

Original Research Paper

Response of Chickpea varieties to different irrigation regimes

CHICKPEA IS AN IMPORTANT PULSE CROP IN BANGLADESH. THE STUDY WAS CONDUCTED AT BINA SUB-STATION MAGURA, TO EVALUATE THE YIELD POTENTIAL OF NEW CULTIVARS OF CHICKPEA UNDER DIFFERENT IRRIGATION REGIMES. THE EXPERIMENTAL DESIGN WAS RCBD (WITH SPLIT-PLOT) HAVING IRRIGATION TREATMENTS IN THE MAIN PLOTS AND CHICKPEA VARIETIES IN THE SUB-PLOTS. THE IRRIGATION TREATMENTS COMPRISED OF: CONTROL (NO IRRIGATION) [T1], IRRIGATION AT VEGETATIVE STAGE (25-30 DAS) [T2], IRRIGATION AT FLOWERING STAGE (45-50 DAS) [T3], AND IRRIGATION AT VEGETATIVE STAGE (25-30 DAS) AND FLOWERING STAGE (45-50 DAS) [T4]. THE VARIETIES WERE: V1 = BINASOLA-5; V2 = BINASOLA-6 AND V3 = BINASOLA-4. IRRIGATION WATER WAS APPLIED UP TO FIELD CAPACITY AS PER TREATMENT. THE RESULTS REVEALED THAT IRRIGATION TREATMENTS HAD DETRIMENTAL EFFECT ON ALL YIELD ATTRIBUTES (PLANT HEIGHT, SEED PER POD, BRANCH PER PLANT) AND SEED YIELD. THE SEED YIELD GRADUALLY REDUCED WHEN IRRIGATION WAS APPLIED. THE HIGHEST SEED YIELD (1.87 T HA-1) WAS OBTAINED FROM CONTROL TREATMENT WHICH RECEIVED NO IRRIGATION. THE VARIETIES HAD ALSO SIGNIFICANT EFFECT ON ALL YIELD ATTRIBUTES AND SEED YIELD. THE CULTIVAR BINASOLA-5 PRODUCED THE HIGHEST YIELD (1.20 T HA-1). THE HIGHEST WATER USE EFFICIENCY (263.01 KG HA-1 CM-1) WAS ALSO FOUND IN CONTROL (T1) TREATMENT, WHICH RECEIVED NO IRRIGATION. FROM THE RESULTS OF THE STUDY, IT IS REVEALED THAT UNDER THE PREVAILING CLIMATIC AND SOIL CONDITION, THE CHICKPEA CULTIVARS DO NOT NEED ANY IRRIGATION AT MAGURA, RATHER IT REDUCES YIELD.

Keywords: Chickpea, Seed yield, Irrigation, Water productivity

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the third most important food legume crop worldwide. It is an important grain legume in many developing countries. Chickpea or Bengal gram or gram (*Cicer arietinum*) is an important pulse crop of the semi-arid tropics, particularly in the rainfed ecology of the Indian subcontinent (Ali and Kumar, 2005). Chickpea seed contains 13% to 33% protein, 40% to 55% carbohydrate, and 4% to 10% oil (Stallknecht et al. 1995). Fatty acid composition varies with chickpea type but is approximately 50% oleic and 40% linoleic (Duke 1981). The daily per capita availability of 14 g chickpea is a source of about 2.3 per cent energy (56 Kcal) and 4.7 per cent protein (2.7 g), besides being an important source of Ca and Fe (10-12 per cent). Malic and oxalic acids secreted from leaves, stems and pods have medicinal applications for bronchitis, catarrh, cutamenia, cholera, constipation, diarrhoea, digestive disorders, snakebite, sunstroke and warts. These acids are known to lower blood cholesterol level as well. Chickpea is used for human consumption as well as for feeding the animals. Chickpea flour is used in the preparation of various types of sweets. Chickpea also plays an important role in sustaining soil productivity by improving its physical, chemical and biological properties and trapping atmospheric nitrogen in their root nodules (Ali and Kumar, 2005). A good crop of chickpea could fix up to 141 kg N ha-1 which economizes nitrogen application for succeeding cereals to the tune of 56-58 kg N ha-1 (Ahlawat et al., 1981).

There are two groups of chickpea, depending on seed size, shape, and color. The large-seeded chickpeas (in excess of 26 g/100 seeds) are called kabuli and the smaller ones are called desi. Desi types are traditionally grown in India, other parts of Asia, and in Ethiopia and account for more than 80% of the world production of chickpea (Muehlbauer et al. 1982). Important strategies to enhance production and productivity of chickpea include: high yielding varieties, appropriate

sowing time, irrigation, bio-fertilizer, integrated management of pest and diseases, etc. (Sohu et al., 2015; Patel et al. 2014; Kadam et al. 2014; Moemeni et al., 2013).

Most of the chickpea crop in the world is produced on residual moisture but supplemental irrigation can enhance production. Irrigation during the pre-flowering period and at early pod fill resulted in increased yield at several locations in India (Saxena 1980). Irrigation prolonged the reproductive period of chickpea and produced higher total biomass and more pods per plant. Conversely, 100-seed weight and harvest index were reduced (ICRISAT 1987). Amin et al. (1994) reported that under residual moisture conditions, extra short-duration chickpeas had a 30% yield advantage over commonly grown long-duration cultivars. Local and improved cultivars produced similar yields when irrigated, but improved management provided a 19% yield advantage when compared to traditional cultivation practices. Ulla et al. (2010) concluded that the irrigation of chickpea cultivars had positive effects on phosphate solubilizing micro-organisms activity and the crop yields. Rinaldi et al. (2008) found that total plant biomass was related to water availability and radiation interception. But in good conditions of available water there was a lengthening of the crop cycle, with reduction of pod growth, harvest index and nutrient toward the seeds. Consequently, the best values of water use efficiency were found in the treatment irrigated with 50 mm only at flowering or at pod filling.

