

SCHEDULING OF IRRIGATION AT DIFFERENT GROWTH STAGES OF CHICKPEA UNDER OVERHEAD SPRINKLER

D.N. Jagtap*, A.A. Dademal, M.J. Mane, V.G. More, P.S. Bodake and P.B. Sanap
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra (415 712), India
E-mail: mauli296@gmail.com (*Corresponding Author)

Abstract: A field experiment entitled “Scheduling of irrigation at different growth stages of chickpea under overhead sprinkler” was conducted at Agricultural Research Station, Repoli during *Rabi* 2015-16, 2016-17, 2017-18 and 2018-19 to study the response of irrigation on growth, yield and quality of chickpea and estimate water requirement of chickpea in medium black soil. The experiment was laid out in randomised block design with 7 treatments and three replications. The treatment consist of Irrigation levels {I₁ : Irrigation scheduled at seedling stage (20 DAS), I₂: Irrigation scheduled at flowering stage (40 DAS), I₃: Irrigation scheduled at grain filling stage (60 DAS), I₄ : Irrigation scheduled at seedling and flowering stage (20 and 40 DAS), I₅: Irrigation scheduled at seedling and grain filling stage (20 and 60 DAS), I₆: Irrigation scheduled at flowering and grain filling stage (40 and 60 DAS) and I₇: Irrigation scheduled at seedling, flowering and grain filling stage(20,40 and 60 DAS)} with I₀: Control. From the four years data it can be concluded that irrigation scheduling at seedling and flowering stage proved to be significantly highest in grain yield of chickpea, where water use efficiency was 8.34 kg/ha-mm. The water use efficiency was highest when irrigation was scheduled at flowering stage (14.58 kg/ha-mm). Irrigation at grain filling stage could not produce significant effect on grain yield. Irrigation at seedling and flowering stage could increase the yield by 78.07 % over unirrigated chickpea, whereas only one irrigation at flowering stage yielded 55.65 % increase in grain yield as compare to unirrigated chickpea. The maximum Total cost (Rs. 42474 ha⁻¹), Gross return (Rs. 43560 ha⁻¹), Net return (Rs. 1086 ha⁻¹) and BC ratio (1.03) recorded by treatment (I₄) irrigation scheduled at seedling and flowering stage (20 and 40 DAS).

Keywords: Chickpea, Critical growth stages, Irrigation scheduling, Yield.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important pulse crop of *rabi* season cultivated mainly in semi-arid and warm temperate regions of the world. It contains 18 to 24 per cent protein which is almost three times more than that of cereals. India is one of the important chickpea growing countries in Asia with an area of 9.93 million ha and production of 9.53 million tonnes with productivity of 960 kg ha⁻¹. Chickpea is the second most important pulse crop cultivated in *rabi* season in Maharashtra over area 18.20 lakh ha with 16.22 lakh tones production and 891 kg ha⁻¹ productivity [1].

Several biotic and abiotic stresses lead to low productivity. However, a major breakthrough in productivity of chickpea is yet to be witnessed. There are many factors *viz.*, environment, agronomy and socio economical which are responsible for poor productivity of chickpea in the state. Irrigated agricultural development has a high priority in the present world where production of food must keep pace with a rapidly increasing population. It is clear that with high yielding varieties in hand, higher agricultural production is expected from efficient use of available water resources. Irrigation plays an important role in chickpea productivity. 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. Therefore, it is felt necessary to develop the technology for yield maximization of chickpea regarding irrigation scheduling at critical growth stages of crop.

With the above background in view, an attempt has been made to study scheduling of irrigation at different growth stages of chickpea under overhead sprinkler.

