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Research Article

Effect of Land Configuration, Irrigation Levels and Nipping on Growth, Yield and Economics of Chickpea (*Cicer arietinum* L.) Under Mild Winter of South Gujarat

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ABSTRACT

Effect of different land configuration, irrigation and nipping was studied on clay soil of NAU, Navsari under south Gujarat condition .The field experiment was conducted during rabi season of 2018-19 at Soil and water management research farm NAU, Navsari. Plant height, branches per plant, pods per plant, grain yield, stover yield and economics significantly influenced by different treatments of land configuration, irrigation and nipping. However, harvest index and protein content was not influenced significantly as an effect of different land configuration, irrigation and nipping treatments. Main plot recorded significantly higher growth and yield parameters as well as economics under raised bed sowing. Among sub plot, irrigation at 20, 40, 60 and 80 DAS obtained higher plant height, branches per plant, pods per plant, yield and economics. Similarly sub- sub plot treatment, nipping at 25 DAS also recorded higher growth, and yield parameters and net returns and B:C. The same treatment also recorded maximum water use efficiency. However, interaction effect of L×I×N found significant with respect to pods per plant.

Keywords: *Chickpea, Irrigation, Land configuration economics, Nipping and Yield.*

INTRODUCTION

Pulses are critical and cheapest source of plant based-protein, minerals and vitamins. Pulses contain 20-25 per cent protein, which is nearly twice the protein content of wheat and thrice that of rice. Besides, it is ample source of vit. A (I.U. 316), vit. C (3), vit. K (0.29), thiamine (0.3), ribo-flavin (0.51), nicotinic acid (2.1), biotin (10g/100g), choline (194), folic acid (125g/100g), inositol (240) and pantothenic acid (1.3). Apart from this, pulses have health benefits as it helps in reducing obesity, diabetes and malnutrition etc. In India, chickpea is grown in an area about 106 lakh ha, production is 112 lakh tones and productivity is 1056 kg ha^{-1}.

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Chickpea production has increased from 3.65 to 6.33 million tones from 1951 to 2007 with an annual growth rate of 0.58%. 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^{-1} (Anon., 2018). In India, chickpea is usually sown on flat bed by seed drill. Several research workers have indicated that changing of sowing method provides suitable environment for germination, growth and development, which eventually increase the crop yield. Land configuration system plays an important role in minimizing salinity, soil erosion and improving water use efficiency of field crops. Easy and uniform germination as well as growth and development of plant are provided by changing of sowing method. Chickpea is the most important *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 drought (Anon., 2003). Irrigation also plays a vital role in not only increasing the productivity of chickpea, but also improving the physico-chemical properties of soil. Under irrigated condition, crop may sometimes make vigorous vegetative growth adversely affecting the development of reproductive parts. In chickpea, there is a strong apical dominance, so many authors was believed that shoot apex/ apical meristem produce auxin, which inhibits the axillary buds into actively growing shoots. When the apical meristem/bud is detached, the cytokinins are able to promote the growth of lateral buds into branches (Campbell et al., 2008). More branches will possibly initiate more flower buds and possibly more yield. Hence, experiment was conducted to evaluate the effect of land configuration, irrigation levels and nipping on growth, yield and economics of chickpea (*Cicer arietinum* L.) under mild winter of South Gujarat.

MATERIALS AND METHODS

An experiment was carried out during *rabi* season of 2018-19 at soil and water management research unit (SWMRU), Navsari agricultural university, Navsari, Gujarat. The experiment was laid out in split-split plot design with twenty four treatment combinations having three land configuration treatment in main plot (L_1: Flat bed, L_2: Ridge and furrow and L_3: Raised bed), four irrigation levels in sub plot (I_1: 20 DAS, I_2: 20 & 40 DAS, I_3: 20, 40 & 60 DAS and I_4: 20, 40, 60 & 80 DAS) and two nipping levels (N_0: Non-nipping N_1: Nipping at 25 DAS) in sub-sub plot with four replications. Chickpea variety GJG-3 was sown at the rate of 60 kg ha^{-1} with the recommended rate of fertilizers were 20:40:00 kg NPK ha^{-1} and source of fertilizer urea and SSP, respectively and they were applied as bas basal fertilizer. One hand weeding was done at 25 DAS sowing. The soil of the farm alkaline in reaction, medium in organic carbon and low, medium and high in available N, P and K. Growth and yield parameters were recorded at various stages of crop and at harvest. Data were analyzed statistically through ANOVA technique as given by Panse and Sukhatme (1967). Water use efficiency was calculated by this given formula:

$$\text{Water use efficiency} = \frac{Grain\ yield\ (kg/ha}{Water\ applied\ (ha-mm)}$$

RESULT AND DISCUSSION

Effect of land configuration

The plant height (42.1 cm) and number of branches per plant (16.9) at harvest were significantly more with raised bed method of sowing as compared to flat bed method (40.2 cm and 12.2), respectively. However, ridge and furrow was found at par with higher treatment in plant height. It is attributed due to better soil structure and maintenance of air-

water regime as well as good supply of nutrient and water in the root zone of crop. Similar results also recorded with Gethe et al. (2016), Patel et al. (2016) in chickpea crop and Babazoi et al. (2019) in black eyed bean (cowpea) under raised bed.

Yield and yield attribute i.e. pods per plant was significantly higher under raised bed method sowing. The data indicates that land configuration favorably effect on chickpea crop in terms of plant population, growth and yield attributes under raised bed method of sowing had resulted in to significantly higher seed yield. Data observed that raised bed method of sowing recorded higher grain yield. The increase in grain and stover yield under raised bed method of sowing was to the extent of 42.36 and 24.25 per cent, respectively over flat bed method. Singh et al. (2010), Chourasiya et al. (2016). Whereas, harvest index and protein content was not influenced by different land configuration treatments. Maximum water use efficiency and economics was noticed under raised bed treatments compared to flat bed. This might be due to more yields produced under raised bed sowing. Similar results obtained in the present investigation are in agreement with Singh et al. (2008), Mishra et al. (2012), Yadav and Singh (2014) and Kumar et al. (2015).

