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Performance of chickpea (*Cicer arietinum* L.) under Planting techniques and irrigation levels

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ABSTRACT

Field experiment was conducted during two consecutive year of 2009-10 and 2010-11 at Agricultural Research Station, Navsari Agricultural University, Tanchha to find out the effect of planting techniques and irrigation levels on chickpea growth and yield. Total 12 treatment combinations including three irrigation levels as main plot treatment (viz., I_1: One irrigation at branching stage, I_2: One irrigation at pod development stage and I_3: Two irrigations at branching and pod development stages) and four Planting pattern as sub plot treatment (viz., P_1: Flat bed sowing, P_2: Furrow after two rows, P_3: Furrow after three rows and P_4: Furrow after four rows) with one control were evaluated in split plot design. Significantly higher grain (1122, 1152 and 1137 kg/ha, respectively) and stover (1960, 1838 and 1899 kg/ha, respectively) yields were recorded under application of two irrigation at branching and pod development stages and remained in the $I_3 > I_2 > I_1$ order of significance. Various planting techniques significantly improved the grain and stover yields of chickpea being maximum grain (1109, 1140 and 1125 kg/ha, respectively) and stover (1958, 1830 and 1894 kg/ha, respectively) yields were obtained under treatment furrow after four rows method of sowing. Higher and profitable yield of green gram was obtained under furrow after four rows pattern of sowing and applied two irrigation at branching and pod development stage.

Key word: Chickpea, Irrigation, Land configuration, Planting techniques etc.

I. INTRODUCTION

Chickpea is the most important winter pulse crop of India occupying 6.93 million ha with an annual production of 5.6 million tonnes (FAO 2006). It is predominantly grown on residual soil moisture as is evident from the fact that of the total area in the country, only 1.96 million ha (28.3%) is irrigated (FAI 2005). Hence, its production is largely depends on the availability of residual soil moisture. The cultivation of chickpea in clay soil on flat beds faces the problem of water logging and poor aeration and adversely affects the productivity. Water logging results in heavy plant mortality under over irrigated conditions. Under such circumstances, a small change in flat field condition through planting techniques may help in improving the productivity of chickpea. Further, the moisture stress at some of the critical stages of growth often leads to its lower productivity. But, irrigating the crop at most critical stages, appropriate quality and through suitable method is the key factor for high and economical yield. Therefore, the present investigation was undertaken to ascertain beneficial effects of irrigation and land configuration treatments on performance of chickpea.

II. MATERIALS AND METHODS

The field experiment was conducted at the Agricultural Research Station, NAU, Tanchha, during the *rabi* season of 2009-10 and 2010-11. The experiment was conducted on clayey soil having organic carbon (0.38 %), available nitrogen (209 kg/ha), available phosphorus (30 kg/ha) and available potassium (354 kg/ha). The soil was slightly alkaline in reaction. Total 12 treatment combinations consisting of three levels of irrigation as main plot treatment (*viz*., I_1: One irrigation at branching stage, I_2: One irrigation at pod development stage and I_3: Two irrigations at branching and pod development stages) and four planting techniques as sub plot treatment (viz., P_1: Flat bed sowing, P_2: Furrow after two rows, P_3: Furrow after three rows and P_4: Furrow after four rows) and with one control was laid out in split plot design with three replications. Chickpea *var*., GG-2 was sown on 21 and 22 November during 2009 and 2010 respectively. The seed was sown 30 cm row apart by bullock drawn seed drill. The crop was fertilized with 20-40 kg NP/ha through urea and diammonium phosphate, applied as basal. The crop was raised as per the recommended package of practices except the treatment. Data were recorded on plant height (cm), dry matter accumulation (g/plant), number of root nodules per plant, pods pre plant, grain weight per plant and grain and stover yields (kg/ha). The data recorded were statistically analyzed using MSTATC Software. The purpose of analysis of variance was to determine the significant effect of treatments chickpea. LSD test at 5% probability level was applied when analysis of variance showed significant effect for treatments (Steel and Torrie, 1960).

III. RESULTS AND DISCUSSION

Growth attributes

Irrigation: The crop was irrigated twice at branching and pod development stages significantly increased growth attributes *viz.,* plant height, dry matter accumulation and number of root nodules /plant during both the years as well as in pooled analysis. Moisture during critical growth stages to the plant favourably influenced the metabolic activities in terms of higher rate of cell enlargement which directly reflected into better plant growth regarding plant height ultimately dry matter accumulation. The optimum supply of moisture as well as aeration enhanced the root development and nodulation. Similar positive effect of irrigation had been reported by Thenua *et al.* (2010).

Planting techniques: Plant height, dry matter accumulation and number of nodules/plant were recorded significantly higher with furrow after four rows method of sowing during both the years and in pooled. However, plant height and nodule/plant were found on par with furrow after three rows on pooled basis. This might be due to maintenance of proper air and moisture regime under furrow after four rows sowing which improved the drainage resulting in good supply of available nutrients, soil aeration, soil environment and better microbial activity which ultimately resulted into proper root growth under furrow after four rows consolidately reflecting in betterment of growth and development. The results were in conformity with those reported by Ugale *et al*. (2000).

