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Effect of Various Irrigations Levels on Different Chickpea Varieties

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Abstract: In order to study the effect of different irrigations levels on chickpea, an experiment was conducted at Malakandher Research Farms, NWFP Agricultural University, Peshawar during 2000.Statistical analysis of the data showed that irrigations levels had a significant effect on emergence unit area^{-1}, days to flowering, days to maturity, pods plant^{-1}, grain yield and biological yield. Maximum emergence unit area^{-1}, pods plant^{-1}, plant height, grain yield, biological yield and harvest index in most of the cases were recorded in those plots, which were given two irrigations, when compared with other treatments. In case of varieties, maximum emergence unit area^{-1}, pods plant^{-1}, grain yield, biological yield and harvest index were recorded in NIFA-95 while CM-72 gave minimum emergence unit area^{-1}, grain yield, biological yield and harvest index. The highest biological yield was obtained from plots treated three times, while the lowest biological yield was obtained from control plots. Maximum grain yield was produced by plots irrigated two times, while minimum grain yield was produced by control plots. Maximum harvest index was obtained from control plots and seeded with CM-72, while minimum harvest index was recorded in plots sown with CM-72 and applied three irrigations.

Key words: Irrigations levels, different varieties, chickpea

Introduction

Water is the major constituent of all living organisms. Between 60 & 90% of the mass living thing is water. The transportation of nutrients to various parts of the plant is carried out by water. Water is an excellent solvent and has great capability to dissolve a wide variety of substances. It is an essential constituent of protoplasm; about 70% of most tissues consist of water. Water is important constituent in photosynthesis in two ways, firstly it provides hydrogen for building up of glucose, and secondly opening and closing of stomata is regulated by increase or decrease in the amount of water. Water together with salt (e.g., nitrates), absorbed by the roots ultimately reaches leaves, where it is used in photosynthesis. Moisture conservation and regulation to adequately meet the crop needs at the critical stages of crop growth and development are crucial for realization of full yield potential of chickpea.

Supplemental irrigation, particularly at the pod filling stage, to improve plant water status, gives economic increase in yields in areas of super optimal temperature during the reproductive growth. Sexana (1980) reported that supplemental irrigations to release the crop from soil moisture stress at critical stages of crop growth has been found to result in substantial yields increase in chickpea. The late flowering and pod setting stages appear to be the most sensitive stages to soil moisture stress (Palled and Ponnia, 1985). Rehman *et al.* (1983) concluded that yields were depressed when the irrigations treatments were given at flowering, with or without pre flowering irrigation. Maximum grain yield, dry matter, pods plant^{-1}, seeds pod^{-1} and 1000 grain weight were obtained for two irrigations (Zaman and Malik, 1988). Pawar *et al.* (1992) reported that seed yield was highest with irrigations at all 3 growth stages and lowest with no irrigations, seed protein content was highest with 3 irrigations and lowest with no irrigations. Mean grain yield, straw yield, pods plant^{-1} and grains plant^{-1} were highest with 2 irrigations.

Materials and Methods

In order to study the effect of irrigation levels on the yield and yield components of chickpea, an experiment was conducted at Malakandher Research Farms, NWFP Agricultural University, Peshawar, during 2000. The experiment was laid out in Randomized Complete Block (RCB) design with split plot arrangements having four replications. The following factors and their level were studied in the experiment.

Irrigation levels (Main plot factor)

L_1 = Control
L_2 = Single irrigation at 40 days after sowing
L_3 = 2 irrigation at 40 days and 80 days after sowing.
L_4 = 3 irrigation at 40 days, 80 and 120 days after sowing.

Varieties (Sub plot factor)

V_1 = NIFA-88 V_2 = NIFA-95
V_3 = CM-72 V_4 = E-231.

A basal dose of 150-50-0 NPK Kg ha^{-1} was applied in form of D.A.P and urea. Sowing was done in the moist soil by dropping the seed in the furrows drawn by a hand hoe and covering immediately. Four irrigation levels were used in the experiment (L_1 = Control, L_2 = Single irrigation at 40 days after sowing, L_3 = 2 irrigation at 40 days and 80 days after sowing, L_4 = 3 irrigation at 40 days, 80 and 120 days after sowing). Standard agronomic practices were followed throughout the growing season.

The following data were recorded during the experiment: emergence unit area^{-1}, days to flowering, days to maturity, pods unit area^{-1}, plant height, hundred seed weight (g), grain weight (Kg ha^{-1}), biological yield (Kg ha^{-1}), harvest index (%).