Effect of irrigation

Growth and yield parameters was significantly higher under application of irrigation at 20, 40, 60 and 80 DAS due to optimum moisture supply promoted the cell division and cell elongation and ultimately increased plant growth and photosynthetic activity which enable the plant to intercept more amount of radiant energy and directly higher number of branches per plant due to optimum supply of moisture in the root zone there by more nutrients uptake and translocation, which ultimately linked with the growth and yield of plant. Similar results are also supported by Mustafa et al. (2008) and Mondal et al. (2012), Yagmur and Kaydan (2011) and Razzak et al. (2014). Harvest index and protein content did not affected by the effect of irrigation, in case of water use efficiency obtained higher with irrigation given at 20, 40, 60 and 80 DAS. Higher gross returns, net returns and B:C were calculated under same treatment. This was due to higher grain and stover yield under this treatment, ultimately observed in net return and BC ratio. Similar results were also obtained by Chourasiya et al. (2016) and Singh, (2017).

Effect of nipping

Nipping at 25 DAS, recorded remarkably higher number of branches per plant, pods per plant, grain yield, stover yield, gross returns, net returns and B:C ratio, whereas, more plant height was found under non-nipping treatment. The same treatment also noticed higher water use efficiency.

The increase in number of branches with nipping might be due to removal of apical portion of main shoot resulted in more secondary branches because distribution of carbohydrate towards the lateral auxiliary buds below nipped portion. Nipping also activated the dormant lateral buds to produce more number of secondary branches. In chickpea plants, the development of axillary buds is inhibited normally by Indole Acetic Acid produced in the apical portion of plant. If the source of auxin is removed by removing the apical meristem, the lateral branching gets activated and accelerated and resulted in more branches per plant. These results are in accordance with the findings of Adinde et al. (2016), Dhaka et al. (2018) and Vasanthan et al. (2019).

Interaction effect

Interaction effect of L×I×N on pods per plant was found significant. Remarkably higher pods per plant recorded under raised bed, irrigation at 20, 40, 60 and 80 DAS and nipping at 25 DAS over other treatment combinations. This is due to the combined effect of all three treatments, land configuration, irrigation and nipping.

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

Treatments	Plant height at harvest (cm)	Branches plant^{-1}	Pods plant^{-1}	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)	Protein content (%)
(a) Main plot [Land configuration (L)]							
L_1: Flat bed	40.2	12.2	68.65	1546	2758	36.02	19.81
L_2: Ridge and furrow	41.6	14.9	83.49	1944	3111	38.27	20.02
L_3: Raised bed	42.1	16.9	92.12	2201	3427	38.99	20.51
SEm±	0.43	0.18	1.34	54	73	0.88	0.29
CD (P=0.05)	1.49	0.64	4.65	188	252	NS	NS
CV (%)	5.89	7.18	9.35	16.21	13.28	13.24	8.28
(b) Sub plot [Irrigation scheduling (I)]							
I_1: 20 DAS	39.9	12.7	69.83	1641	2802	37.42	19.74
I_2: 20 & 40 DAS	40.9	13.9	76.88	1783	3057	37.04	20.00
I_3: 20,40 & 60 DAS	41.8	15.1	85.83	2006	3139	38.33	20.26
I_4: 20,40,60 & 80 DAS	42.6	16.8	93.13	2159	3397	38.25	20.46
SEm±	0.46	0.21	0.93	47	73	0.76	0.18
CD (P=0.05)	1.33	0.62	2.72	136	212	NS	NS
CV (%)	5.46	7.15	5.64	12.14	11.53	9.98	4.53
(c) Sub-sub plot [Nipping (N)]							
N_0: Non- nipping	46.6	14.1	79.63	1827	2988	37.68	19.94
N_1: Nipping at 25 DAS	36.1	15.1	83.21	1967	3209	37.84	20.29
SEm±	0.31	0.13	0.47	21	32	0.35	0.13
CD (P=0.05)	0.89	0.38	1.36	60	92	NS	NS
CV (%)	5.20	6.39	4.03	7.64	7.17	6.54	4.50
Significant Interaction	-	-	L×I×N	-	-	-	-

Tables 2: WUE and economics of chickpea as influenced by different treatments of land configuration, irrigation and nipping

Treatments	Water use efficiency (kg/ha-mm)	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C
(a) Main plot [Land configuration (L)]				
L_1: Flat bed	12.74	83397	45684	1.20
L_2: Ridge and furrow	15.93	104974	64582	1.59
L_3: Raised bed	18.09	118567	78951	1.98
(b) Sub plot [Irrigation scheduling (I)]				
I_1: 20 DAS	27.35	88870	51311	1.36
I_2: 20 & 40 DAS	14.86	97348	58688	1.51
I_3: 20,40 & 60 DAS	11.14	107394	67604	1.69
I_4: 20,40,60 & 80 DAS	8.99	115638	74685	1.81
(c) Sub-sub plot [Nipping (N)]				
N_0: Non- nipping	15.03	98410	60348	1.57
N_1: Nipping at 25 DAS	16.14	106215	65797	1.61

Selling price of chickpea:- Grain : ₹ 50 kg^{-1} Stover: ₹ 3.0 kg^{-1}

CONCLUSION

It was concluded from the field experiment that crop planted on raised bed method, irrigation with 20, 40, 60 and 80 DAS with nipping at 25 DAS gives higher yield and economically more feasible.

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