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Response of chickpea varieties to irrigation at critical growth stages under middle Gujarat condition

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Abstract

The field experiment was conducted at Agricultural Research Station, Anand Agricultural University, Derol, Panchmahal, Gujarat, India during *rabi* seasons of the year (2019-20 and 2020-21). Treatments for chickpea varieties to irrigation at critical growth stages were studied in split plot design (SPD) with four replications to study the “response of chickpea varieties to irrigation at critical growth stages”. Result of field experimentations, revealed that pre sowing irrigation + Irrigation at branching + pod development stage was recorded higher growth and yield attributes, yield, gross returns, net returns, benefit cost ratio in comparison to rest of treatments. The results revealed non-significant differences for protein content recorded at harvest due to different treatments.

Keywords: Chickpea, irrigation and varieties

Introduction

Chickpea is the most important pulse crop cultivated in *rabi* season in Gujarat covering total area 8.50 lakh hectares and 15.64 lakh tonnes production of the state with 1841 kg/ ha productivity (Annon., 2024-25) ^[2]. In Gujarat, ground water is one of important source of irrigation. Through wells, it is utilized for irrigation purpose during *rabi* season as supplementary. Water in the wells is limited; hence it is necessary to utilize the limited water resources judiciously so that the maximum area of *rabi* pulses can be brought under irrigation. Applying minimum irrigation water at the critical growth stages, the yield of *Rabi* pulse like gram can be increased, for determining the water requirement of crops it is necessary to study the different approaches of scheduling of irrigation and application of irrigation at critical growth stages is one of practical approach of scheduling irrigation. Singh *et al.* (2006) ^[7] reported that the two irrigations at pre flowering and pod development stages gave more seed yield over no irrigation and single irrigation at pre flowering stage. Krishnamurthy and Steeramulu (2007) ^[4] observed the highest seed yield and yield contributing characters of chickpea when crop was irrigated at flowering stage and pod formation stage. Now a days we are facing some unfavorable environmental changes such as irregular and unevenly distributed rainfall, very hot summer, very cold winter, floods, storms, droughts, etc. which are greatly effecting crop production. Keeping above in view a field experiment was conducted to find out the “response of chickpea varieties to irrigation at critical growth stages”.

Materials and methods

The field experiment was carried out to study the “Response of chickpea varieties to irrigation at critical growth stages”. The experiment was conducted at Agricultural Research Station, Anand Agricultural University, Derol, Dist: Panchmahals, Gujarat, India during *rabi* seasons of the year (2019-20 and 2020-21). The plot size was 3.6 x 5.0 m. Treatments for chickpea varieties to irrigation at critical growth stages was studied in split plot design (SPD) with four replications Main plot (Irrigation Levels): I₀: Pre sowing irrigation, I₁: I₀ + Irrigation at branching + pod development stage, I₂: I₀ + Irrigation at flowering + pod development stage and I₃: I₀ + Irrigation at branching, flowering and pod development stage and Sub plot (Varieties): V₁: GJG 3, V₂: GJG 6 and V₃: GG 5. The soil of the experimental field was sandy loam in texture having low in nitrogen, medium in phosphorus and high in potassium. All the recommended agronomic

practices were followed for raising the crop during experimentation. The observations on growth and yield attributes were recorded. Protein content was recorded after harvest analyzed from replicated sample.

Results and Discussion

The results of two years experimental findings on “response of chickpea varieties to irrigation at critical growth stages” have been discussed under following different heads.