Yield attributes and yield

Irrigation: Significantly higher pods/plant and grain weight/plant was recorded, when crop irrigated twice at branching and pod development stages. The increase in yield attributes was expected as sufficient amount of available moisture present in the upper soil layer with low tension. Under such condition, the rate of water and nutrient absorption were higher as the surface soil is enriched in the required plant nutrients leads to the better growth and development of crop. Ultimately, it reflected into yield of chickpea by producing significantly higher seed (1122, 1152 and 1137 kg/ha, respectively) and stover (1960, 1838 and 1899

kg/ha, respectively) yields during both the years and pooled. However, harvest index was remained unchanged.

Planting techniques:All the growth attributing characters *viz*., pods/plant and grain weight/plant were found significantly higher with furrow after four rows method of sowing. Further, it was found at par with furrow after three and two row during both the years and furrow after three rows in pooled analysis. This might be due to better growth of plant in term of dry matter accumulation under this treatment, which might adequately supplied more photosynthetes for development. The present findings were in accordance with those reported by Shinde *et al*. (2000). Adoption of either furrow after four rows or furrow after three rows techniques of sowing were found equally effective by producing significantly higher grain yield during individual years. However, in pooled, furrow after four rows methods of sowing recorded significantly the highest grain yield. Further, it increased grain yield by 12.43, 11.47 and 11.95 %, respectively during first and second year and in pooled data compared to flat bed sowing. Whereas, stover yield was found significantly the highest under the treatment furrow after four rows. The increase in chickpea grain and stover yields with this treatment was due to the cumulative effect exerted from better improvement in drainage, soil environment, aeration, soil microbial activity, root development and optimum moisture-air equilibrium throughout the crop growth besides supply of available nutrients to the crop resulting in better growth and development ultimately reflected into better grain yield. These findings corroborated the results of Shinde *et al*. (2000) and Ugale *et al*. (2000).

Interaction effect

Interaction between irrigation levels and planting pattern did not exert any significant effect on different growth and yield attributes, grain and stover yields, harvest index,. This might be due to no synergistic effect found between irrigation levels and planting techniques.

Control vs rest

All the growth parameters like plant height, number of root nodules per plant and dry matter accumulation were found significant. Significantly the highest values were observed due to treatment mean over control during both the years of study as well as in pooled analysis. Similarly, yield attributes like pods per plant, grain weight per plant (g) and seed index were recorded the highest due to treatment mean during both the years as well as in pooled analysis. The positive improvement of growth and yield attributes were reflecting on chickpea and produced significantly higher grain and stover yields under treatment mean over control during the years of 2009-10 and 2010-11 as well as in pooled analysis. It might be due moisture availability during different growth stages of crop which enhance the metabolic activities in terms of higher rate of cell division and cell enlargement and favourable environment in the root zone resulting in absorption of more water and nutrients from soil because of cumulative effect exerted from better improvement in drainage, soil environment, aeration, soil microbial activities, root development. Thus, enhance availability of nutrients, water, light and space which might have accelerate the photosynthetic rate, thereby increasing the supply of carbohydrates, which finally improved growth and yield of crop. These results also confirms with Shinde *et al*. (2000), Pramanik *et al*. (2009) and Thenua *et al*. (2010).

Economics

Furrow after four rows technique of sowing secured maximum net realization of Rs. 41513/ha with BCR of 2.24 and lowest net realization of Rs. 35442/ha with BCR of 1.94 was obtained under flat bed sowing treatment. The data further revealed that the maximum net realization of Rs. 41725 ha^{-1} with BCR of 2.21 were obtained in treatment two irrigations at branching and pod development stages.

Form for going discussion, it can be concluded that sowing the crop by adopting furrow after four rows planting pattern and irrigate the crop twice at branching and pod development stages was found beneficial by securing higher grain and stover yields of chickpea and profitable economical return.

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Table 1. Growth and yield attributes of chickpea as influenced by irrigation levels and planting techniques

