

## YIELD RESPONSE OF GRAM TO IRRIGATION IN PAKISTAN

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The response of gram to number of irrigations was determined during 1995-96 and 96-97. Effect of irrigation on branches per plant, seeds per pod and 100-seed weight was non-significant in both the years. However, plant height, pods per plant and grain yield were increased significantly by applying one or two irrigations as compared to without irrigation. The results suggested that one irrigation at flowering was enough to obtain the maximum yield of gram.

**Key words:** Gram, Irrigation, Growth stages

### Introduction

Gram (*Cicer arietinum* L.) is an important rabi (crops sown from October to December in Pakistan) pulse crop, rich in protein. It has a great importance in human diet. It is a hardy crop and is commonly grown in barani areas (areas where rain-water is the only source of irrigation) of the country. However, gram is also cultivated under irrigated conditions. Response of gram to irrigation at different vegetative stages has been well documented. Irrigation at stages like branching, flowering, grain formation, etc., resulted reasonable increase in grain yield as compared to that obtained without irrigation (Raghu and Choubey 1983). Seed yield of gram increased by 25, 31, 50 and 69% with 1,2,3 and 4 irrigation, respectively (Katare *et al* 1984). However, this response is very much dependent upon the climatic of the locality. Thus, Dec *et al* (1987) observed similar yields of gram sown without irrigation or with one irrigation and it was also noted that two irrigations increased vegetative growth and straw yield giving lesser harvest index values. Number of irrigation also produce remarkable effect on yield components like pods per plant, seeds per pod, seed weight, etc. These factors ultimately produce an intergrated effect interms of grain yield. A significant effect of irrigation on number of pods per plant and 1000-seed weight has been reported (Maity and Jana 1987). Yield increase by 0.09  $\text{tha}^{-1}$  in response to irrigation has also been reported as compared to that of without irrigation (Patel *et al* 1991). This experiment was therefore conducted under irrigated conditions at Faisalabad to study the effect of number of irrigations on plant development, yield of gram and the appropriate number and stage of irrigation conducive to attain maximum yield. The results would be helpful for growing gram under irrigated conditions of the country.

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### Materials and Methods

The experiment was conducted at the research field of University of Agriculture, Faisalabad, during the years 1995-96 and 96-97. A triplicated Randomized Complete Block Design was used to carry out the experiment. Gram variety Punjab 91 was sown in lines with a hand drill in individual plots of 10 x 5 meter keeping the seed rate at 20  $\text{kg}^{-1}\text{acre}$ , row to row distance was kept at 30 cm and fertilizer was applied at recommended dose (Nand P @ 12 and 25  $\text{kg}^{-1}\text{acre}$ , respectively).

All the other agronomic and intercultural operations were carried out uniformly. Attack of pod borer was checked by using thiodan @ 1 liter  $\text{acre}^{-1}$ . Data on various morphological and yield related characters viz., plant height, number of branches per plant, number of pods per plant, seeds per pod, 100-seed weight and grain yield were collected at maturity. Data collected during both crop seasons (1995-96 and 96-97) was statistically analysed using ANOVA techniques of (Steel and Torrie 1984) to sort out the significant differences among treatments. Treatment means were compared using LSD test.

### Results and Discussion

Response of gram (cv. Punjab 91) to number of irrigations was similar in both the years but the differences due to irrigation treatments were significant for plant height, number of fruiting branches, number of pods per plant and grain yield during both the years. Seeds per pod and 100-seed weight, however, showed non-significant effect of irrigation treatments.

A comparison of treatment presented in (Table 1 A B) depicted that mean plant height and number of fruiting branches were reduced while an increase in pod number, seeds per

pod, 100-seed weight and grain yield was recorded in 1996-97 as compared to that of 1995-96. This may be attributed to difference in environmental conditions (temperature, humidity, rainfall, etc.) during the two years which affected the growth and development of the crop. It would also be noted from Table 1 A that plant height was maximum when two irrigations were applied while it was minimum under control where no irrigation was applied to the crop. Increase in plant height with one and two irrigations was 15.40 and 50.71%, respectively, in 1995-96 and 16.85 and 33.13% in 96-97. Mean number of fruiting branches per plant also reduced in 1996-97, however, effect of irrigation number was statistically non-significant in both the years.

