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PERFORMANCE OF GRAM UNDER GRADED LEVELS OF IRRIGATION AND FERTILIZATION

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The field studies on the effect of irrigation and fertilization on production potential of gram (*Cicer arietinum* L.) during 1979-80 and 1980-81 revealed that it responded favourably to one irrigation applied at preflowering stage (45 days after sowing) along with full recommended fertilizer dose of 20-60-30. One more post sowing irrigation was not found beneficial. The mean maximum water use efficiency (167.4 kg grain / cm ha) and nutrient response (33 82 kg grain / kg nutrient applied) were obtained, respectively under control irrigation (T_0) and 33.3% of recommended fertilizer dose (F_3). In the other way, lower water use efficiency and nutrient response were obtained under I_2 F_3 because of less unit increase in grain yield with each unit addition of fertilizer and irrigation water over I_0 F_3.

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There are periods when plants are sensitive to water stress as far as quanity and quality of the harvest are concerned. Such sensitivity in plants life provides an apportunity to economic water use in crop production by skipping irrigation at less sensitive stages. Yadav (1972) found ihat one irrigation given to Kabuli variety of gram either at preflowering (45 days atter sowing) or at flowering stage (70 days after sowing produced more grain yield when compared with control. Sharma *et al.* (1974) reported that irrigation at post flowering was better over preflowering stage. However Singh *et al.* (1977) did not observe any variation in grain yield by giving irrigation either at preflowering or post flowering but yield decreased when crops received irrigations at both stages.

Gram is responsive to the addition of fertilizers (Chundhawat *et al.* 1976) and irrigation application (Dastane *et al.* 1971). However, Mudholkar and Ahlawat (1974) reported that gram did not respond to nitrogen and 41 kg $P_2 0_5$ /ha was the optimum dose for gram. Therefore, the present study aimed to determine the production potential of gram under limited supply of irrigation water and fertilizer.

MATERIALS AND METHODS

An invastication was carried out during *rabi* 1979-80 and 1980-81 at Borwat farm of Agriculture Research Station, Banswara, Rajasthan to evaluate the porformance of gram under graded levels of irrigation and fertilizations. The soil of experimental field was clay loam, well drained and uniform texture having 7.8 pH. The field capacity, permanent wilting point and bulk density of soil were 19.20%, 8.6%, and 1.43 gcm3, respectively. Organic carbon, available phosphorus and potash were 0.45%, 45 and 450 kg/ha. respectively.

Treatments consisted of combinations of three levels of irrigation viz. control, (I_0) one preflowering stage (I_1) and two irrigations (preflowering + podfilling stages (I_2) and three levels of fertilizers viz. full recommended dose (29-60-30 F_1) 66.6% (F_2) and 33.3% (F_3) of recommended fertilizer dose. The treatments were replicated three times in a split plot design keeping irrigation levels in main plot and fertilizer levels in subplot. Urea (46% N), single superphosphate (16% $P_2 0_5$) and muriate of potash (60% $K_2 0$) were placed in side bands to supdly the fertilize, teatments. Full dose of nitrogen phosphorus and potash were applied at sowing time of the experiment. 7.5 cm delta of water was applied in each irrigation. Seeds of gram CV. Rs.-10 were drilled by bullock drawn seed drill at the rate of 90 kg/ha in rows 30 cm apart.

Grain yield and water and fertilizer use efficiencies were recorded to evaluate the treatments. The irrigation water and fertilizer use efficiencies for different treatments were deter-

mined by deviding grain yield by respective delta of water and total nutrients applied, respectively. IWUE (kg / cm. ha) = $\frac{\text{Grain yield kg/ha}}{\text{Delta of waterin cm.}}$

Fertilizer use efficiency = $\frac{\text{Seed yield kg/ha.}}{\text{Fertilizer (N+P+K) applied inkg/ha.}}$

RESULTS AND DISCUSSION

Grain yield :

Grain yield of gram increased with increasing frequencies of irrigation during both years (Table-1). Increases in yield with one irrigation at preflowering stage (45 days after sowing) over control were 4.90 and 4.25 q/ha, respectively during 1979-80 and 1980-81 with 36 per cent increase over the control during both years. The mean numerical increase with one post sowing irrigation over control was 4.57 q/ha and 36 per cent Application of one more irrigation at pod filling stage had no beneficial effect on grain production when compared with one post sowing irrigation applied at preflowering stage. Similar effect of one post sowing irrigation on grain yield was reported by Singh *et al.* (1980). This might be due to scheduling of irrigation at preflowering stage can be attributed more number of branches and subsequently more number of pods per plant, which ultimately resulted in more number seeds and seed yield. Irrigation at pod filling stage was not helpful in augumenting either the number of branches or pods per plant.