Treatment	Plant height at harvest (cm)			Dry matter accumulation at harvest (g/plant)			No. of root nodules/plant (At 60 DAS)			Pods/plant			Grain weight/ plant (g)		
	09-10	10-11	Pooled	09-10	10-11	Pooled	09-10	10-11	Pooled	09-10	10-11	Pooled	09-10	10-11	Pooled
Irrigation (Main plot)															
One irrigation at branching stage	43.7	44.4	44.1	4.0	4.1	4.07	8.5	8.9	8.7	26.4	27.7	27.0	4.2	4.2	4.2
One irrigation at pod development stage	44.5	45.1	44.8	4.2	4.3	4.3	9.0	9.6	9.3	27.8	29.3	28.5	4.3	4.3	4.3
Two irrigations at branching and pod development stages	48.4	49.0	48.7	4.8	4.8	4.8	10.0	10.6	10.3	30.4	31.8	31.1	4.8	4.8	4.8
SEm±	0.7	0.7	0.5	0.1	0.1	0.1	0.3	0.3	0.2	0.6	0.6	0.4	0.1	0.1	0.1
CD (P=0.05)	2.6	2.8	1.6	0.4	0.4	0.3	1.2	1.3	0.7	2.4	2.2	1.3	0.4	0.5	0.3
CV %	5.1	5.3	5.2	9.2	8.9	9.0	11.1	11.7	11.4	7.4	6.5	7.0	8.8	9.6	9.2
Planting techniques (Sub plot)															
Flat bed sowing	44.1	44.9	44.5	4.1	4.1	4.1	8.5	9.1	8.8	26.7	28.1	27.4	4.2	4.2	4.2
Furrow after two rows	45.1	45.8	45.4	4.2	4.3	4.2	9.2	9.6	9.4	28.1	29.5	28.8	4.3	4.4	4.3
Furrow after three rows	46.00	46.4	46.2	4.4	4.5	4.4	9.3	9.8	9.5	28.5	29.9	29.2	4.4	4.5	4.4
Furrow after four rows	47.1	47.7	47.4	4.7	4.8	4.8	9.8	10.3	10.0	29.5	30.8	30.2	4.7	4.8	4.8
SEm±	0.7	0.6	0.5	0.1	0.1	0.1	0.3	0.3	0.2	0.6	0.6	0.4	0.1	0.1	0.1
CD (P=0.05)	2.1	1.9	1.4	0.4	0.4	0.3	0.8	0.8	0.5	1.9	1.8	1.2	0.4	0.4	0.2
Interaction															
SEm±	1.2	1.1	0.7	0.2	0.2	0.1	0.5	0.5	0.3	1.1	1.0	0.6	0.2	0.2	0.1
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control vs Rest															
Treatment mean	45.6	46.2	45.9	4.3	4.4	4.4	9.2	9.7	9.4	28.2	29.6	28.9	4.4	4.5	4.4
Control mean	39.9	40.7	40.3	3.6	3.7	3.7	7.3	7.9	7.6	24.9	26.5	25.7	3.7	3.8	3.8
SEm±	1.2	1.1	1.1	0.2	0.2	0.2	0.4	0.4	0.4	1.0	1.0	1.0	0.2	0.2	0.2
CD (P=0.05)	3.4	3.1	3.2	0.6	0.6	0.6	1.3	1.3	1.3	3.1	2.9	2.9	0.6	0.6	0.6

NS: Non significant

Table 2. Yield and economics of chickpea as influenced by irrigation levels and planting techniques

Treatment	Grain yield (kg/ha)			Stover yield (kg/ha)			Harvest index (%)			Cost of cultivation (x10^3`/ha)	Net return (x10^3`/ha)	Benefit : cost ratio
	09-10	10-11	Pooled	09-10	10-11	Pooled	09-10	10-11	Pooled			
Irrigation (Main plot)												
One irrigation at branching stage	968	1003	986	1793	1642	1718	35.1	37.9	36.5	18.6	34.1	1.8
One irrigation at pod development stage	1028	1063	1046	1860	1731	1796	35.6	38.0	36.8	18.6	37.3	2.0
Two irrigations at branching and pod development stages	1122	1152	1137	1960	1838	1899	36.4	38.5	37.4	18.9	41.7	2.2
SEm±	28	26	19	29	33	22	0.8	0.8	0.6			
CD (P=0.05)	111	103	63	114	129	72	NS	NS	NS			
Planting techniques (Sub plot)												
Flat bed sowing	986	1023	1005	1812	1665	1739	35.2	38.0	36.6	18.3	35.4	1.9
Furrow after two rows	1021	1056	1039	1849	1719	1784	35.6	38.1	36.8	18.7	36.8	2.0
Furrow after three rows	1040	1073	1057	1866	1734	1800	35.8	38.2	37.0	18.6	37.8	2.0
Furrow after four rows	1109	1140	1125	1958	1830	1894	36.1	38.4	37.2	18.5	41.5	2.2
SEm±	27	26	19	30	27	20	0.8	0.7	0.5			
CD (P=0.05)	80	76	53	88	82	58	NS	NS	NS			
Interaction												
SEm±	47	44	27	51	48	31	1.4	1.2	0.8			
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS			
Control vs Rest												
Treatment mean	1039	1072	1056	1871	1737	1804	35.7	38.2	36.9	19.0	37.4	2.0
Control mean	878	915	896	1688	1548	1618	34.2	37.1	35.7	18.3	29.8	1.6
SEm±	49	47	43	50	46	47	1.4	1.3	1.2			
CD (P=0.05)	144	138	123	148	137	134	NS	NS	NS			

NS: Non significant