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Effect of different sowing method and moisture conservation practices on production and productivity of chickpea crop (*Cicer arietinum* L.)

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Abstract
An experiment was conducted at Uttar Pradesh in rural district Mandhana 10 km from Kanpur during rabi, season of 2022-23 on silty loam soil, having pH 7.86, EC 0.14 dSm^{-1}, organic carbon 0.44%, available N, P and K 187.0, 14.0 and 172.0 kg ha^{-1} respectively. The experiment was laid out in split plot design with three replication. The experiment was conducted with 12 treatment combination comprising three methods of sowing {W_1- Conventional sowing method, W_2-Broad bed and furrow sowing method (BBF), W_3- Narrow seed bead sowing method} in main plot and four treatments of moisture conservation practices in sub-plot (M_0– Control, M_1-Soil mulching, M_2-Paddy straw mulch-10 Tonne/ha), M_4–Deep ploughing. Based on the experimental results W_3- Narrow seed bead sowing method of sowing is superior over the remaining methods with moisture conservation practice M_2-Paddy straw mulch-10 Tonne/ha in respect growth parameters, yield attributes and yield.

Keywords: Chickpea, methods of sowing, moisture conservation practices, growth, yield attributes and yield

Introduction
Chickpea (*Cicer arietinum* L.) occupies prominent position among the various pulse crop grown in India. Chickpea also known as the 'King' of all pulses in over country and it contributed more than 1/3rd of area and 40% of the total pulse production. India ranks first in the world in respect of production as well as acreage and produces 11.23 million tons chickpea grains from 10.56-million-hectare area with an average productivity of 1063 Kg ha^{-1} during 2017-18. India contributes 71 per cent of chickpea production of the world (DAC&FW) 2020.
Among all state in India's, Madhya Pradesh has first position among all pulses crop producing state, it also shares about 23% of total pulse production and covered about 32.97% area of chickpea crop in country. Uttar Pradesh also rank 3rd among areas as well as in production of chickpea. Its covered about 25.2lakh ha land and 21.9 lakh tone production. In the Uttar Pradesh, the important Bengal gram growing districts are *viz*. Chitrakoot, Kanpur, Jhansi, Meerut, Aligarh and Agra etc. (Singh 1987, Smithson *et al*., 1985) [12, 13].
In over food, Chickpea is most important sources of energy and mineral substrate such protein, soluble and insoluble fiber, essential minerals. Among the all-pulses crop, chickpea occupied average 60-67% carbohydrates, 6% fat and 12-25% protein and essential amino acid. It is commonly used for human consumption as well as for feeding animals. In rainfed areas, not all the rainfall received is available for the crops, but a significant part is lost as runoff and evaporation. Hence, concentrated efforts are needed to develop soil and moisture conservation practices to mitigate the water stress to maximize food production with minimum environmental degradation. In-situ application of crop residues and division of field into beds and furrows could be used as low-cost input technology, which helps to conserve more rainwater in soil by minimizing runoff of water from soil surface under water scarcity situations. (Singh *et al.,* 2012) [11] Land configuration plays a major role in minimizing soil erosion and improving water and nutrient use efficiency of field crops. Most of the crops normally grow on poor, marginal soils with imbalanced nutrient application (Ramesh *et al.*, 2020) [9].
In prospect of increase the input use efficiency, the application of critical inputs under resource scared conditions because low requirements for seed, fertilizers and irrigation water under FIRB (Sayre and Moreno Ramos 1997 and Ram *et al.* 2011) [10, 8] in comparison to planting in

flat land. This scientific method of seed planting was also saving in seeds and fertilizer to some extent i.e 25-30% following (Kumar *et al.* 2012) [3]. It is also observed that there was still a gap in optimum combination(s) of critical requirements for technologies in chickpea especially in respect of optimum planting method and moisture conservation practices such as mulching. Consequently, the present investigation was assumed to refine the what technological gap in respect of method of sowing of crops, moisture conservation practices. Therefore, it so far as effects on the crop productivity and profitability are concerned. Thus, In the present investigation an efforts was made to evaluate the "Effect of different sowing method and moisture conservation practices on production and productivity of Chickpea crop. (*Cicer arietinum* L.).