A siginficant reduction in grain yields was observed with decreasing levels of recommended fertilizer dose.

Reduction in grain yields with 2/3rd (66.6%) and 1/3 (33.3%) of recommended fertilizer dose (20-60-30) were 5.04 and 8.35 q/ha, respectively during 1979-80 and 2.86 and 6.0 q/ha during 1980-81 when compared with grain yields obtained with full recommended fertilizer dose. The mean numerical decrease with 2/3rd and 1/3rd dose over full recommended dose were 3.95 and 7.17 q/ha and corresponding decreases were 20 and 36 per cent. respectively. Full recommended dose of fertilizer with one irrigation at preflowering stage produced highest grain yield of 54.10 and 20.23 q/ha, respectively during 1970-80 and 1980-81.

Irrigation water use efficiency :

On an average highest and lowest water use efficiences of 167.40 and 81.15 kg grain/cm - ha were recorded in control and two post sowing irrigation applied at preflowering and pod filling stage.

This was due to proportionately higher increase in yield at lower delta of water because crop plants try to economise the water loss under limited water suppiy conditions With higher delta of irrigation water, there was no proporonately increase ni grain yield therefore, water use efficiency decreased. Rathore and Singh (1979) and Singh *et al* (1980), also reported decreased water use effici-

Table Grain yield of gram as influenced by different levels of irrigation and fertilizer.

Treatment	Total water/ nutrient applied	Grain yield q/ha			Irrigation water use efficiency grain kg/cm. ha.			Nutrient response grain kg/kg of nutrient		
		1979-80	1980-81	Mean	1979-80	1980-81	mean	1979-80	1980-81	Mean
1	2		3			4			5	
A. Irrigation leels										
I_0	7.5 cm	13.34	11.77	12.56	177.07	156.93	167.40	—	—	—
I_1	15.0 cm	18.24	16.02	17,13	121.60	106.80	114.20	—	—	—
I_2	22.5 cm	19.47	17.05	18.26	86.53	75.78	81.15	—	—	—
C. D. at 5%	—	1.91	4.13	—	—	—	—	—	—	—
B. Fertilizer levels										
F_1	110 kg	21.48	17.90	19.69	—	—	—	19.53	16.27	17.90
F_2	73 kg	16.44	15.04	15.74	—	—	—	22.60	20.60	21.56
F_3	37 kg	13.13	11.90	12·52	—	—	—	35.49	32.16	33.82
C. D. at 5%	—	0.96	1.47	—	—	—	—	—	—	—
C. Irrigation x Fertilizer										
I_0 F_1	7.5/110	17.10	14.02	15.56	228.00	186.93	207.46	15.55	12.75	14.15
I_0 F_2	7.5/73	12.93	11.68	12.31	172.40	155.73	164.06	17.71	16.00	16.85
I_0 F_3	7.5/37	10.00	9.60	9.80	133.33	128.00	130.66	27.03	25.95	26.49
I_1 F_1	15/110	24.10	20.23	22.17	160.67	134.87	147.77	21.91	18.39	20.15
I_1 F_2	15/73	16.57	16.20	16.39	110.47	108.00	109.23	22.70	22.19	22.44
I_1 F_3	15/37	14.05	11.62	12.84	93.67	77.47	85.57	37.97	31.41	39.69
I_2 F_1	22.5/110	23.25	19.43	21.34	103.33	86.36	94.84	21.14	17.66	19.40
I_2 F_2	22.5/73	19.83	17.25	18.54	88.13	76.67	82.40	27.16	23.63	25.39
I_2 F_3	22.5/37	15.33	14.47	14.90	14.13	64.31	66.22	41.43	39.11	40.27
C. D. at 5%	—	—	—	—	—	—	—	—	—	—

encies in increased frequencies of irrigation.

Nutrient response :

The mean highest and lowest nutrient response of 33.82 and 17 90 kg grain/kg of nutrient applied were observed in 1/3rd and full recommended fertilizer dose, respectively.

Though highest WUE and nutrient response were recorded with control irrigation and lowest dose of fertilizer, such higher values are not desirable on economic ground.

Irrigation water use efficiency reduced with the reduction of recommended fertilizer dose at same level of irrigation. However, nutrient response significantly increased with increasing levels of irrigation at same fertilizer dose. This was because of irrigation water makes more available nutrients for plant growth subsequently produced more healthy plants and more grain yield, which ultimately increased the nutrient response,

It may be inferred from the present study that gram crop should be irrigated once at preflowering stage with full recommended fertilizer dose where water supply is limited.

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