Effect of irrigation levels and varieties

Significantly higher plant height was recorded in treatment I₃: I₀ + Irrigation at branching, flowering and pod development stage, but it was at par with treatments I₂ and I₁ in both the year as well as pooled. Significantly higher plant height was recorded in variety V₃: GG 5 in first year and pooled, while second year at par with variety V₁: GJG 3. Similar result was observed by Lende and Patil (2017) [5] and Aditi *et al.* (2022) [1]. More number of branches per plant was recorded I₃: I₀ + Irrigation at flowering + pod development stage statistically at par with I₃ and I₁ in both the year as well as pooled. Similar result was observed by Aditi *et al.* (2022) [1]. Patel *et al.* (2016) [6] also reported that, two irrigations at branching and pod-development stages in chickpea resulted in higher growth attributes over single irrigation at either stage. More number of branches per plant was recorded in variety V₂: GJG 6 statistically at par with variety V₃: GG 5 in both the year as well as pooled. More number of pods per plant was recorded I₁: I₀ + Irrigation at branching + pod development stage statistically at par with I₃ and I₂ in both the year but I₃ in pooled. Similar result was observed by Aditi *et al.* (2022) [1] and Krishnamurthy and Steeramulu (2007) [4]. More number of pods per plant was recorded significantly in variety V₃: GG 5 in pooled, but both year are unaffected. More number of seeds per pod was recorded I₁: I₀ + Irrigation at branching + pod development stage statistically at par with I₂ and I₃ in both the year, but I₃ in pooled. Number of seeds per pod was unaffected in varieties in both the year as well as pooled. Days to 50% flowering and maturity was significantly influenced due to different treatments in irrigation levels and varieties for both the year as well as pooled. Highest seed index (g) was found in I₁: I₀ + Irrigation at branching + pod development stage statistically at par with I₃ and I₂ in both the year as well as pooled. The highest seed index (g) was found in variety V₂: GJG 6 statistically at par with variety V₁: GJG 3 in both the year as well as pooled. Treatment I₁: I₀ + Irrigation at branching + pod development stage recorded significantly higher seed yield 1966, 2009 and 1988 kg/ha, but it was at par

with treatments I₃ and I₂ in first year, second year and pooled. Lende and Patil (2017) [5] was observed irrigation scheduling at branching and pod development stage recorded significantly more grain yield. Singh *et al.* (2006) [7] and Krishnamurthy and Steeramulu (2007) [4] also observed the highest seed yield of chickpea when irrigated at flowering and pod formation stage. Similar result was observed by Thomas *et al.* (2010) [8] and Aditi *et al.* (2022) [1]. Seed yield was unaffected in varieties for first year and pooled, but second year significantly higher seed yield 1844 kg/ha, was recorded in variety V₃: GG 5. Treatment I₁: I₀ + Irrigation at branching + pod development stage recorded significantly higher haulm yield 2401, 2379 and 2390 kg/ha, but it was at par with treatments I₃ and I₂ in first year, second year and pooled. In varieties haulm yield was unaffected during first year, second year found significantly higher haulm yield 2280 kg/ha, was recorded in variety V₃: GG 5 at par with V₁: GJG 3, and pooled also significantly higher haulm yield 2278 kg/ha, was recorded in variety V₃: GG 5. Chourasiya *et al.* (2016) [3] found that, irrigation in chickpea at branching and pod-development stages enhanced seed yield and straw yield significantly over single irrigations at either stage owing to availability of moisture at critical stages which favorably impacted yield attributes and ultimately the yield.

Interaction effects of irrigation levels and varieties

The interaction effects between irrigation levels and varieties with respect to growth and yield attributes was found non-significant, Except number of branches per plant, number of pods per plant, days to maturity and seed index. The interaction effects between year, year and irrigation, year and varieties, year and irrigation and varieties with respect to growth and yield attributes was found non-significant

Protein content

The results revealed non-significant differences for protein content recorded at harvest due to different treatments in during the year 2020-21.

Economics

The economics of various treatments, treatment I₁: I₀ + Irrigation at branching + pod development stage registered the highest net return of ₹75432/ha with BCR 3.28. Followed by profitable treatments I₂: I₀ + Irrigation at flowering + pod development stage with BCR 3.08. Similar result was observed by Chourasiya *et al.* (2016) [3], Lende and Patil (2017) [5] and Aditi *et al.* (2022) [1].

Table 1: Growth and yield attributing characters as influenced by different treatments in chickpea

Treatment	Plant height (cm.) at harvest			No. of branches/ plant			No. of pods/ plant		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
(a) Main plot (Irrigation Levels): 4									
I ₀ : Pre sowing irrigation	46.2	45.9	46.1	4.8	4.6	4.7	60.9	59.4	60.1
I ₁ : I ₀ + Irrigation at branching + pod development stage	57.0	54.5	55.7	6.8	6.4	6.6	74.6	73.2	73.8
I ₂ : I ₀ + Irrigation at flowering + pod development stage	59.8	55.9	57.9	6.9	6.8	6.8	68.1	68.9	68.5
I ₃ : I ₀ + Irrigation at branching, flowering and pod development stage	60.2	57.3	58.8	6.8	6.6	6.7	72.3	70.0	71.1
S. Em. ±	1.44	2.06	1.26	0.15	0.21	0.13	2.74	2.63	1.64
CD at 5%	4.62	6.60	3.74	0.49	0.68	0.39	8.62	8.29	4.88
CV%	8.96	13.38	11.30	8.45	12.10	10.37	11.89	11.64	11.77
(b) Sub plot (Varieties): 3									
V ₁ : GJG 3	54.8	54.3	54.5	5.8	5.5	5.7	67.8	66.9	67.3
V ₂ : GJG 6	52.5	50.3	51.4	6.6	6.4	6.5	66.6	66.3	66.4
V ₃ : GG 5	60.1	55.7	57.9	6.5	6.4	6.4	72.5	70.4	71.5
S. Em. ±	1.11	0.88	0.71	0.12	0.17	0.10	1.40	1.58	1.29
CD at 5%	3.24	2.58	2.02	0.35	0.49	0.29	NS	NS	3.68

