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Irrigation management on growth, yield and quality of chickpea (*Cicer arietinum* L.)

Nagesh Lende and Hemant Patil

Abstract
An experiment entitled "Irrigation management for chickpea (*Cicer arietinum* L.)" was conducted during *rabi* season 2010-11 at Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri Dist. Ahmednagar (Maharashtra). In order to fulfill the objectives of the experiment seven treatments with three replications were laid out in randomized block design. The seed of deshi chickpea cv. Digvijay were dibbled at 30x10 cm spacing for ridges and furrows layout. Sowing was done on 28th October, 2010. The relationship between yield of Digvijay chickpea, water use efficiency and consumptive use of water were determined. The differences due to irrigation treatments were found to be significant in respect to the growth parameters of chickpea were significantly higher when irrigation given at branching and pod development stage with furrows irrigation, while these parameters were decreased significantly when irrigated at flowering followed by branching stage. The yield attributes, seed and straw yield of chickpea per hectare were significantly highest when irrigation applied at branching and pod development stage with all furrows irrigated. The seed yield was significantly higher (26.92 q ha^{-1}) when irrigation given at branching and pod development stage with all furrows irrigated (T_6), but it was decreased as number and quantity of irrigation reduced. The growth functions *viz.*, absolute growth rate, net assimilation rate, crop growth rate were significantly higher when irrigation applied at branching and pod development stage with all furrows irrigated as compared to others. The quality parameters like protein content (23.80 %) and protein yield (6.41 q ha^{-1}) were significantly higher due to irrigation at branching and pod development with all furrows irrigated followed by irrigation given at pod development stage with all furrows irrigated (22.81 and 5.30 q ha^{-1}). The higher water use efficiency was recorded when irrigation given at pod development stage with all furrows irrigated (102.51 kg ha^{-1} cm) as compared to other irrigation treatments. Irrigation scheduling at branching and pod development stage with all furrows irrigated (T_6) recorded higher gross monetary return (Rs.82558 ha^{-1}), net monetary return (Rs. 55,308 ha^{-1}) and benefit cost ratio (3.03) than rest of the treatments.

Keywords: irrigation, growth, yield, quality, chickpea

Introduction
Chickpea (*Cicer arietinum* L.) is the most important pulse crop in India. Chickpea is cultivated on 7.54 million ha area with 6.13 million tones production with 812 kg ha^{-1} productivity in the 19th century. Chickpea is the second most important pulse crop cultivated in *rabi* season in Maharashtra covering 22.47 per cent of the total area (13.32 lakh ha) and 21.88 per cent production of the state (12.44 lakh tones) with 935 kg ha^{-1} productivity. The existing level of chickpea production in the state is lower than its potential (5 t ha^{-1}). Several biotic and abiotic stresses lead to low productivity. However, a major breakthrough in productivity of chickpea is yet to be witnesses. There are many factors *viz.*, environment, agronomy and socio-economical which are responsible for poor productivity of chickpea in the state. Irrigation scheduling technique at critical growth stages assumes greater significance. Critical growth period is a stage of growth of plant at which moisture stress exercises the greatest influence on both the quantity and quality of produce. In Maharashtra, productivity of chickpea is very low owing to limited soil moisture in *rabi* season, shorter winter season, negligible adoption of improved agro technologies as well as minimum use of inputs. This might be because of the good soil moisture availability, soil aeration, microbial activity, water drainage, nutrient availability, etc. Chickpea is one of the most important *rabi* pulse crop in Asia. India is largest producer (25 %), importer (20 %) and consumer (27 %) of Pulses in the world. Therefore, it is felt necessary to develop the technology for yield maximization of Deshi chickpea regarding irrigation technique and critical stages of crop.

Material and Methods
The field experiment was conducted during *rabi* 2010-11 at Pulse Improvement Project, M.P.K.V., Rahuri.

The experiment was laid out in Randomized Block Design with three replications and seven treatments. The experimental gross plot size consists of 5.00 x 4.20 m^2 and net plot was 4.60 x 3.60 m^2. The details of treatment with symbols.

