}\text{)}}{\text{Total water used (mm)}}$$

Results and Discussion

Seed yield (kg ha^{-1})

The chickpea yield was significantly enhances by irrigation management. The highest seed yield was recorded with treatment T_7 (irrigation at pre-flowering + pod-development + seed filling stages) (1949 kg ha^{-1}) and it was on par with treatment T_4 (irrigation at

pre-flowering + pod-development stages) (1796kg ha^{-1}). Significantly the lowest yield was recorded in treatment T_3 (irrigation at seed filling stage) (1012 kg ha^{-1}). This is due to the improved growth due to these irrigation treatments and continued good growing conditions resulted in significantly higher yield attributes in these treatments. The chickpea recorded significantly higher grain yield due to application of irrigation at pre-flowering + pod development + grain filling stages. Similar results were found by Thenua *et al.* 2010 and Kantar *et al.* 2010 reported that this may be due to the fact that reproductive phases are quite sensitive to moisture stress and adequate moisture helps prevent flower drop and higher grain filling leads to higher yield.

Total water used (mm) and water use efficiency (kg ha^{-1} mm^{-1})

Total water used (mm) and water use efficiency (WUE) in chickpea was significantly affected by different irrigation practices. The highest total water used was recorded in treatment T_7 (irrigation at pre-flowering + pod-development + seed filling stages) (194 mm) and significantly lower total water used was recorded in treatment T_1 (irrigation at pre-flowering stage) (100 mm). The highest WUE (13.26 kg ha^{-1} mm^{-1}) was recorded in treatment T_1 (irrigation at the pre-flowering stage), which was significantly superior to other treatments and statistically similar to treatment T_4 (irrigation at pre-flowering and pod development stages), which recorded a WUE (12.0 kg ha^{-1} mm^{-1}). Although treatment T_7 (irrigation at pre-flowering + pod development + seed filling stages) resulted in the highest seed yield, its WUE was lower (10.0 kg ha^{-1} mm^{-1}), indicating that increasing the number of irrigations gradually reduced water productivity. These findings are in line with the results reported by Jagtap *et al.* 2020 and Anwar *et al.* 2001. Significantly higher WUE (13.26 kg ha^{-1} mm) was recorded with treatment (T_1) (irrigation at pre-flowering stage) than all other treatments.

Table 1: Seed yield (kg ha^{-1}), Total water used (mm) and water use efficiency (kg ha^{-1} mm^{-1}) of chickpea as influenced by irrigation scheduling at different growth stages.

Treatments	Seed yield (kg ha^{-1})	Total water used (mm)	Water use efficiency (kg ha^{-1} mm^{-1})
T_1 - Irrigation at pre-flowering stage	1326	100	13.26
T_2 – Irrigation at pod-development stage	1169	104	11.24
T_3 – Irrigation at seed filling stage	1012	106	10.1
T_4 – Irrigation at pre-flowering + pod-development stages	1797	150	12.0
T_5 – Irrigation at pre-flowering + seed filling stages	1639	152	11.0
T_6 – Irrigation at pod-development + seed filling stages	1482	156	10.4
T_7 – Irrigation at pre-flowering + pod-development + seed filling stages	1949	194	10.0
S. Em. ±	**50**	-	**0.41**
CD (p=0.05)	**155**	-	**1.25**

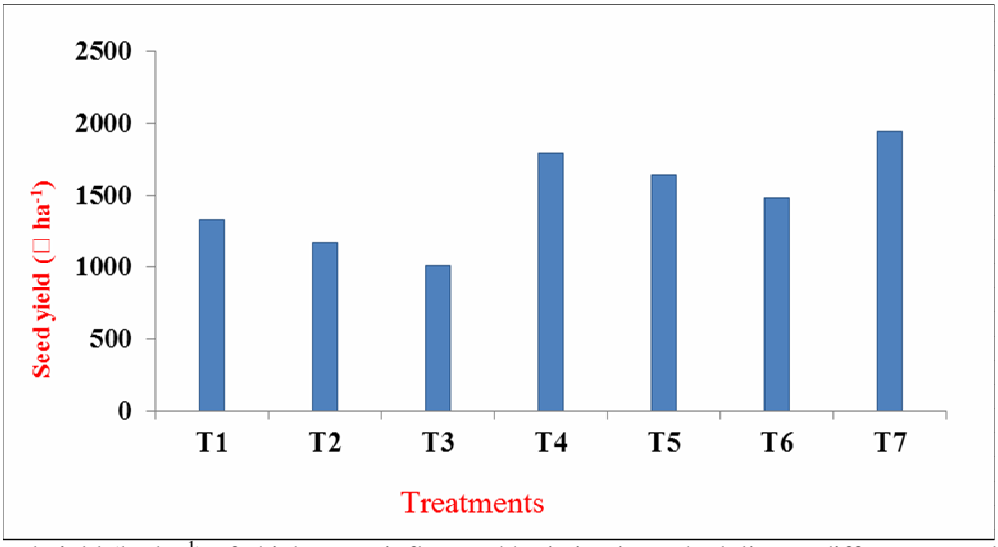

Fig 1. Seed yield (kg ha^{-1}) of chickpea as influenced by irrigation scheduling at different growth stages.

