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## Influence of land configuration, irrigation levels and nipping on growth and yield of chickpea (*Cicer arietinum* L.)

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### Abstract

An experiment was conducted at soil and water management research farm, NAU, Navsari during *rabi* seasons of 2017-18. Plant height, branches per plant, dry matter accumulation, pods per plant, 100 seed weight, grain and stover yield as well as harvest index and economics significantly influenced by different treatments of land configuration, irrigation levels and nipping. The field experiment consist of three land configuration (L<sub>1</sub>: Flat bed, L<sub>2</sub>: Ridge and furrow and L<sub>3</sub>: Raised bed), four irrigation levels (I<sub>1</sub>: 20 DAS, I<sub>2</sub>: 20 & 40 DAS, I<sub>3</sub>: 20, 40 & 60 DAS and I<sub>4</sub>: 20, 40, 60 & 80 DAS) and two nipping treatments (N<sub>0</sub>: Non-nipping and N<sub>1</sub>: Nipping at 25 DAS). Raised method of land configuration recorded significantly higher growth, yield and economics than flat bed. Among irrigation levels, irrigation applied at 20, 40, 60 and 80 DAS showed higher growth and yield parameters as well as economics. In case of nipping at 25 DAS recorded higher branches per plant, pods per plant yield and economics, whereas, non-nipping was observed more plant height. However, 100 seed weight and harvest index was not affected significantly by different treatments of land configuration irrigation and nipping.

**Keywords:** Economics, irrigation and land configuration

### Introduction

Chickpea or Chana Dal, a premier pulse crop of India and also known by the names of garbanzo bean, ceci bean, sanagalu, hummus and Bengal gram. Among the pulses, chickpea is world's third most important crop. It contains 21.5 per cent protein, 61.5 per carbohydrates, 4-5 per cent fat, 0.49 per cent lysine, 0.04 per cent tryptophane and 0.11 per cent methionine (Katiyar, 1982)<sup>[9]</sup>. Besides this, chickpea's haulm is an excellent source of feed for cattle and grain concentrates are very much used for dairy cattle. In India, chickpea is grown in an area about 106 lakh ha, production is 112 lakh tones and productivity is 1056 kg ha<sup>-1</sup>. Chickpea production has increased from 3.65 to 6.33 million tones from 1951 to 2007 with an annual growth rate of 0.58%. Seven states of India are Madhya Pradesh (32.97%), Maharashtra (18.36%), Rajasthan (16.70%), Andhra Pradesh (8.55%), Karnataka (8.21%), Uttar Pradesh (6.85%) and Gujarat (2.92%). Pulses are an integral part of food grain production and popularly known as "Poor man's meat" and "rich man's vegetable". Pulses are considered next to cereal crop and generally grown in low fertile soils, with a minimum use of resources. The ability of leguminous crops to use atmospheric nitrogen through biological nitrogen fixation is economically more beneficial and environmentally acceptable due to this, they are vital part of cropping system. In India, pulses occupy 293 lakh hectares area and production of 245 lakh tones. Out of the total area, more than 73 lakh ha is in Madhya Pradesh alone, earning a prime status in pulse production commodity and registering a remarkable 25% of the country's pulse area with 33% production, thereby ranking first both in area and production. The excess demand is primarily due to the stagnation in productivity which is further increased by the decline in area under cultivation. This led to decline in the per capita net availability of pulses in country sharply over the years.

In Gujarat, Chickpea is sown in an area of 2.95 million ha with 3.62 million tones production and productivity of 1227 kg ha<sup>-1</sup> (Anon., 2018)<sup>[3]</sup>.

The major constraints underlying the production of pulses in India have been the unfavorable weather conditions, limited area under irrigated condition during *rabi* season, defective sowing method and less adoption of improved agro-techniques.