Data on emergence unit area^{-1} was calculated from date of sowing till when more than 80% plants had emerged in each sub plot. Days to flowering data was recorded from date of sowing till when more than 80% plants produced flowers. Data on days to maturity was noted from date of sowing till when more than 90% plants reached physiological maturity. Number of pods plant^{-1} was recorded by harvesting three plants from each sub plot and then counted the number of pods plant^{-1} and their mean was then calculated. Plant height data was recorded on ten plants randomly selected in each sub plot with the help of meter rod. Thousand grains weight data was recorded by weighing one thousand grains from each subplot with an electronic balance and then their mean was calculated. The data recorded for grain yield, biological yield and harvest index was calculated:

$$\text{Grain yield (kg ha}^{-1}\text{)} = \frac{\text{Grain yield (Kg) subplot}^{-1}}{\text{Area sub plot}^{-1}} \times 10000$$

$$\text{Biological yield (kg ha}^{-1}\text{)} = \frac{\text{Biological yield (Kg) subplot}^{-1}}{\text{Area sub plot}^{-1}} \times 10000$$

$$\text{Harvest Index (H.I)} = \frac{\text{Grain yield}}{\text{Biological yield}^{-1}} \times 100$$

The data collected during the experiment was analyzed according to RCB design and upon obtaining significant differences Least Significant Differences (LSD) test was applied Steel and Torrie (1980).

Results and Discussion

Statistical analysis of the data (Table 1) indicated that different varieties had a significant ($P \le 0.05$) effect on emergence unit area^{-1}. While irrigation levels and interaction between varieties and irrigation were non significant. Mean values of the data revealed that highest emergence unit area^{-1} of 43.50 seedlings were noted in plots sown with NIFA-95 followed by NIFA-88. Whereas minimum of 36.25 seedlings unit area^{-1} were observed in plots sown with CM-72. Statical analysis of the data (Table 2) indicated that different varieties had a significant ($P \le 0.05$) effect on days to flowering.

Statistical analysis of the data (Table 3) revealed that various irrigation levels and varieties of chickpea had a significant ($P\le 0.05$) effects on days to maturity, while their interaction was non significant. Plots treated with three irrigations took maximum (171.25) days to maturity. While minimum (146.25) days to maturity were taken by control plots. Mean values for varieties indicated that plots sown with CM-72 took maximum of 167.50 days to maturity, while plots grown with NIFA-95 recorded minimum (153.75) days to maturity, which was at par with plots, seeded with NIFA-88. Similarly, mean values for IxV interaction revealed that maximum (180) days to maturity were taken by those plots which received three irrigations and sown with CM-72. Control plots sown with NIFA-95 recorded minimum days to maturity which was at par with plots sown with NIFA-88 (Table 3). The probable reason could be that irrigation has enhanced vegetative growth which had prolonged the growing season. Similar results were also reported by Dixit *et al.* (1992), who concluded that irrigation prolonged the growing season by 16-25 days. Statistical analysis of the data revealed that different irrigations levels and varieties had a significant ($P \le 0.05$) effect on plant height while their interaction was non significant.

Analysis of the data (Table 4) indicated that different irrigation levels and varieties had significantly ($P \le 0.05$) affected pods unit area^{-1}, while their interaction was non significant. Data pertaining to pods unit area^{-1} showed that maximum (1954.38) pods unit area^{-1} was recorded in those plots which were, treated three irrigations. Whereas minimum of 1656.69 pods unit area^{-1} were obtained in control plots. Mean values of the data also revealed that maximum pods unit area^{-1} of 2087.75 were produced in plots sown with NIFA-95 while minimum pods unit area^{-1} by CM-72 (1587.81). Similarly, mean values for IxV interaction though non-significant revealed that maximum (2216.75) pods unit area^{-1} was produced by those plots, which received two irrigations, and sown with NIFA-88. Mean values (Table 4) also indicated that control plots sown with E-231 recorded minimum pods unit area^{-1}. The possible reason for this increase in pods unit area^{-1} may be that the provision of sufficient may have enhanced the production of photosynthesis, which resulted in highest number of pods unit area^{-1}. The results agree with the findings of Naik *et al.* (1993), Hernandez and Barrales (1992).

There was a gradual increase in plant height corresponding to irrigation levels (Table 5). Taller plant height (66.89 cm) were attained in those plots, which were treated with three irrigations whereas shorter plants (61.23 cm) were recorded in control plots. Mean values of the data concerning varieties indicate that plant height was maximum (71.37 cm) in plots sown with CM-72, while plots sown with E-231 recorded minimum plant height of 56.19 cm. Similarly, mean value for IxV interaction showed that maximum plant height of 73.39 cm was recorded where two irrigations was applied and sown with CM-72. Maximum plant height was recorded in control plots seeded with E-231 (Table 5). Dixit *et al.* (1993) who showed that plant height increased with increasing irrigation frequency.