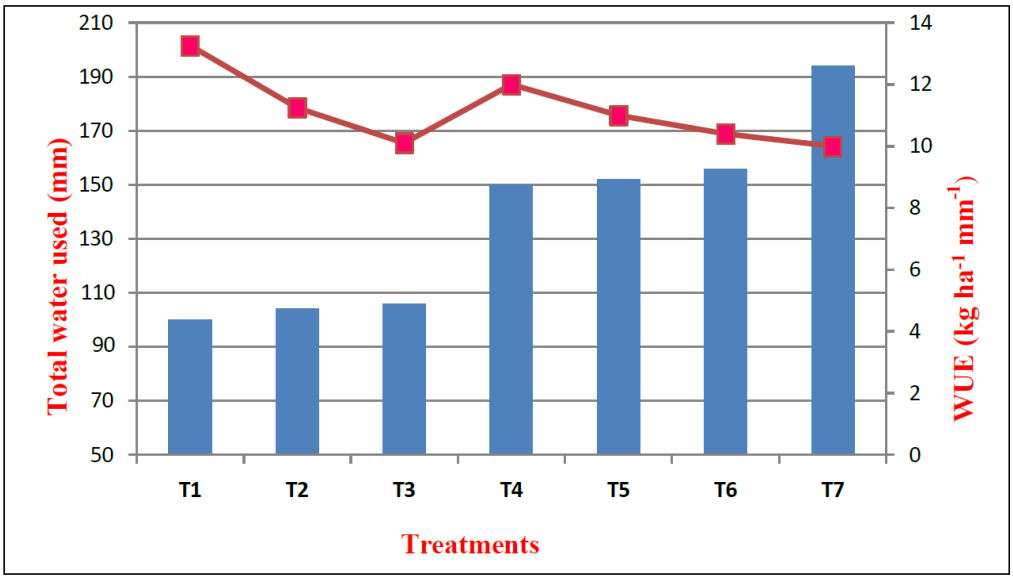

Fig. 2 : Water use studies of chickpea as influenced by irrigation scheduling at different growth stages.

Conclusion

The application of irrigation at the pre-flowering + pod-development + seed filling stages (T_7) was found to be significantly higher than other treatments in chickpea yield but was statistically at par with irrigation at pre-flowering + pod-development stages (T_4). The water applied was significantly higher in treatment (T_7) than rest of the treatments. WUE was significantly higher with pre-flowering stage (T_1) than other treatments.

References

Ahlawat, J.P.S., Singh, A. and Saraf, C.S. (2010). Effects of winter legumes on the nitrogen economy and productivity of succeeding cereals. *Experiment Agriculture.* **17**(2), 55-62.

Anwar, M.R., McKenzie, B.A., Hill, G.D and Peri, P.L. (2001). A predictive model of chickpea (*Cicer arietinum* L.) yield. *Agronomy New Zealand.* **31**(5), 1-11.

Directorate of Economics & Statistics, Government of India, Ministry of Agriculture & Farmer Welfare (DA & FW 2010-11 to 2022-23).

Doughton, J.A., Vallis, I., & Saffigna, P.G. (1993). Nitrogen-fixation in chickpea. 1. Influence of prior cropping or fallow, nitrogen-fertiliser and tillage. *Australian Journal of Agricultural Research*. **44**(7), 1403-1413.

Gaur, P.M., Tripathi, S., Gowda, C.L., Ranga Rao, G.V., Sharma, H.C., Pande, S and Sharma, M. (2010). Chickpea seed production manual.

Indiastat (2023). www.indiastat.org, Area, production and productivity of chickpea.

Jagtap, D.N., Dademal, A.A., Mane, M.J., More, V.G., Bodake, P.S and Sanap, P.B. (2020). Scheduling of irrigation at different growth stages of chickpea under overhead sprinkler. *International Journal of Science Environment and Technology*. **9**(3), 395-401.

Kantar, F., Shivakumar, B.G., Arrese-Igor, C., Hafeez, F.Y., González, E.M., Imran, A and Larrainzar, E. (2010). Efficient biological nitrogen fixation under warming climates. *Climate change and management of cool season grain legume crops*, **4**(8), 283-306.

Kumar, P. R., Mali, S. S., Singh, A. K. & Bhatt, B. P. (2021). Impact of irrigation methods, irrigation scheduling and mulching on seed yield and water productivity of chickpea *(Cicer arietinum)*. *Legume Research*, **44**(10),1247-1253.

Nagesh Lende and Patil, H. (2017). Irrigation management on growth, yield and quality of chickpea (*Cicer arietinum* L.). *Journal of Pharmacognosy and Phytochemistry*, **6**(5), 528-533.

Pang, J., Turner, N. C., Du, Y.-L., Colmer, T. D. & Siddique, K. H. M. (2017). Pattern of water use and seed yield under terminal drought in chickpea genotypes. *Frontiers in Plant Science*. **4**(8),1375

Rahman, M.M., Bakr, M. A., Mia, M.F., Idris, K.M., Gowda, C.L.L., Kumar, J., Deb, U.K., Malek, M.A and Sobhan, A. (2000). Legumes in Bangladesh. (In) Legumes in rice and wheat cropping systems of the Indo-Gangetic Plain, Constraints and Opportunities. *International Crops Research Institute for the Semi-Arid Tropics, Patancheru, India; and Cornell University, New York,* USA. 584-587.

Singh, G., Ram, H., Aggarwal, N. and Turner, N.C. (2016). Irrigation of chickpea (*Cicer arietinum* L.) increases yield but not water productivity. *Experimental Agriculture*, **52**(1), 1-13.

Thenua, O.V.S.; Singh, S.P and Kumar, B.G. (2010). Productivity and economics of chickpea-fodder sorghum cropping system as influenced by P sources, biofertilizers and irrigation to chickpea. *Indian Journal of Agronomy*. **55**(1), 22-27.

Yolcu, R. (2008). A research on irrigation water requirement and evapotranspiration under Diyarbakir conditions for different growth stages irrigated chickpea (*Cicer arientinum* L.). Master Thesis, Çukurova University Institute of Science and Technology, Adana (in Turkish).