The main objective of the study was to evaluate the yield potential of new cultivars of chickpea under different soil moisture regimes.

2. MATERIAL AND METHODS

2.1 Experimental location

The experiment was conducted at BINA sub-station, Magura (23°25'44.3"N, 89°26'11.01"E, 10m above MSL). The Climatic parameters during the growing period of chickpea is presented in Table 1. It was observed that no rainfall occurred during the cropping season through November to March. During the growing period of chickpea, maximum and minimum temperature varied from 16.19 to 38.11 oC and 7.49 to 27.71 oC, respectively. The average relative humidity varied from 60.88 to 73.58 %.

2.2 Treatments and cultural practices

Chickpea seeds were sown on 30th November 2012. The experimental design was RCBD (with split-plot) having irrigation treatments in the main plots and chickpea varieties in the sub-plots. The irrigation treatment were: T1 = Control (no irrigation), T2 = Irrigation at vegetative stage (25-30 DAS), T3 = Irrigation at flowering stage (45-50 DAS), and T4 = Irrigation at vegetative stage (25-30 DAS) and flowering stage (45-50 DAS). The varieties were: V1 = Binasola-5; V2 = Binasola-6 and V3 = Binasola-4.

Irrigation water was applied up to field capacity as per treatment. Soil moisture was measured by gravimetric method up to 60 cm for every 15 cm intervals at the time of sowing, before irrigation and at harvest. Other cultural practices were followed as and when necessary. The crop was harvested on 28th March, 2013. All agronomic data were collected at harvest time.

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92 Table. 1. Climatic parameters during the growing days of chickpea (from seeding to harvest)

Growing period (Month)	Days after seeding (DAS)	Maximum temperature (°C)	Minimum temperature (°C)	Average temperature (°C)	Relative humidity (%)	Rainfall (cm)
		Range	Range		Range	Average
November	0-1	26.93 - 32.44	13.22 -22.55	24.63	54-68	60.88
December	2-32	16.19 -29.03	9.35 -19.53	20.34	54-92	73.58
January	33-64	17.56 -28.26	7.49 -20.43	19.05	58-78	69.23
February	65-93	25.34 -32.66	11.52- 19.70	22.20	63-81	71.19
March	94-122	29.52 -38.11	13.93- 27.71	28.03	47-78	61.33

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95 3 RESULTS AND DISCUSSION

96 3.1 Yield attributes and seed yield

97 The mean effects of irrigation and varieties on yield and yield attributing characters are presented in Table 2. Irrigation
98 treatments had significant effect on all yield attributes (plant height, seed per pod, branch per plant) and seed yield. The
99 varieties had also significant effect on all yield attributes and seed yield of chickpea. The highest seed yield (1.87 t ha⁻¹)
100 was obtained from T1 treatment which received no irrigation, and Binasola-5 produced the highest yield (1.20 t ha⁻¹).
101 Contrarily, when irrigation was applied, the seed yield gradually reduced.

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103 Table. 2. Mean effect of irrigation and varieties on yield and yield attributing characters of chickpea at Magura sadar
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Treatments	Plant height (cm)	No of branch/ plant (nos)	Pod/ plant (nos)	Seed/pod (nos)	Seed yield (t ha ⁻¹)
T ₁	53.75	2.51	62.02	1.51	1.87
T ₂	51.37	2.26	57.57	1.26	1.34
T ₃	47.62	2.31	45.20	1.15	0.61
T ₄	46.00	2.24	43.80	1.22	0.55
LSD _{0.05}	3.38	0.43	20.19	0.23	0.31
V ₁	51.55	2.35	56.25	1.38	1.20
V ₂	48.01	2.23	52.71	1.20	0.97
V ₃	49.50	2.41	47.23	1.28	0.95
LSD _{0.05}	2.93	0.37	17.48	0.21	0.31

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3.2 Total water use and water use efficiency

Table 3 summarizes the water requirement and water use efficiency of chickpea under different irrigation regimes. The highest seed yield as well as water use efficiency ($263.01 \text{ kg ha}^{-1} \text{ cm}^{-1}$) was also found in control (T_1) treatment, which received no irrigation.

Table 3. Water requirement and water use efficiency of chickpea at Magura Sadar Upazila

Treatments	No. of irrigation	Irrigation water (cm)	Effective rainfall (cm)	Soil moisture depletion (cm)	Water requirement (cm)	Yield (kg ha^{-1})	Water use efficiency ($\text{kg ha}^{-1} \text{ cm}^{-1}$)
T_1	0	0	0	7.11	7.11	1870	263.01
T_2	1	2.50	0	6.23	9.73	1340	137.72
T_3	2	5.00	0	4.98	11.98	610	50.92
T_4	2	5.00	0	5.13	12.13	550	45.34

4. CONCLUSION

From the results of our study, it is revealed that under the prevailing condition of soil and climatic, the chickpea cultivars do not need any irrigation at Magura, rather it reduces yield.

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