Table 1

S. No	Treatment	Symbol used
1	No irrigation (control)	T_1
2	Irrigation at branching : All furrows	T_2
3	Irrigation at branching : Alternate furrows	T_3
4	Irrigation at pod development stage : All furrows	T_4
5	Irrigation at pod development stage : Alternate furrows	T_5
6	Irrigation at branching and Pod development stage : All furrows	T_6
7	Irrigation at branching and Pod development stage: Alternate furrows	T_7

Digvijay variety of chickpea is used for the present investigation. This variety is wilt resistant, fetches higher market price. It is semi spreading type, with profuse branching and has higher podding capacity. The sowing was done on 28th Oct. 2010 with ridges and furrows at 30 x 10 cm spacing. A basal dose of 25 kg N ha^{-1} through Urea and 50 kg P_2O_5 ha^{-1} through single super phosphate was applied uniformly to all treatments just before dibbling. FYM was applied before last harrowing @ 5 t ha^{-1}. For control of insect-pests one spray of 0.07 % Endosulphan (35 EC) and second spray of 0.05 % Chloropyriphos 20 EC was applied @ 500 lit water ha^{-1}.

Result and Discussion

The results obtained from the field investigation "Irrigation Management for Chickpea" conducted during *rabi* season of 2010-2011 are interpreted with an objective to draw a specialize conclusion.

Plant height (cm)

The mean height of plant at various growth stages as influenced by different treatment are presented in Table 1. The maximum mean plant height increased from 18.67 cm to 37.08 cm up to harvest of crop. This indicated that growth rate was fast up to 60 DAS. After 60 DAS, the mean plant height increased with relatively slow rate due to irrigation treatment. It was 19.90, 32.60, 45.60 and 45.60 cm at 30, 60, 90 DAS and at harvest, respectively. The irrigation at branching and pod development stage with all furrows irrigated was significantly superior over rest of the treatment. The highest plant height was recorded by treatment T_6 (Irrigation at branching and pod development stage all furrows irrigated).

Number of Primary branches per plant

The data regarding mean number of primary branches per plant as affected by irrigation treatment are presented in Table 2 The mean number of primary branches per plant was significantly influenced due to irrigation scheduling at 30 (3.50), 60 (6.03), 90 (6.47) DAS and at harvest (6.50). The irrigation at branching and pod stage all furrows irrigated produced significantly more number of primary branches per plant as compared to other treatment. These results were in corroborated with Sable (1995), Chandegara and Yadavendra (1998), Reddy *et al.* (2004), Krishnamurthy and Steermanulu (2007).

Plant spread (cm)

The plants spread of chickpea was significantly affected due to irrigation scheduling at all growth stages except 30 DAS. Irrigation at branching and pod development stages all furrows irrigated were significantly more as compared to rest of the treatment. Similar results were reported by Singh *et al.* (2008) [6] Krishnamurthy and Steermanulu (2007), Pandia (1998) and Dixit *et al.* (1993).

Dry matter per plant (g)

The dry matter accumulation per plant increased with age of the crop. Accumulation of dry matter of initial stage *i.e.* 30 DAS was 0.71 g $plant^{-1}$, thereafter increased gradually and maximum at harvest was 31.56 g $plant^{-1}$.

Table 2: Mean plant height as influenced by different irrigation treatment

S. No.	Treatment	Plant height (cm)			
		30 DAS	60 DAS	90 DAS	At harvest
T_1	No Irrigation	18.70	22.90	29.50	29.60
T_2	Irrigation at Branching : All furrows	18.60	26.10	36.80	36.90
T_3	Irrigation at Branching: Alternate furrows	17.90	24.30	31.40	33.73
T_4	Irrigation at Pod development stage: All furrows	19.30	29.70	41.40	41.40
T_5	Irrigation at Pod development stage: Alternate furrows	17.90	25.30	33.70	33.90
T_6	Irrigation at Branching and Pod development stage: All furrows	19.90	32.60	45.60	45.60
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	18.40	27.50	38.20	38.40
	General Mean	18.67	26.91	36.66	37.08
	S.E. $\pm$	0.35	0.46	0.53	1.03
	CD at 5 %	1.08	1.42	1.63	3.18
	CV %	3.27	2.96	2.50	4.83

Table 3: Mean no. of primary branches/plant as influenced by different irrigation treatmt.