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Land configuration system plays a major important role in minimizing soil erosion, salinity and improving water use efficiency of field crops. Easy and uniform germination as well as growth and development of plant are provided by manipulation of sowing method. Raised bed planting also prevented excess moisture problem in heavy soils. The superiority of ridges and furrow system could be ascribed to proper drainage of excess water coupled with adequate aeration at the time of irrigation or heavy rainfall. Parihar *et al.* (2009) [14] witnessed that ridges and furrow method of sowing improved grain as well as stover yield of pearl millet and succeeding mustard over the flat bed method of sowing. Poor soil management is also one of the major constraints for low productivity of crops particularly in clayey soil. The germination, penetration, development and proliferation of root in the soil are dependent on the physical conditions of soil are looseness, friability, infiltration rate and soil crusting. Chickpea is the most important winter (*rabi*) pulse crop in semi-arid region of India. The risk involved in growing chickpea by farmers are that the low rainfall period, proves to be insufficient in providing enough residual moisture during the growth period for sustain the crop yield of chickpea. The yield reduction of chickpea is due to the shorter period available for crop growth and increase incidence of terminal heat stress (Anon., 2003) [2]. Irrigation also plays a vital role in not only increasing the productivity of chickpea, but also improving the physico-chemical properties of soil. As water is basic requirement for food production and energy, so it becomes a limiting factor for realizing high economic yield. Therefore, as the demand for water increase universally, the supply of timely and adequate irrigation becomes important and thus irrigation at important growth stages assume greater significance. Under irrigated condition, crop may sometimes make profuse vegetative growth adversely affecting the development of reproductive structures. In chickpea, there is a strong apical dominance, so many authors are believed that shoot apex/ apical meristem produce auxin, which inhibits the axillary buds into actively growing shoots. When the apical meristem is detached, the cytokinins are able to promote the growth of lateral buds into branches (Campbell *et al.* 2008) [6]. More branches will possibly initiate more flower buds and possibly more yield. Nipping in chickpea is one of the important operation for the enhancement of yield and yield contributing characters. Singh and Diwakar (1995) [17] reported that nipping at early growth stages of crop could increase number of branches while restricting profuse vegetative growth thereby promoting crop yield. Nipping at different growth stages tend to enhance number of branches and number of pods that in turn boost up chickpea yield (Aziz, 2000) [5]. Therefore, an experiment was conducted to know the influence of land configuration, irrigation levels and nipping on growth and yield of chickpea to attain maximum productivity.

### Materials and methods

The experiment was conducted on clayey soils of soil and water management research unit, Navsari Agriculture University, Navsari during *rabi* seasons of 2017-18. The experiment was laid out in split-split plot design with four replications. Main plot comprises land configuration treatments (L<sub>1</sub>: Flat bed, L<sub>2</sub>: Ridge and furrow and L<sub>3</sub>: Raised bed), sub plot different irrigation levels (I<sub>1</sub>: 20 DAS, I<sub>2</sub>: 20 & 40 DAS, I<sub>3</sub>: 20, 40 & 60 DAS and I<sub>4</sub>: 20, 40, 60 & 80 DAS) and sub-sub plot nipping treatments (N<sub>0</sub>: Non-nipping N<sub>1</sub>: Nipping at 25 DAS). Thus, total twenty four treatment

combinations were tested, chickpea was fertilized with urea and SSP with 20:40:0 kg N, P and K ha<sup>-1</sup>. The soil of the farm alkaline in reaction, medium in organic carbon and low, medium and high in N, P and K. chickpea variety GJG-3 was taken for experiment, different growth and yield parameters were recorded at various stages of crop and at harvest. Data were analyzed statistically through analysis of variance technique as by Panse and Sukhatme (1967) [13].

### Results

#### Effect of land configuration

The height of the plant, branches per plant and dry matter accumulation at harvest were significantly affected by different treatments of land configuration. The higher plant height, number of branches and maximum dry matter accumulation were recorded with raised bed method of sowing. However, ridge and furrow treatment found to be at par with raised bed method in terms of height. Similarly, pods per plant, grain and stover yield as well as net returns and benefit cost ratio were also higher with same treatment. Whereas, 100 seed weight and harvest index did not influence by land configuration treatments.

#### Effect of irrigation

Irrigation at different stages significantly influenced the growth, yield and yield parameters and economics *viz.*, plant height, dry matter accumulation at harvest, number of branches, pods per plant, grain and stover yield and gross returns, net returns and B: C. The highest growth, yields parameters and economics registered under irrigation applied at 20, 40, 60 and 80 DAS. Whereas, treatment I<sub>3</sub> remained at par with higher treatment with respect to plant height, but 100 seed weight and harvest index was not affected to reach the significant level.

#### Effect of nipping

Nipping at 25 DAS, noted significantly higher dry matter accumulation, branches per plant, pods per plant grain and stover yield, gross returns, net returns and benefit cost ratio, whereas, higher plant height was recorded with non-nipping treatment.

#### Interaction effect

Interaction effect of land configuration, irrigation and nipping was registered significant in pods per plant. Treatment combination L<sub>3</sub>I<sub>4</sub>N<sub>1</sub> was recorded significantly higher pods per plant as compared to other treatment combinations.

### Discussion

The results of the study showed that raised bed sowing significantly influenced growth yield and economics of chickpea crop might be due to cumulative effect of soil environment, root development, optimum soil-water relationship and nutrients to the crop in resulting better growth, yields and yield parameters. These results are conformity with Ramesh and Devasenapathy (2006) [16], Pramanik *et al.* (2009) [15], Singh *et al.* (2010) [10] and Chourasiya *et al.* (2019) [7].

Significance differences were observed with respect to plant height, number of branches, dry matter accumulation, pods per plant yields and economics. The differences on growth and yield parameters might due to presence of more available soil moisture with higher level of irrigation promoted the vegetative growth and functioning of all the physiological processes through adequately supply of water along with

nutrients in the root zone, and also better translocation of photosynthate from source to sink and growth hence observed more number of number of pods per plant, number of branches, grains per pod and 100 grain weight and overall improvement in growth and yield attributing characters due to irrigating crop at right time These findings are agreement with the results of Anwar *et al.* (2003) [4], Mustafa *et al.* (2008) [12] and Mondal *et al.* (2012) [11].