Materials and Methods

An experiment was conducted at Uttar Pradesh in rural district Mandhana 10 km from Kanpur during rabi, season of 2022-23. The experiment was laid out in split plot design with three replication. The experiment was conducted with 12 treatment combination comprising three methods of sowing {W_1- Conventional sowing method, W_2-Broad bed and furrow sowing method (BBF), W_2-Broad bed and furrow sowing method (BBF)} in main plot and four treatments of moisture conservation practices in sub-plot (M_0– Control, M_1-Soil mulching, M_2-Paddy straw mulch-10 Tonne/ha), M_4–Deep ploughing. The experimental field was prepared after pre sowing irrigation at proper moisture condition. The crop was fertilized with application of 100 kg Diammonium phosphate were used to fulfil nitrogen, phosphorus requirement as basal dressing. Chickpea cultivar KPG-59 (Uday) was grown in the experimental field. A uniform seed rate of 100 kg ha^{-1}. The sowing of crop was done as per treatment. The soil of the experimental field was alluvial in origin and silty loam in texture and slightly alkaline in reaction having pH 7.86, EC 0.14 dSm^{-1}, organic carbon 0.44%, available N, P and K 187.0, 14.0 and 172.0 kg ha^{-1} respectively. The data obtained on grain yield were analysed statistically.

Results and Discussion

1. Growth Characters

It is visualized from the data given in table-1 & 2 among the growth characters *viz*; plant height at 30, 60, 90 DAS and harvest stage, number of primary, secondary and tertiary branches, number of nodules at 45 and 60 DAS and dry matter accumulation at 30, 60, 90 DAS and harvest stage were studied. Different sowing method and moisture conservation practices of chickpea crop was exhibited significant variation in plant height, number of branches and dry matter accumulation. The maximum plant height at 60, 90 DAS and harvest stage, number of primary, secondary and tertiary branches and number of nodules at 45 and 60 DAS and dry matter accumulation at 60, 90 DAS and harvest stage was documented from method of sowing of chickpea crop in narrow seed bead which were statistically superior than method of sowing of chickpea crop in broad bed and furrow sowing method (BBF). The improvement in Plant height, branches/plant and pods/plant parameters was mainly influenced due to better plant growth under raised and ridge planting system. significant improvement in seed yield of chickpea was recorded under ridge and raised bed planting system. Mishra *et al.* (2012) [5] However, number of nodules at 45 and 60 DAS did not show significant variation from method of sowing of chickpea crop. The improvement in root and shoot weight under raised bed and ridge planting over flatbed is mainly due congenial soil environment and better soil depth Pramanik *et al*., (2009 a) [7]. Raised bed also encourage initial root and shoot growth of plant. To overcome the problem of water logging due to flooding or aberrant weather with higher precipitation, the novel strategy is to sow the crop on beds under furrow irrigated raised bed (FIRB) (Kumar *et al*., 2012) [3].

The maximum plant height at 30, 60, 90 DAS and harvest stage, number of primary, secondary and tertiary branches, number of nodules at 45 and 60 DAS and dry matter accumulation at 30, 60, 90 DAS and harvest stage observed the maximum number of nodules at 60 of chickpea crop were documented from application of moisture conservation practices with Paddy straw mulching (10 t/ha) which were statistically at par with application of deep ploughing and statistically superior than dust mulching. The minimum number of nodules at 60 were documented from without moisture conservation practices of chickpea crop in control plot. Kibe and Singh, (2002) [2] reported that plant biomass and grain yield production is directly influenced by plant water uptake and evapotranspiration. Tillage levels and their interaction with moisture conservation practices significantly affected the plant stand of chickpea at harvest Dhar *et al.* (2008a) [1]. Deep summer ploughing, followed by 2 harrowing established significantly a greater number of plants as compared to zero tillage. Kumar *et al*., (2020c) [4] effect of the higher soil moisture, favourable soil temperature, and reduced crop-weed competition in the straw mulching treatment effectively translated to higher grain yield in chickpea. The higher productivity of cultivar was associated with early biomass accumulation. Results further demonstrated that rice straw mulching and early maturing rice cultivar followed by high biomass chickpea cultivar could upscale the condition.