I x V Interaction S. Em. $\pm$	2.22	1.77	1.42	0.24	0.33	0.21	2.80	3.15	2.58
CD at 5%	NS	NS	NS	NS	NS	0.59	NS	NS	7.35
CV%	7.96	6.62	7.35	7.62	10.96	9.38	9.94	11.38	10.67
Y S. Em. $\pm$	-	-	0.89	-	-	0.09	-	-	1.16
CD at 5%	-	-	NS	-	-	NS	-	-	NS
Y x I S. Em. $\pm$	-	-	1.78	-	-	0.19	-	-	2.32
CD at 5%	-	-	NS	-	-	NS	-	-	NS
Y x V S. Em. $\pm$	-	-	1.00	-	-	0.15	-	-	1.83
CD at 5%	-	-	NS	-	-	NS	-	-	NS
Y x I x V S. Em. $\pm$	-	-	2.00	-	-	0.29	-	-	3.65
CD at 5%	-	-	NS	-	-	NS	-	-	NS

Table 2: Yield attributing characters as influenced by different treatments in chickpea

Treatment	No. of seeds / pod			Days to 50% flowering			Days to maturity		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
(a) Main plot (Irrigation Levels): 4									
I ₀ : Pre sowing irrigation	1.5	1.4	1.4	30.1	30.7	30.4	86.4	86.8	86.6
I ₁ : I ₀ + Irrigation at branching + pod development stage	1.8	1.8	1.8	34.5	35.3	34.9	94.5	94.9	94.7
I ₂ : I ₀ + Irrigation at flowering + pod development stage	1.8	1.7	1.7	36.6	37.1	36.8	96.6	96.8	96.7
I ₃ : I ₀ + Irrigation at branching, flowering and pod development stage	1.7	1.6	1.6	36.7	37.0	36.8	96.7	97.0	96.8
S. Em. $\pm$	0.06	0.07	0.04	0.38	0.42	0.28	0.52	0.49	0.36
CD at 5%	0.19	0.20	0.13	1.22	1.33	0.84	1.66	1.58	1.06
CV%	12.41	13.64	13.01	3.85	4.11	3.98	1.92	1.82	1.87
(b) Sub plot (Varieties): 3									
V ₁ : GJG 3	1.8	1.7	1.7	32.2	32.9	32.5	91.3	91.6	91.4
V ₂ : GJG 6	1.7	1.6	1.6	35.1	35.6	35.4	94.0	94.3	94.1
V ₃ : GG 5	1.6	1.5	1.5	36.1	36.5	36.3	95.4	95.9	95.6
S. Em. $\pm$	0.05	0.04	0.04	0.33	0.29	0.22	0.35	0.35	0.25
CD at 5%	NS	NS	NS	0.97	0.85	0.63	1.02	1.03	0.71
I x V Interaction S. Em. $\pm$	0.10	0.11	0.07	0.66	0.58	0.44	0.70	0.71	0.49
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	1.42
CV%	12.34	13.36	12.83	3.84	3.33	3.60	1.50	1.51	1.50
Y S. Em. $\pm$	-	-	0.03	-	-	0.20	-	-	0.25
CD at 5%	-	-	NS	-	-	NS	-	-	NS
Y x I S. Em. $\pm$	-	-	0.06	-	-	0.40	-	-	0.50
CD at 5%	-	-	NS	-	-	NS	-	-	NS
Y x V S. Em. $\pm$	-	-	0.05	-	-	0.31	-	-	0.35
CD at 5%	-	-	NS	-	-	NS	-	-	NS
Y x I x V S. Em. $\pm$	-	-	0.11	-	-	0.62	-	-	0.70
CD at 5%	-	-	NS	-	-	NS	-	-	NS

Table 3: Yield attributing characters as influenced by different treatments in chickpea