A similar response for number of pods per plant was observed in both the years against number of irrigations. Ap-

plication of one or two irrigations significantly increased the number of pods by 53.8 and 82.57%, in 1995-96, respectively, as compared to that of without irrigation. However, pod number was statistically at par in  $I_1$  and  $I_2$ . The results are in harmony with those obtained by (1987) Maity and Jana who also observed that number of pods per plant were significantly influenced by the irrigation levels. Similar trend was also observed in 1996-97.

Mean grain yield of gram increased in 1996-97 and the effect of irrigation was much prominent in this year as compared to that in 1995-96. Grain yield increased by 72.8 and 67.54% with one and two irrigations in 1996-97, respectively while this increase was 37.46 and 58.02% in 1995-96. The results are in agreement with those obtained by (Raghu and Choubey 1983 and Katara *et al* 1987), while results are at variance with Dev *et al* (1987) who observed that *Cicer arietinum* gave simi-

**Table 1 A**

Mean values of six agronomic traits of gram (Punjab 91) as affected by different numbers of irrigation. Values in parenthesis represent the percent increase over control

Treatments	Plant height (cm)		Branches per plant		Pods per plant	
	1995-96	1996-97	1995-96	1996-97	1995-96	1996-97
$I_0$ (control)	47.66 b*	49.14 b	5.23	4.60	44.77 b	59.11 b
$I_1$	55.00 b (15.40%)	57.42 a (16.85%)	5.26	4.67	68.88 a (53.88%)	72.87 a (23.28%)
$I_2$	71.83 a (50.71%)	65.42 a (33.13%)	6.30	5.00	81.72 a (82.57%)	76.03 a (28.62%)
LSD	13.20	7.08	ns	ns	15.79	12.00
Mean	58.16	57.33	5.60	4.76	65.12	69.34

**Table 1 B**

Treatments	Seeds per pod		100-seed weight (g)		Grain yield (tha <sup>-1</sup> )	
	1995-96	1996.97	1995-96	1996-97	1995-96	1996-97
$I_0$ (control)	1.36	1.40	24.19	26.55	1.12 b	1.14 b
$I_1$	1.34	1.48	23.27	26.36	1.54 a (37.48)	1.97 a (72.80)
$I_2$	1.36	1.38	23.32	25.23	1.77 a (58.02)	1.91 a (67.54)
LSD	ns	ns	ns	ns	0.42	0.21
Mean	1.35	1.42	23.59	26.05	1.48	1.67

ns, Not significant;  $I_1$ , One irrigation at flowering;  $I_2$ , Two irrigations, 1st at branching and 2nd at flowering; \*, Means sharing common letters do not differ significantly at 0.05 probability level.

lar yields when grown without irrigation and with one irrigation and the yield resulting from zero and one irrigation were significantly higher than the yields of those from two irrigations which increased vegetative growth and resulted in significantly higher straw yield.

It was observed that irrigation at branching stage enhance vegetative growth of the plants resulting in greater plant height. A single irrigation at flowering had a little effect on vegetative growth. Flowering stage was the most critical one because number of pods depended on flowering and pod formation after fertilization. Shortage of water at that stage hampered the proper pod formation and development as a response of poor flowering, and poor fertilization in the ovules or dropping of weak flowers. These factors conclusively influenced the final grain yield. Thus irrigation at flowering stage increased the number of pods per plant (in both  $I_1$  and  $I_2$  treatments) as compared to that of without irrigation. This effect was further evident in terms of grain yield which was greater with two irrigations ( $I_2$ ; one at branching and second at flowering). However,  $I_1$  (one irrigation at flowering) and  $I_2$  stood at par with each other for grain yield. This may be due to the fact that number of pods increased with the in-

crease in number of irrigations. Therefore it may be concluded that under irrigated conditions one irrigation at flowering stage is enough rather than two irrigations, to obtain maximum grain yield of gram.

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