MATERIALS AND METHODS

A field experiment entitled “Scheduling of irrigation at different growth stages of chickpea under overhead sprinkler” was conducted at Agricultural Research Station, Repoli during *Rabi* 2015-16, 2016-17, 2017-18 and 2018-19 to study the response of irrigation on growth, yield and quality of chickpea and estimate water requirement of chickpea in medium black soil. The experiment was laid out in randomised block design with 7 treatments and three replications. The treatment consist of Irrigation levels {**I₁** : Irrigation scheduled at seedling stage (20 DAS), **I₂**: Irrigation scheduled at flowering stage (40 DAS), **I₃**: Irrigation scheduled at grain filling stage (60 DAS), **I₄**: Irrigation scheduled at seedling and flowering stage (20 and 40 DAS), **I₅**: Irrigation scheduled at seedling and grain filling stage (20 and 60 DAS), **I₆**: Irrigation scheduled at flowering and grain filling stage (40 and 60 DAS) and **I₇**: Irrigation scheduled at seedling, flowering and grain filling stage(20,40 and 60 DAS)} with **I₀**: Control. The crop was sown with spacing 45 cm x 20 cm and seed rate 70 kg per ha. The FYM 5 tons/ha and recommended dose of fertilizer 25 kg N/ha, 50 kg P₂O₅ /ha and 50 kg K₂O/ha was

applied as a basal dose at the time of sowing. The depth of applied irrigation water was 50 mm. One common pre sowing irrigation was given to all treatments.

RESULTS AND DISCUSSION

Data presented in Table 1 revealed that day to 50 percent flowering, days to maturity and no. of grains plant⁻¹ showed significant variation due to different irrigation scheduling. Number of grains plant⁻¹ was significantly higher in treatment (I₄) irrigation scheduled at seedling and flowering stage (20 and 40 DAS) as compare to rest of the treatments and it was at par with irrigation scheduled at flowering stage (40 DAS). However, no. of grains pod⁻¹ dose not differed significantly due to different irrigation scheduling. The similar results were reported by [2] and [3].

Data from Table 2 revealed that grain weight plant⁻¹ (g) and no. of pods plant⁻¹ was significantly higher in treatment (I₄) irrigation scheduled at seedling and flowering stage (20 and 40 DAS) and it was at par with irrigation scheduled at flowering stage (40 DAS). Grain yield (kg ha⁻¹) showed variation from 308.10 to 834.28 kg ha⁻¹ in pooled data. The statistically significant grain yield (834.28 kg ha⁻¹) of chickpea was observed in the treatment (I₄) receiving Irrigation scheduled at seedling and flowering stage (20 & 40 DAS) over rest of the treatments. The lowest yield recorded in treatment (I₇) receiving Irrigation scheduled at seedling, flowering and grain filling stage (20, 40 and 60 DAS). The same finding also reported by [2] and [3].

Data from Table 3 indicate that, Irrigation scheduling at seedling and flowering stage proved to be significantly highest in grain yield of chickpea, where water use efficiency was 8.34 kg/ha-mm. The water use efficiency was highest when irrigation was scheduled at flowering stage (14.58 kg/ha-mm). Irrigation at grain filling stage could not produce significant effect on grain yield. The similar finding also reported by [2] and [3].

Irrigation at seedling and flowering stage could increase the yield by 78.07% over unirrigated chickpea, whereas only one irrigation at flowering stage yielded 55.65 % increase in grain yield as compare to unirrigated chickpea.

The maximum Total cost (Rs. 42474 ha⁻¹), Gross return (Rs. 43560 ha⁻¹), Net return (Rs. 1086 ha⁻¹) and BC ratio (1.03) recorded by treatment (I₄) irrigation scheduled at seedling and flowering stage (20 and 40 DAS).

From the four years data it can be concluded that irrigation scheduling at seedling and flowering stage proved to be significantly highest in grain yield of chickpea, where water use efficiency was 8.34 kg/ha-mm. The water use efficiency was highest when irrigation was

scheduled at flowering stage (14.58 kg/ha-mm). Irrigation at grain filling stage could not produce significant effect on grain yield. Irrigation at seedling and flowering stage could increase the yield by 78.07 % over unirrigated chickpea, whereas only one irrigation at flowering stage yielded 55.65 % increase in grain yield as compare to unirrigated chickpea. The maximum Total cost (Rs. 42474 ha⁻¹), Gross return (Rs. 43560 ha⁻¹), Net return (Rs. 1086 ha⁻¹) and BC ratio (1.03) recorded by treatment (I₄) irrigation scheduled at seedling and flowering stage (20 and 40 DAS).