Analysis of the data (Table 6) revealed that different varieties had a significant ($P \le 0.05$) effect on hundred-grain weight. While different irrigation levels and interaction between irrigation levels and varieties was non significant. Heavier grains (24.17g) were produced in plots seeded with E-231, while lighter grains (17.15g) were obtained from plots planted with CM-72. Mean value of the data regarding different levels of irrigation showed that maximum hundred grain weight of (21.17 g) was noted in those plots which received two irrigations followed by plots irrigated three times, while minimum hundred grain weight was recorded when one irrigation was applied. Similarly, mean values for IxV interaction though non-significant revealed that maximum hundred-grain weight (25.69 g) was produced by those plots which received

Table 1: Effect of various irrigation levels and different varieties on emergence unit area^{-1} of chickpea

Irrigation levels	Varieties				
	NIFA-88	NIFA-95	CM-72	E-231	Mean
Control	39.75	43.50	36.25	36.50	39.00

LSD values at 5%level of probability for varieties = 2.032
Mean in the columns followed by different letters are significantly different at $P \le 0.05$

Table 2: Effect of various irrigation levels and different varieties on days to flowering of chickpea

Irrigation levels	Varieties				
	NIFA-88	NIFA-95	CM-72	E-231	Mean
Control	70	70	80	75	73.75b
One irrigation	80	80	90	85	83.75a
Mean	75c	75c	85a	80b	

LSD values at 5%level of probability for irrigation = 1.156
LSD values at 5%level of probability for varieties = 0.1064
Mean in the columns followed by different letters are significantly different at $P \le 0.05$

Table 3: Effect of various irrigation levels and different varieties on days to maturity of chickpea

Irrigation levels	Varieties				
	NIFA-88	NIFA-95	CM-72	E-231	Mean
Control	140	140	155	150	146.25d
One irrigation	150	150	165	160	156.25c
Two irrigation	160	160	170	165	163.75b
Three irrigation	165	165	180	175	171.25a
Mean	153.75c	153.75c	167.50a	162.50b	

LSD values at 5%level of probability for irrigation = 0.8164
LSD values at 5%level of probability for varieties = 0.7319
Mean in the columns followed by different letters are significantly different at $P \le 0.05$

Table 4: Effect of various irrigation levels and different varieties on pods unit area^{-1} of chickpea

Irrigation levels	Varieties				
	NIFA-88	NIFA-95	CM-72	E-231	Mean
Control	1835.50	1920.60	1436	1434.50	1656.70b
One irrigation	2081.80	2120	1600.50	1593.50	1848.90a
Two irrigation	2216.80	2096.30	1632.80	1684.50	1907.60a
Three irrigation	2212.30	2214	1682	1709.30	1954.40a
Mean	2086.60a	2087.80a	1587.80b	1605.40b	

LSD values at 5%level of probability for irrigation = 135.0
LSD values at 5%level of probability for varieties = 108.80
Mean in the columns followed by different letters are significantly different at $P \le 0.05$

Table 5: Effect of various irrigation levels and different varieties on plant height of chickpea.

Irrigation levels	Varieties				
	NIFA-88	NIFA-95	CM-72	E-231	Mean
Control	62.92	61`.03	68.98	52.01	61.23b
One irrigation	62.72	63.79	69.98	52.91	62.35b
Two irrigation	66.68	67.23	73.39	59.96	66.82a
Three irrigation	67.38	67.20	73.11	59.88	66.89a
Mean	64.93b	64.81b	71.37a	56.19c	

LSD values at 5%level of probability for irrigation = 2.271
LSD values at 5%level of probability for varieties = 2.501
Mean in the columns followed by different letters are significantly different at $P \le 0.05$

Table 6: Effect of various irrigation levels and different varieties on hundred grain weight of chickpea

Irrigation levels	Varieties NIFA-88	NIFA-95	CM-72	E-231	Mean
Control	20.58	20.84	15.98	24.07	20.37
One irrigation	19.87	19.05	17.74	23.55	20.05
Two irrigation	20.26	20.84	18.23	25.52	21.17
Three irrigation	20.26	20.01	18.11	25.69	21.02
Mean	20.20bc	20.18bc	17.51c	24.71a	

LSD values at 5%level of probability for varieties = 2.912
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

Table 7: Effect of various irrigation levels and different varieties on grain yield (Kg ha^{-1}) of chickpea

Irrigation levels	Varieties NIFA-88	NIFA-95	CM-72	E-231	Mean
Control	2393.08	2354.18	2143.1	2122.3	2253.16c
One irrigation	2558.48	2597.28	2402.8	2558.4	2529.20b
Two irrigation	2861.1	2951.38	2402.8	2690.3	2726.40a
Three irrigation	2687.48	2895.88	2368.1	2593.1	2636.10ab
Mean	2625.04ab	2699.7a	2329.2c	2491.0b	