S. No.	Treatment	Number of primary branches per plant			
		30 DAS	60 DAS	90 DAS	At harvest
T_1	No Irrigation	2.10	3.30	3.43	4.00
T_2	Irrigation at Branching : All furrows	2.20	4.80	5.00	5.33
T_3	Irrigation at Branching: Alternate furrows	2.50	3.90	4.10	4.17
T_4	Irrigation at Pod development stage: All furrows	2.40	5.60	5.87	5.90
T_5	Irrigation at Pod development stage: Alternate furrows	2.00	3.77	3.93	5.03
T_6	Irrigation at Branching and Pod development stage: All furrows	3.50	6.03	6.47	6.50
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	2.80	5.40	5.63	5.67
	General Mean	2.50	4.69	4.92	4.97
	S.E. ±	0.20	0.23	0.24	0.24
	CD at 5 %	0.62	0.69	0.72	0.75
	CV %	14.04	8.34	8.31	8.49

Table 4: Mean plant spread as influenced by different irrigation treatment

S. No.	Treatment	Plant spread (cm)			
		30 DAS	60 DAS	90 DAS	At harvest
T_1	No Irrigation	11.00	27.50	34.47	34.50
T_2	Irrigation at Branching : All furrows	12.93	25.70	34.17	34.30
T_3	Irrigation at Branching: Alternate furrows	13.47	27.70	34.03	34.10
T_4	Irrigation at Pod development stage: All furrows	14.00	29.40	37.57	37.60
T_5	Irrigation at Pod development stage: Alternate furrows	13.53	27.90	35.37	34.40
T_6	Irrigation at Branching and Pod development stage: All furrows	16.00	32.60	39.57	39.80
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	17.33	29.30	36.47	36.53
	General Mean	14.04	28.59	35.95	36.03
	S.E. ±	1.50	0.35	0.24	0.23
	CD at 5 %	-	1.09	0.74	0.72
	CV %	18.52	2.14	2.18	2.12

The highest dry matter (35.80 g plant^{-1}) at harvest was recorded by the treatment comprises irrigation at branching and pod development stage with all furrows irrigated. These results are in accordance with Dixit *et al.* (1993), Krishnamurthy and Steermanulu (2007), Yadav (2009).

Number of root nodules

At 45 DAS, irrigation at branching and pod development stage: all furrows irrigated recorded highest root nodules (8.60) than rest of the treatments. Whereas, at pod development stage, significantly highest (22.60 plant^{-1}) root nodule was recorded in the treatment T_6.

Table 5: Dry matter per plant as influenced by different irrigation treatment.

S. No.	Treatment	Dry matter per plant (g)			
		30 DAS	60 DAS	90 DAS	At harvest
T_1	No Irrigation	0.74	11.78	20.15	26.89
T_2	Irrigation at Branching : All furrows	0.73	12.80	24.34	30.45
T_3	Irrigation at Branching: Alternate furrows	0.67	11.45	22.65	30.34
T_4	Irrigation at Pod development stage: All furrows	0.71	14.10	24.90	33.69
T_5	Irrigation at Pod development stage: Alternate furrows	0.68	12.69	22.71	31.25
T_6	Irrigation at Branching and Pod development stage: All furrows	0.72	14.50	26.19	35.80
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	0.69	13.89	24.89	32.48
	General Mean	0.71	13.03	23.69	31.56
	S.E. ±	0.02	0.51	0.52	1.31
	CD at 5 %	-	1.57	1.60	4.06
	CV %	5.31	6.78	3.80	7.24

Weight of root nodules per plant (mg)

At 45 DAS, irrigation at branching and pod development stage: all furrows irrigated recorded significantly highest weight of nodules (0.75 mg plant^{-1}) which was at par with the treatment T_4 (0.67 mg plant^{-1}) comprises irrigation at pod development stage: all furrows irrigated. Same trend was observed at pod development stage (122.49 mg plant^{-1}). Similar results were observed by Saxena *et al.* (1990) [5], Dixit *et al.* (1993) Chanegra and Yadavendra (1998), Reddy *et al.* (2004).