2. Yield and yield attributes

It is illustrated from the data given in table-3 & 4 that different sowing method and moisture conservation practices of chickpea crop was exhibited significant variation in yield attributes *viz*; number of pods per plant, number of seed per pod and 1000- seed weight in chickpea crop. The maximum number of pods per plant, number of seed per pod and 1000-seed weight in chickpea crop were documented from method of sowing of chickpea crop in narrow seed bead which were statistically superior than method of sowing of chickpea crop in broad bed and furrow sowing method (BBF). The minimum yield attributes *viz*; number of pods per plant, number of seed per pod and 1000- seed weight in chickpea crop were documented from sowing of chickpea crop in conventional method. Although, the maximum number of pods per plant of chickpea crop were documented from application of moisture conservation practices with Paddy straw mulching (10 t/ha) which were statistically at par with application of deep ploughing and dust mulching. The minimum number of pods per plant were documented from without moisture conservation practices of chickpea crop in control plot. Patel *et al.* (2009) [6] concluded that the ridge and furrow method of sowing was significantly increased the seed and straw yield than flatbed sowing method. The beneficial effect of ridge and furrow on productivity of chickpea might be due to lose and friable seed bed provided to the root length

of chickpea. Shrivastava *et al*. (2018) [14] Conducted an experiment Narsinghpur district of Madhya Pradesh during the year 2014-15 and reported that the crop yield under raised bed planting was 12.8 q/ha. This was higher by 2.5 q over the flat bed planting.

However, the maximum grain yield was documented from method of sowing of chickpea crop in narrow seed bead which were statistically superior than method of sowing of chickpea crop in broad bed and furrow sowing method (BBF). The minimum grain yield was documented from sowing of chickpea crop in conventional method. Among application of moisture conservation practices of chickpea crop, the maximum grain yield of chickpea crop was documented from application of moisture conservation practices with Paddy straw mulching (10 t/ha) which were statistically superior than application of deep ploughing and dust mulching. The minimum grain yield was documented from without moisture conservation practices of chickpea crop in control plot. Foliage mulch @ 5.0 tonnes/ ha was found equally effective with 3 harrowing and with deep summer ploughing + 2 harrowing in case of pods /plant and 100-grain weight; and with deep summer ploughing + 2 harrowing in case of grains /pod. (Burman *et al*. 2004) [1].

Table 1: Plant height and number of nodules as influenced by sowing method and moisture conservation practices.

S.N	Treatments	Number of nodules		Plant height	
		45 DAS	60 AS	60 DAS	90 DAS
A. Main plot (Sowing method)					
1.	Conventional sowing method	12.885	28.335	28.625	35.853
2.	Broad bed and furrow sowing method (BBF)	13.005	28.258	32.918	37.190
3.	Narrow seed bead sowing method	13.045	28.528	36.988	38.935
	SE(m) SE(d) ± C.D. at 5%	0.149 0.210 N/S	0.327 0.462 N/S	0.394 0.558 1.590	0.428 0.606 1.727
B. Sub plot (Moisture conservation practices)					
1.	Control	10.543	26.403	30.973	35.757
2.	Dust mulching	12.613	27.560	32.177	36.877
3.	Paddy straw mulching (10 t/ha)	14.940	30.077	34.620	38.797
4.	Deep ploughing	13.817	29.453	33.603	37.873
	SE(m) SE(d) ± C.D. at 5%	0.197 0.279 0.591	0.425 0.602 1.274	0.475 0.672 1.422	0.551 0.780 1.651
	Interaction (AxB) SE(d) ± C.D at 5%	0.48 N/S	1.042 N/S	1.163 N/S	1.351 N/S

Table 2: Number of branches and dry matter accumulation of chickpea as influenced by sowing method and moisture conservation practices