LSD values at 5%level of probability for irrigation = 189.167
LSD values at 5%level of probability for varieties = 147.78
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

Table 8: Effect of various irrigation levels and different varieties on biological yield of chickpea

Irrigation levels	Varieties NIFA-88	NIFA-95	CM-72	E-231	Mean
Control	6284.71	5833.31	4375.01	4895.81	5347.20c
One irrigation	6458.32	6527.81	5763.91	6527.81	6319.50b
Two irrigation	6857.61	7152.81	6562.51	6976.20	6888.00a
Three irrigation	7048.61	7291.71	7187.51	7291.71	7204.90a
Mean	6662.31a	6701.41a	5972.24b	6423.64a	

LSD values at 5%level of probability for irrigation = 381.52
LSD values at 5%level of probability for varieties = 414.16
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

Table 9: Effect of various irrigation levels and different varieties on harvest index of chickpea

Irrigation levels	Varieties NIFA-88	NIFA-95	CM-72	E-231	Mean
Control	22.18de	23.98cd	23.77cd	23.77cd	25.44
One irrigation	25.58cd	26.06Bcd	25.35Bcd	24.77bcd	25.44
Two irrigation	29.75ab	29.60ab	20.80de	25.36bcd	26.38
Three irrigation	25.26bcd	27.95abc	17.50e	21.60de	23.08
Mean	25.69	26.90	23.87	23.88	

LSD values at 5%level of probability for Interaction = 5.482
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

three irrigations and sown with E-231. Data (Table 6) also indicated that control plots sown with CM-72 recorded minimum hundred grain weight. These results are contrary to those reported by Jadhav *et al.* (1992), who revealed that greatest positive effect on grain yield plant^{-1} was given by 1000 grain weight followed by dry matter production plant^{-1}, harvest index and number of branches plant^{-1}.

Statistical analysis of the data revealed that different irrigations levels and varieties had a significant ($P \leq 0.05$) effect on grain yield, while interaction among levels and different varieties was non significant (Table 7). Mean value of the data indicated that maximum grain yield of 2726.40 Kg ha^{-1} was recorded in those plots, which were treated with two irrigations followed by plots which received three irrigations. These results are in line with those of Pawer *et al.* (1992), who concluded that yield of all crops except lentils were significantly increased by irrigation and two irrigations generally gave higher yields than one irrigation. Similarly, minimum grain yield of 2253.60 Kg ha^{-1} was produced by plots sown with NIFA-95. Whereas minimum grain yield of 2329.20 Kg ha^{-1} was observed in those plots which were seeded with CM-72. It can be inferred from the data that maximum grain yield 2951.38 Kg ha^{-1} was produced in those plots which received two irrigations and seeded with NIFA-95. Minimum grain weight was recorded by control plots sown with E-231.

Analysis of the data (Table 8) showed that biological yield was significantly ($P \leq 0.05$) affected by different irrigations levels and varieties, while their interaction was non significant. Data (Table 8) showed that biological yield was increased with increase in irrigation levels. Maximum biological yield of 7204.90 Kg ha^{-1} was observed in those plots, which were treated with two irrigations whereas minimum biological yield (5347.20 Kg ha^{-1}) was recorded in control plots. Data concerning varieties indicate that biological yield was maximum (6701.41 Kg ha^{-1}) from plots sown with NIFA-95, while plots sown with CM-72 recorded minimum biological yield. Similarly, mean value for IxV interaction showed that maximum biological yield (7291.71 Kg ha^{-1}) was recorded where three irrigations was applied and sown with NIFA-95 and E-231. Mean (Table 8) also indicated that minimum biological yield was recorded in control plots seeded with CM-72. From these results it is clear that biological yield increased with increase in irrigation frequency.

Statistical analysis of the data (Table 9) revealed that different irrigations levels and varieties had a non significant effect on harvest index. While different irrigation levels and interaction between irrigation levels and varieties was significant. Maximum harvest index of 26.38% was observed in plots which were treated two times followed by plots, which received three irrigations, while minimum harvest index (25.44%) was recorded from control which was at par with plots treated with one irrigation (Table 9). Among varieties highest harvest index of 26.90% was produced by plots seeded with NIFA-95. Lowest harvest index of 23.87% was recorded in plots sown with CM-72. However interaction were significant. It is clear from the mean values obtained from plots treated with three irrigations and seeded with CM-72, while minimum harvest index of 17.50% was recorded from plots sown with CM-72 and applied three irrigations.

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