Table 6: Number of root nodules and their weight per plant as influenced by different irrigation treatment

S. No	Treatment	Number of root nodules (45 DAS)	Weight of root nodules(mg) (45 DAS)
T_1	No Irrigation	15.60	0.51
T_2	Irrigation at Branching : All furrows	19.50	0.63
T_3	Irrigation at Branching : Alternate furrows	18.30	0.57
T_4	Irrigation at Pod development stage: All furrows	20.20	0.67
T_5	Irrigation at Pod development stage: Alternate furrows	18.20	0.57

T_6	Irrigation at Branching and Pod development stage: All furrows	22.60	0.75
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	19.70	0.64
	General Mean	19.16	0.62
	S.E. ±	0.51	0.009
	CD at 5 %	1.58	0.030
	CV %	4.63	3.80

Yield and Yield contributing characters

Number of pods per plant

The number of pods per plant was recorded significantly highest (46.50) in the treatment T_6 (Irrigation at branching and pod development stage: all furrow irrigated) which was at par with the treatment T_4 (31.26). The lowest number of pods per plant was recorded where no irrigation was given i.e. T_1 (18.63). Similar observations were recorded by Ramshe *et al.* (1987), Dixit *et al.* (1993) and Krishnamurthy and Steermanulu (2007).

Seed weight per plant (g)

The weight of seeds per plant was significantly influenced due to different treatment. The irrigation at branching and pod development stage all furrow irrigated recorded significantly highest seed weight per plant (9.21 g) which was at par with T_4 (8.11). Irrigation at pod development stage: all furrow irrigated. These results are in accordance with Kamble (1989) [3], Sabale (1995) and Singh *et al.* (2006).

Table 7: Effect of irrigation treatments on yield and yield contributing characters

S. No	Treatment	Number of pods plant^{-1}	Weight of seed plant^{-1} (g)	Test weight (g)	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})
T_1	No Irrigation	18.63	3.95	19.20	11.10	17.23
T_2	Irrigation at Branching : All furrows	22.50	7.57	22.60	21.33	29.19
T_3	Irrigation at Branching: Alternate furrows	21.50	5.54	21.00	16.01	25.62
T_4	Irrigation at Pod development stage: All furrows	31.26	8.11	23.50	23.22	29.96
T_5	Irrigation at Pod development stage: Alternate furrows	23.63	6.24	22.20	18.12	25.56
T_6	Irrigation at Branching and Pod development stage: All furrows	46.50	9.21	24.10	26.92	31.80
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	27.13	7.55	23.20	21.53	29.46
	General Mean	27.31	6.88	22.26	19.75	26.97
	S.E. ±	5.33	0.41	0.405	1.22	2.33
	CD at 5 %	16.44	1.25	1.24	3.78	7.20
	CV %	11.92	7.17	6.15	10.77	15.00

Test weight (g)

The differences in the mean test weight as affected by different treatment were significant. The irrigation at branching and pod development (all furrows irrigated) recorded significantly higher test weight (24.10 g) i.e. T_6 than other treatment but at par with irrigation at pod development stage (all furrows irrigated) (23.50 g) *i.e.* T_4 and irrigation at branching and pod development stage (all furrows irrigated) (23.20 g) *i.e.* T_7 treatment.

Seed yield (q ha^{-1})

The seed yield of chickpea due to T_6 *i.e.* irrigation scheduling at branching and pod development stage (all furrows irrigated) recorded significantly more grain yield (26.92 q ha^{-1}) followed by T_4 irrigation at pod development stage (all furrows irrigated) (23.22 q ha^{-1}). The lowest mean seed yield per hectare was recorded when no irrigation was applied (11.10 q ha^{-1}). Similarly, Ugale *et al.* (2000) Singh *et al.* (2006) and Krishnmurthy and Steermanulu (2007) also observed the highest seed yield of chickpea when irrigated at flowering and pod formation stage.

Stover yield (q ha^{-1})

The yield of Stover was significantly affected due to irrigation scheduling treatment. Irrigation at branching pod development stage: all furrows irrigated produced significantly higher Stover yield (31.80 q ha^{-1}) than rest of the treatments but it was at par with irrigation at pod development stage all furrows irrigated (29.96 q ha^{-1}).

Growth functions: Absolute photo-synthetically active radiation (APAR)

Photo synthetically active radiation (PAR) was computed using the linear relation obtained from line quantum sensor and digital lux meter. The PAR here recorded by keeping the sensor above the canopy and at ground surface within the crop. The sensor was kept in inverted position within and above the canopy for measured the reflected PAR. APAR was determined by using the formula given by Asrar *et al.* (1989).