Nipping at 25 DAS produced significantly higher number of branches, pods per plant and grain and stover yield. The increase in growth and yield which was caused by enhanced branching and dispersion of carbohydrate towards auxiliary buds below nipped portion which helps in production of more branches per plant and number of pods per plant. These results are in accordance with Khan *et al.* (2006) [10], Gnyandev *et al.* (2009) [8] and Adinde *et al.* (2016) [1].

**Tables 1:** Growth and yields of chickpea as influenced by different treatments of land configuration, irrigation levels and nipping

Treatments	Plant height at harvest (cm)	Branches plant <sup>-1</sup>	Dry matter accumulation AH (g plant <sup>-1</sup> )	Pods plant <sup>-1</sup>	100 seed weight (g)	Grain yield (kg ha <sup>-1</sup> )	Sover yield (kg ha <sup>-1</sup> )	Harvest index (%)
<b>(a) Main plot [ Land configuration (L)]</b>								
L <sub>1</sub> : Flat bed	39.3	11.7	17.93	67.02	22.73	1463	2680	35.96
L <sub>2</sub> : Ridge and furrow	40.8	14.4	22.10	80.83	23.34	1885	3039	37.89
L <sub>3</sub> : Raised bed	41.1	16.5	24.87	89.83	23.47	2133	3364	38.13
SEm±	0.40	0.19	0.47	1.29	0.32	44	72	1.19
CD (P=0.05)	1.40	0.68	1.64	4.47	NS	152	247	NS
CV (%)	5.67	7.89	12.41	9.22	8.03	13.66	13.35	18.14
<b>(b) Sub plot [ Irrigation scheduling (I)]</b>								
I <sub>1</sub> : 20 DAS	39.0	12.2	17.46	67.55	22.74	1580	2751	36.16
I <sub>2</sub> : 20 & 40 DAS	40.1	13.5	19.94	74.84	23.09	1748	2973	36.84
I <sub>3</sub> : 20,40 & 60 DAS	40.9	14.8	23.05	84.00	23.32	1916	3069	38.20
I <sub>4</sub> : 20,40,60 & 80 DAS	41.6	16.2	26.07	90.50	23.58	2063	3318	38.10
SEm±	0.45	0.21	0.92	1.23	0.31	50	73	0.70
CD (P=0.05)	1.31	0.62	2.68	3.57	NS	145	212	NS
CV (%)	5.47	7.38	12.11	7.62	5.99	13.47	11.87	9.26
<b>(c) Sub-sub plot [ Nipping (N)]</b>								
N <sub>0</sub> : Non- nipping	45.7	13.8	20.87	77.55	23.08	1753	2925	37.10
N <sub>1</sub> : Nipping at 25 DAS	35.1	14.6	22.39	80.90	23.28	1900	3130	37.56
SEm±	0.31	0.15	0.48	0.49	0.21	22	32	0.36
CD (P=0.05)	0.91	0.43	1.38	1.41	NS	64	91	NS
CV (%)	5.47	7.30	8.95	4.29	6.41	8.45	7.24	6.73
Significant Interaction	-	-	-	L×I×N	-	-	-	-

**Tables 2:** Economics of chickpea as influenced by different treatments of land configuration, irrigation levels and nipping

Treatments	Gross returns (₹ ha <sup>-1</sup> )	Net returns (₹ ha <sup>-1</sup> )	BC ratio
<b>(a) Main plot [Land configuration (L)]</b>			
L <sub>1</sub> : Flat bed	83397	45684	1.20
L <sub>2</sub> : Ridge and furrow	104974	64582	1.59
L <sub>3</sub> : Raised bed	118567	78951	1.98
<b>(b) Sub plot [Irrigation scheduling (I)]</b>			
I <sub>1</sub> : 20 DAS	88870	51311	1.36
I <sub>2</sub> : 20 & 40 DAS	97348	58688	1.51
I <sub>3</sub> : 20,40 & 60 DAS	107394	67604	1.69
I <sub>4</sub> : 20,40,60 & 80 DAS	115638	74685	1.81
<b>(c) Sub-sub plot [Nipping (N)]</b>			
N <sub>0</sub> : Non- nipping	98410	60348	1.57
N <sub>1</sub> : Nipping at 25 DAS	106215	65797	1.61

Selling price of chickpea: -Grain: 50 kg-1 Stover: 3.0 kg-1

## Conclusion

In this study to maximize the yield of chickpea raised bed method of sowing, irrigating the crop at 20, 40, 60 and 80 DAS and nipping done at 25 DAS was found promising and profitable by securing higher yields and economics.

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