S.N	Treatments	Number of branches			Dry matter accumulation at		
		Primary	secondary	Tartary	60 DAS	90 DAS	Harvest
A. Main plot (Sowing method)							
1.	Conventional sowing method	3.55	7.81	11.37	17.46	44.65	106.47
2.	Broad bed and furrow sowing method (BBF)	3.82	9.00	12.98	18.47	18.62	113.39
3.	Narrow seed bead sowing method	4.42	10.56	14.59	19.28	19.28	119.70
	SE(m) SE(d) ± C.D. at 5%	0.04 0.06 0.19	0.11 0.15 0.45	0.15 0.21 0.62	0.21 0.30 0.87	0.42 0.60 1.26	1.30 1.84 5.25
B. Sub plot (Moisture conservation practices)							
1.	Control	3.42	8.48	12.50	17.20	29.56	109.85
2.	Dust mulching	3.75	8.92	12.77	17.84	29.26	112.33
3.	Paddy straw mulching (10 t/ha)	4.35	9.69	13.23	19.51	31.18	116.14
4.	Deep ploughing	4.20	9.42	13.42	19.07	30.00	114.42
	SE (m) SE (d) ± C.D. at 5%	0.05 0.08 0.17	0.13 0.18 0.39	0.18 0.26 0.56	0.27 0.38 0.81	0.49 0.70 1.46	1.66 2.34 3.62
	Interaction (AxB) SE(d) ± C.D at 5%	0.14 N/S	0.32 N/S	0.46 N/S	0.66 N/S	1.21 N/A	0.44 N/S

Table 3: Yield attributes of chickpea as influenced by sowing method and moisture conservation practices.

S.N	Treatments	Number of pods /plants	Number of seed/ pods	Test weight
A. Main plot (Sowing method)				
1.	Conventional sowing method	51.02	1.30	179.40
2.	Broad bed and furrow sowing method (BBF)	48.18	1.42	186.21
3.	Narrow seed bead sowing method	55.87	1.59	191.48
	SE(m) SE(d) ± C.D. at 5%	2.08 2.95 6.41	0.01 0.02 0.06	1.08 1.95 3.41
B. Sub plot (Moisture conservation practices)				
1.	Control	49.86	1.40	182.33
2.	Dust mulching	51.21	1.42	184.32
3.	Paddy straw mulching (10 t/ha)	53.15	1.48	189.00
4.	Deep ploughing	52.55	1.45	187.14
	SE(m) SE(d) ± C.D. at 5%	0.77 3.92 2.77	0.01 0.03 0.08	2.77 3.92 2.62
	Interaction (AxB) SE(d) ± C.D at 5%	1.89 N/S	0.053 N/S	6.79 N/S

Table 4: Yield of chickpea as influenced by sowing method and moisture conservation practices

S.N	Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvesting index (%)
A. Main plot (Sowing method)					
1.	Conventional sowing method	18.833	20.923	39.758	45.645
2.	Broad bed and furrow sowing method (BBF)	19.605	22.155	41.760	46.93
3.	Narrow seed bead sowing method	21.82	23.508	45.328	48.14
	SE(m) SE(d) ± C.D. at 5%	0.207 0.293 0.834	0.239 0.338 0.964	0.446 0.630 1.797	0.506 0.716 0.233
B. Sub plot (Moisture conservation practices)					
1.	Control	16.007	19.320	35.327	45.127
2.	Dust mulching	17.897	20.733	38.630	46.217
3.	Paddy straw mulching (10 t/ha)	20.730	23.077	43.807	47.270
4.	Deep ploughing	19.043	21.653	40.697	44.423
	SE(m) SE(d) ± C.D. at 5%	0.281 0.398 0.843	0.318 0.449 0.952	0.599 0.847 1.794	0.679 0.960 2.033
	Interaction (AxB) SE(d) ± C.D at 5%	0.689 N/S	0.779 N/S	1.467 N/S	1.663 N/S

Conclusion

According to the above results, it can be concluded that narrow seed bead method of sowing is superior over the remaining treatments with application of Paddy straw mulching (10 t/ha) respect growth parameters, yield attributes and yield. Thus, sowing of chickpea on narrow seed bead method with application of application of Paddy straw mulching (10 t/ha) may be recommended to realized higher yields of chickpea crop for farmers.

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