APAR = (PARo + RPARs) – (TPAR + RPARc)

Where,

APR_0 = Incident PAR above canopy

TPAR = Transmitted PAR from canopy

RPARs = Reflected PAR from soil

RPARc = Reflected PAR from canopy

Absorbed photo synthetically active radiation (APAR)

The amount of intercepted PAR not differed significantly among treatments during branching, flowering and maturity stage of chickpea. But at pod development stage the amount of intercepted PAR differed significantly among treatments. The treatment T_6 i.e. irrigation at branching and pod development stage with all furrows irrigated intercepted significantly more PAR by 632.51 mJm^{-2} than rest of the irrigation treatments. Fully irrigated crop intercepted markedly more PAR over control (no irrigation). Similar

results were recorded by Brar *et al.* (2006) [2] and Singh *et al.* (2008) [6].

Radiation utilization efficiency: Radiation use efficiency (RUE)

Radiation use efficiency (RUE) is the dry matter production per unit of photo synthetically active radiation intercepted by the crop.

$$RUE = \frac{\text{Total dry matter } (gm^2)}{\text{APAR } (MJ\ m^{-2})}$$

APAR = Absolute photo synthetically active radiation.

There were significant differences in radiation utilization efficiency as influenced by different irrigation treatment at branching, flowering, pod development and maturity stages of chickpea. The irrigation treatment T_6 *i.e.* irrigation at branching and pod development stage : all furrow irrigated produced significantly higher radiation use efficiency (g Ms^{-1}) 1.62, 1.45, 1.38 and 1.34 g Ms^{-1}) at branching, flowering, pod development and maturity stages respectively than rest of the irrigation treatments. Similar observations were recorded by Singh *et al.* (2008) [6], Agrawal *et al.* (2001) and Rao *et al.* (1999) [4] that heat use efficiency increased successively from emergence to flowering phase of chickpea after vegetative stage was decreased successively. Radiation use efficiency obtained during vegetative phase was comparatively higher than at reproductive phase mainly due to higher heat use efficiency and crop growth rate.

Table 8: Absorbed photo synthetically active radiation as influenced by different irrigation treatment

S. No	Treatment	Absorbed photo synthetically active radiation (APAR) (MJ m^{-2})			
		Branching	Flowering	Pod development	Maturity
T_1	No Irrigation	17.39	300.82	528.69	742.86
T_2	Irrigation at Branching : All furrows	16.37	350.82	620.40	873.34
T_3	Irrigation at Branching : Alternate furrows	15.33	321.35	590.37	833.41
T_4	Irrigation at Pod development stage: All furrows	15.58	333.79	619.68	877.93
T_5	Irrigation at Pod development stage: Alternate furrows	15.34	290.08	596.35	854.14
T_6	Irrigation at Branching and Pod development stage: All furrows	14.82	334.02	632.51	890.66
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	15.44	309.38	628.69	793.45
	General Mean	0.67	17.16	11.18	33.16
	S.E. ±	N.S.	N.S.	34.45	N.S.
	CD at 5 %	15.75	320.04	602.38	837.96
	CV %	7.40	9.28	4.21	6.85

The irrigation treatment T_6 *i.e.* irrigation at branching and pod development stage : all furrow irrigated produced significantly higher radiation use efficiency (g Ms^{-1}) 1.62, 1.45, 1.38 and 1.34 g Ms^{-1}) at branching, flowering, pod development and maturity stages respectively than rest of the irrigation treatments.

Treatment T_1 *i.e.* no irrigation produced significantly low radiation use efficiency at branching, flowering, pod development and maturity stage of chickpea. Similar observations were recorded by Singh *et al.* (2008) [6], Agrawal *et al.* (2001) and Rao *et al.* (1999) [4] that heat use efficiency increased successively from emergence to flowering phase of chickpea after vegetative stage was decreased successively.

Table 9: Radiation use efficiency of chickpea as influenced by different irrigation treatment

S. No	Treatment	Radiation use efficiency (g MJ^{-1})			
		Branching	Flowering	Pod development	Maturity
T_1	No Irrigation	1.42	1.31	1.27	1.21
T_2	Irrigation at Branching : All furrows	1.48	1.34	1.31	1.24
T_3	Irrigation at Branching : Alternate furrows	1.46	1.32	1.27	1.22
T_4	Irrigation at Pod development stage: All furrows	1.52	1.39	1.34	1.28
T_5	Irrigation at Pod development stage: Alternate furrows	1.48	1.32	1.28	1.22
T_6	Irrigation at Branching and Pod development stage: All furrows	1.62	1.45	1.38	1.34
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	1.49	1.38	1.32	1.27
	General Mean	1.50	1.36	1.31	1.25
	S.E. ±	0.024	0.036	0.035	0.023
	CD at 5 %	0.076	0.11	0.11	0.069
	CV %	2.89	4.61	4.63	3.13

Radiation use efficiency obtained during vegetative phase was comparatively higher than at reproductive phase mainly due to higher heat use efficiency and crop growth rate.