Treatment	Seed index (g)			Seed yield (kg/ha)			Haulm yield (kg/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
(a) Main plot (Irrigation Levels): 4									
I ₀ : Pre sowing irrigation	21.6	21.4	21.5	1256	1311	1284	1767	1755	1761
I ₁ : I ₀ + Irrigation at branching + pod development stage	24.6	24.4	24.5	1966	2009	1988	2401	2379	2390
I ₂ : I ₀ + Irrigation at flowering + pod development stage	23.8	23.7	23.4	1847	1888	1868	2292	2262	2277
I ₃ : I ₀ + Irrigation at branching, flowering and pod development stage	24.6	24.4	24.5	1877	1879	1878	2355	2207	2281
S. Em. $\pm$	0.59	0.74	0.47	68	52	43	64	72	48
CD at 5%	1.89	2.36	1.41	218	167	128	204	230	143
CV%	8.70	10.86	9.83	13.59	10.23	11.99	10.04	11.56	10.81
(b) Sub plot (Varieties): 3									
V ₁ : GJG 3	24.2	24.0	24.1	1722	1745	1734	2182	2111	2147
V ₂ : GJG 6	24.7	24.3	24.5	1716	1726	1721	2154	2061	2108
V ₃ : GG 5	22.0	22.2	22.1	1771	1844	1808	2276	2280	2278
S. Em. $\pm$	0.43	0.55	0.35	47	32	28	46	61	38
CD at 5%	1.24	1.60	0.99	NS	93	NS	NS	178	109
I x V Interaction S. Em. $\pm$	0.85	1.10	0.69	94	64	57	93	122	77
CD at 5%	NS	NS	1.98	NS	NS	NS	NS	NS	NS
CV%	7.21	9.33	8.33	10.80	7.23	9.16	8.40	11.35	9.95
Y S. Em. $\pm$	-	-	0.33	-	-	30	-	-	34
CD at 5%	-	-	NS	-	-	NS	-	-	NS
Y x I S. Em. $\pm$	-	-	0.66	-	-	60	-	-	68
CD at 5%	-	-	NS	-	-	NS	-	-	NS
Y x V S. Em. $\pm$	-	-	0.49	-	-	40	-	-	54
CD at 5%	-	-	NS	-	-	NS	-	-	NS
Y x I x V S. Em. $\pm$	-	-	0.98	-	-	80	-	-	108
CD at 5%	-	-	NS	-	-	NS	-	-	NS

Table 4: Protein content (%) as influenced by different treatments in chickpea during 2020-2021

Treatment	Protein content (%)
	2020-21
(a) Main plot (Irrigation Levels): 4	
I ₀ : Pre sowing irrigation	20.3
I ₁ : I ₀ + Irrigation at branching + pod development stage	22.1
I ₂ : I ₀ + Irrigation at flowering + pod development stage	21.8
I ₃ : I ₀ + Irrigation at branching, flowering and pod development stage	21.9
S. Em. ±	0.71
CD at 5%	NS
CV%	9.86
(b) Sub plot (Varieties): 3	
V ₁ : GJG 3	22.1
V ₂ : GJG 6	20.8
V ₃ : GG 5	21.6
S. Em. ±	0.39
CD at 5%	NS
I x V Interaction S. Em. ±	0.78
CD at 5%	NS
CV%	8.90

Table 5: Economics as influenced by different treatments in chickpea

Treatment	Seed yield (kg/ha)	Haulm Yield (kg/ha)	Gross Realization (₹/ha)	Total Cost of cultivation (₹/ha)	Net Realization (₹/ha)	B:C ratio
(a) Main plot (Irrigation Levels): 4						
I ₀ : Pre sowing irrigation	1284	1761	70742	31654	39088	2.23
I ₁ : I ₀ + Irrigation at branching + pod development stage	1988	2390	108533	33101	75432	3.28
I ₂ : I ₀ + Irrigation at flowering + pod development stage	1868	2277	102074	33101	68973	3.08
I ₃ : I ₀ + Irrigation at branching, flowering and pod development stage	1878	2281	102621	33824	68797	3.03
(b) Sub plot (Varieties): 3						
V ₁ : GJG 3	1734	2147	94848	32920	61928	2.88
V ₂ : GJG 6	1721	2108	94094	32920	61174	2.86
V ₃ : GG 5	1808	2278	99017	32920	66097	3.01

Conclusion

The farmers of Middle Gujarat Agro-climatic Zone growing chickpea are recommended to apply three irrigations, first at the time of sowing and remaining two irrigations at branching or at flowering stage and pod development stage for obtaining higher yield and net return.

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