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Table 1: Effect of scheduling of irrigation on Days to 50 percent flowering, Days to maturity, No. of grains plant⁻¹ and No. of grains pod⁻¹ of chickpea

Treatments	Days to 50 percent flowering					Days to maturity					No. of grains plant ⁻¹					No. of grains pod ⁻¹				
	2016	2017	2018	2019	Pooled	2016	2017	2018	2019	Pooled	2016	2017	2018	2019	Pooled	2016	2017	2018	2019	Pooled
I ₁ : Irrigation scheduled at seedling stage (20 DAS)	34.33	47.33	34.00	35.67	37.83	63.67	76.67	65.00	64.00	67.33	45.73	40.07	36.66	50.23	45.34	1.20	1.01	1.01	1.17	1.10
I ₂ : Irrigation scheduled at flowering stage (40 DAS)	41.00	50.67	41.33	41.67	43.67	69.00	78.67	68.67	68.33	71.17	57.10	72.53	61.33	60.10	63.24	1.27	1.10	1.03	1.27	1.17
I ₃ : Irrigation scheduled at grain filling stage (60 DAS)	32.67	46.33	32.67	33.33	36.25	64.33	78.00	64.67	65.00	68.00	42.37	40.03	41.61	50.00	44.13	1.17	1.04	0.99	1.17	1.09
I ₄ : Irrigation scheduled at seedling and flowering stage (20 & 40 DAS)	41.00	51.33	41.67	41.33	43.83	68.67	79.00	68.33	68.67	71.17	54.63	79.20	75.31	64.70	66.18	1.33	1.11	1.13	1.33	1.23
I ₅ : Irrigation scheduled at seedling and grain filling stage (20 and 60 DAS)	37.67	47.67	37.67	38.67	40.42	63.00	73.00	63.00	63.33	65.58	30.87	28.80	40.07	43.50	34.39	1.17	1.01	1.00	1.17	1.09
I ₆ : Irrigation scheduled at flowering and grain filling stage (40 and 60 DAS)	39.67	50.67	40.00	39.67	42.50	68.67	79.67	68.33	69.33	71.50	48.40	60.07	56.37	48.60	52.36	1.13	1.07	1.00	1.13	1.08
I ₇ : Irrigation scheduled at seedling, flowering and grain filling stage (20,40 & 60 DAS)	36.67	50.33	35.67	38.00	40.17	63.67	77.33	64.00	65.00	67.50	28.20	24.60	39.67	39.50	30.77	1.20	0.99	0.95	1.20	1.09
I ₀ : Control	41.00	50.00	41.33	42.00	43.58	70.67	79.67	74.00	73.33	74.42	50.70	51.27	39.21	49.13	50.37	1.23	1.05	0.98	1.23	1.13
S Em±	0.62	1.14	0.95	0.52	0.53	0.57	1.48	1.24	0.70	0.50	3.81	3.63	2.45	3.53	1.98	0.07	0.05	0.05	0.08	0.05
C.D. at 5 %	1.89	NS	2.87	1.58	1.62	1.71	NS	3.78	2.12	1.50	11.58	11.01	7.43	10.71	6.02	NS	NS	NS	NS	NS

Table 2: Effect of scheduling of irrigation on Grain weight plant⁻¹ (g), Number of pods plant⁻¹ and Grain yield (kg ha⁻¹) of chickpea