Quality parameters: Protein content in seed

The mean protein content in seed was recorded as 23.09 per cent. The protein content in seed was not influenced by different irrigation treatment at different growth stages. The irrigation at branching and pod development stage all furrow irrigated recorded maximum protein content (23.80 %) in seed, than the rest of the treatments. The lowest mean protein content in seed was recorded when the chickpea was not irrigated (22.56 %) T_1 (No irrigation). Similar observations were also found by Kulhare *et al.* (1988) and Pawar *et al.* (1992).

Table 10: Protein content in grain and protein yield as influenced by different irrigation treatment

S. No	Treatment	Protein content in grain (%)	Protein yield (q ha^{-1})
T_1	No Irrigation	22.56	2.50
T_2	Irrigation at Branching : All furrows	23.06	4.92
T_3	Irrigation at Branching : Alternate furrows	22.13	3.67
T_4	Irrigation at Pod development stage: All furrows	22.81	5.30
T_5	Irrigation at Pod development stage: Alternate furrows	23.54	4.27
T_6	Irrigation at Branching and Pod development stage: All furrows	23.80	6.41
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	23.75	5.11
	General Mean	23.09	3.48
	S.E. $\pm$	0.51	0.18
	CD at 5 %	-	0.59
	CV %	3.78	9.58

Protein yield per hectare

The mean protein yield of Digvijay chickpea was 3.48 q ha^{-1}. The protein yield per hectare of Digvijay chickpea was influenced significantly due to different irrigation treatment. The protein yield was recorded significantly higher with irrigation at branching and pod development stage (6.41 q ha^{-1}) than rest of the treatment significantly lowest protein yield was recorded under no irrigation (control). These results are in accordance with Kamble (1989) [3], Pawar *et al.* (1992) and Kumar *et al.* (2000).

Economic studies

The mean total cost of cultivation (Rs ha^{-1}), gross monetary return (Rs ha^{-1}), net monetary return and benefit: cost ratio as influenced by various irrigation treatment was Rs 26350, 60844, 34494 ha^{-1} and 2.31, respectively. The irrigation at branching and pod development stage recorded highest total cost of cultivation, gross monetary return, net monetary return and benefit: cost ratio as Rs. 27250, 82558, 55308 ha^{-1} and 3.03, respectively than rest of the treatment.

Table 11: Cost of cultivation, gross monetary returns, net monetary returns and B:C ratio as influenced by different irrigation treatment

S. No	Treatment	Cost of cultivation (Rs ha^{-1})	GMR (Rs ha^{-1})	NMR (Rs ha^{-1})	B:C ratio
T_1	No Irrigation	25650	34334	8684	1.34
T_2	Irrigation at Branching : All furrows	26450	65768	39318	2.48
T_3	Irrigation at Branching : Alternate furrows	26150	49567	23417	1.90
T_4	Irrigation at Pod development stage: All furrows	26450	71448	44998	2.70
T_5	Irrigation at Pod development stage: Alternate furrows	26150	55894	29744	2.14
T_6	Irrigation at Branching and Pod development stage: All furrows	27250	82558	55308	3.03
T_7	Irrigation at Branching and Pod development stage: Alternate furrows	26650	66341	39691	2.49
	General mean	26350	60844	34494	2.30

Conclusion

Highest water use efficiency was observed when irrigation applied at pod development stage: all furrows irrigated (102.51 kg ha^{-1} cm). Highest water saving (%) was observed when irrigation applied at branching and pod development stage with alternate furrows irrigation (66.66). On the basis of results it could be concluded that cultivation of chickpea (cv. Digvijay) in *rabi* season, with irrigation scheduling at branching and pod development stage with all furrows irrigated is the best treatment to obtain better growth and yield among the other treatments studied.

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