Treatments	Grain weight plant ⁻¹ (g)					Number of pods plant ⁻¹					Grain yield (kg ha ⁻¹)				
	2016	2017	2018	2019	Pooled	2016	2017	2018	2019	Pooled	2016	2017	2018	2019	Pooled
I ₁ : Irrigation scheduled at seedling stage (20 DAS)	6.67	6.33	6.73	8.67	7.10	35.53	37.67	36.20	42.73	38.03	396.67	570.49	400.33	382.67	437.54
I ₂ : Irrigation scheduled at flowering stage (40 DAS)	9.67	10.93	9.07	9.93	9.90	39.00	69.60	58.20	47.60	53.60	608.00	1042.47	628.67	637.67	729.20
I ₃ : Irrigation scheduled at grain filling stage (60 DAS)	6.13	6.80	7.80	9.67	7.60	37.40	42.53	42.17	42.13	41.06	397.67	687.53	426.67	414.00	481.47
I ₄ : Irrigation scheduled at seedling and flowering stage (20 & 40 DAS)	11.27	11.87	11.07	9.67	10.97	45.33	69.67	66.77	48.47	57.56	673.00	1160.12	758.33	745.67	834.28
I ₅ : Irrigation scheduled at seedling and grain filling stage (20 and 60 DAS)	6.60	5.00	6.07	8.00	6.42	28.13	34.78	39.67	37.13	34.93	313.33	593.09	343.33	375.00	406.19
I ₆ : Irrigation scheduled at flowering and grain filling stage (40 and 60 DAS)	9.40	9.53	7.10	8.73	8.69	38.73	57.33	56.10	42.67	48.71	586.33	794.81	528.67	408.33	579.54
I ₇ : Irrigation scheduled at seedling, flowering and grain filling stage (20,40 & 60 DAS)	4.80	4.67	6.57	6.40	5.61	23.60	31.67	41.53	33.00	32.45	255.67	313.09	361.00	302.67	308.10
I ₀ : Control	7.60	9.27	6.00	7.63	7.63	38.73	50.67	40.13	39.80	42.20	410.00	650.99	409.33	403.67	468.50
S Em±	0.67	0.58	1.01	0.53	0.40	2.68	3.43	5.32	2.44	2.03	36.65	58.73	41.59	35.89	21.30
C.D. at 5 %	2.03	1.76	3.07	1.60	1.22	8.14	10.41	16.13	7.40	6.16	111.18	178.15	126.15	108.85	64.61

Table 3: Effect of scheduling of irrigation on Percent increase in yield over control and Irrigation water use efficiency (kg/ha mm)

Treatments	Grain yield (kg ha ⁻¹)	Percent increase in yield over control	Irrigation water use efficiency (kg/ha mm)
I ₁ : Irrigation scheduled at seedling stage (20 DAS)	437.54	-6.61	8.75
I ₂ : Irrigation scheduled at flowering stage (40 DAS)	729.20	55.65	14.58
I ₃ : Irrigation scheduled at grain filling stage (60 DAS)	481.47	2.77	9.63
I ₄ : Irrigation scheduled at seedling and flowering stage (20 & 40 DAS)	834.28	78.07	8.34
I ₅ : Irrigation scheduled at seedling and grain filling stage (20 and 60 DAS)	406.19	-13.30	4.06
I ₆ : Irrigation scheduled at flowering and grain filling stage (40 and 60 DAS)	579.54	23.70	5.80
I ₇ : Irrigation scheduled at seedling, flowering and grain filling stage (20,40 & 60 DAS)	308.10	-34.24	2.05
I ₀ : Control	468.50		
S Em±	21.30		
C.D. at 5 %	64.61		

*water applied= 50 mm

Table 4: Economics of chickpea in different treatment as affected by different scheduling of irrigation

Treatments	Total cost (Rs ha ⁻¹)	Gross return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	BC ratio
I ₁ : Irrigation scheduled at seedling stage (20 DAS)	37660	22810	-14850	0.60
I ₂ : Irrigation scheduled at flowering stage (40 DAS)	40203	38070	-2133	0.95
I ₃ : Irrigation scheduled at grain filling stage (60 DAS)	38046	25130	-12916	0.66
I ₄ : Irrigation scheduled at seedling and flowering stage (20 & 40 DAS)	42474	43560	1086	1.03
I ₅ : Irrigation scheduled at seedling and grain filling stage (20 and 60 DAS)	38747	21200	-17547	0.55
I ₆ : Irrigation scheduled at flowering and grain filling stage (40 and 60 DAS)	40254	30240	-10014	0.75
I ₇ : Irrigation scheduled at seedling, flowering and grain filling stage (20,40 & 60 DAS)	39252	16090	-23162	0.41
I ₀ : Control	36577	24450	-12127	0.67
S Em±	-	-	-	-
C.D. at 5 %	-	-	-	-