The Pharma Innovation Journal 2022; 11(7): 1708-1712

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 1708-1712

www.thepharmajournal.com
Received: 13-04-2022
Accepted: 22-05-2022

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Effect of different sowing methods and mulching on growth and yield of Chickpea crop. (*Cicer arietinum* L.)

Vinay Kumar and Ram Niwas

Abstract
This experiment was carried out during Rabi season of 2021-22 at Agricultural Research Farm of faculty of Agricultural Sciences and Allied Industries, Rama University, Mandhana, Kanpur Nagar (U.P). The present experiment was laid out in split plot design, the experiment consists of three sowing techniques in main plot *viz*; Conventional method (S1), Broad bed and furrow method (S2), Narrow bed method (S3) and 4 treatments *viz*; where moisture conservation practices (M0) Control, (M1) Soil mulch, (M2) Paddy straw mulch (5 Tonns/ha), (M4) Maize stubble mulch (10 Tonns/ha) in sub plot with three replications in chickpea. The results of this experiment result indicate the growth parameter *viz*; plant height, number of primary, secondary and tertiary branches and yield attributing characture *viz*; Number of pods per plant, Number of seed per pod and 1000-seed weight of chickpea and grain and straw yield of chickpea was recorded maximum from sowing with narrow bead method which were statistically superior from sowing of crop with Broad bed and furrow method. Although, the minimum number of seed per pod of chickpea crop was calculated from sowing of crop with conventional method. Among moisture conservation practices, growth parameter, yield attributing character and yield of grain and straw with gross and net return was recorded maximum from mulching of crop with maize stubble mulch (10 t/ha) which were statistically much superior than mulching of crop with paddy straw mulch (5 t/ha). Although, the minimum number of seed per pod of chickpea crop was calculated from without mulching.

Keywords: Sowing technique, mulch, growth, yield and quality

Introduction
Chickpea is acknowledged as the 'King' of all pulses and it engaged more than 1/3rd of area and contributes 40% of the total pulse production. Among Asian continent, chickpea is the Primary pulse crop of Indian sub-continent. India is the main producer and consumer of chickpea in the world level. On average it is grown in area of 6.3 million ha and production about 5.1 MT. The standard productivity of chickpea is 806 kg ha^{-1}. (FAOSTAT 2017-18).
Madhya Pradesh has first position among all pulses crop producing state in India, which has to be share about 23% of total pulse production. It covers about 32.97% area of chickpea crop in country. In over country, the Uttar Pradesh rank 3rd among areas as well as in production of chickpea. It hold about 25.2lakh ha land and 21.9 lakh tone production and yield 86.6 q ha^{-1}. Among Uttar Pradesh, the important Bengal gram growing districts are *viz*. Chitrakoot, Kanpur, Jhansi, Meerut, Aligarh and Agra etc. (Singh 1987, Smithson *et al*., 1985) [9, 11].
Chickpea is most important sources of energy substrate such protein, soluble and insoluble fiber, essential minerals. Amongst the all pulses crop, in chickpea contain average 60-65% Carbohydrates, 6% Fat and 12-25% Protein and essential amino acid. In addition, through symbiotic nitrogen fixation, it provided up to 80% of soil nitrogen of needed for crop production. Therefore the farmers essential to application of less N fertilizers and the remaining fertilizers can use for the other non legume crops. There has to be two type of chickpea are recognized i.e., Desi type with small seeded, most purplish flowers and grains included 17-22% good quality protein and 60-64% carbohydrate which known as Bengal gram (Sindhu *et al*., 1974) and its contribute nearly 80% of the worldwide chickpea production. Second is Kabuli type, which having bold and cream coloured seed. It is also covered around 10% area.
Chickpea is a *Rabi* season crop which have required cold and dry climate for its successful cultivation in semi-arid regions. To satisfy the hues demand, its quantum jump in chickpea production is essential. Now in India, majority of farmers are generally grown the pulses under resource limiting condition.

The increase in input use efficiency in prospect of application of critical inputs under resource scared was also because low requirements for seed, fertilizers and irrigation water under FIRB (Sayre and Moreno Ramos 1997 and Ram *et al.* 2011) [7] in comparison to planting in flat land. It was also saving in seeds and fertilizer to the some extent i.e 25-30% following raised bed system of planting (Kumar *et al.* 2012) [3]. It is also noticed 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. Therefore, the present investigation was undertaken to refine the technological gap in respect of planting technique of crops, moisture conservation practices. Therefore it so far as effects on the crop productivity and profitability are concerned.

Mulching also minimize the deterioration of soil and weed infestation and also checks the water evaporation. Therefore, it also facilitates to more preservation of soil moisture and helps in regulate the temperature fluctuations, improves physical, chemical and biological properties of soil. Organic mulch includes rice straw, maize stubble etc accounts for the greatest volume of mulch use in commercial crop production.

Considering above all facts in view, the present investigation entitled "To study response of different sowing technique and mulching on production and productivity of Chickpea crop. (*Cicer arietinum* L.)".

Materials and Method

Geographically, Kanpur is situated in sub tropical region at an altitude of 125.9 meter from the mean sea level and latitude ranging of 25^0 56' to 28° 58' North and longitude 79° 31' to 80° 34' East. The climate of locality is semi arid with moderate rainfall and cold winters. The mean annual rainfall is 850 mm extending generally from the mid June to mid October. The temperature rises maximum during May - June (45-48 °C) and come down to 4-5 ^0C during December - January. Occasional showers are also received during winter and summer.

The experiment was laid out in Split Plot Design. Sowing technique S_1 Conventional method, S_2 Broad bed and furrow method, S_3 Narrow bead method, and (Moisture conservation practices) which were M_0 Control, M_1 Soil mulch, M_2 Paddy straw mulch (5 t/ha), M_3 Maize stubble mulch (10 t/ha).

Experimental Findings

Initial plant population was not dominance significantly due to different sowing technique and mulching of chickpea crop. Likewise, interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on initial plant population.

The plant height at 30 DAS don't exhibit any significant result by different sowing technique and mulching of chickpea crop. , the maximum plant height at 60, 90 DAS of crop growth was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par from mulching of crop with paddy straw mulch (5 t/ha). Although, the minimum plant height at 60, 90 DAS of crop growth was calculated from without mulching.

The number of primary, secondary and tertiary branches of crop growth was significantly dominance by different sowing technique and mulching of chickpea crop. The maximum number of primary, secondary and tertiary branches of crop was calculated from sowing with narrow bead method which were statistically superior from sowing of crop with Broad bed and furrow method. Although, the minimum number of primary, secondary and tertiary branches of crop was calculated from sowing of crop with conventional method.

The maximum number of primary, secondary and tertiary branches of crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically much superior than mulching of crop with paddy straw mulch (5 t/ha). Although, the minimum number of primary, secondary and tertiary branches of crop was calculated from without mulching interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on number of primary, secondary and tertiary branches of crop.

The maximum number of nodules at 45 DAS of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically superior than mulching of crop with paddy straw mulch (5 t/ha). Although, the maximum number of nodules at 60 DAS of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par from mulching of crop with paddy straw mulch (5 t/ha). However, the minimum number of nodules at 45 and 60 DAS of chickpea crop and of crop growth was calculated from without mulching. Interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on number of primary, secondary and tertiary branches of crop.

The maximum number of pods per plant of chickpea crop was calculated from sowing with narrow bead method which were statistically superior from sowing of crop with Broad bed and furrow method. Although, the minimum number of pods per plant of chickpea crop was calculated from sowing of crop with conventional method. The maximum number of pods per plant of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par with mulching of crop with paddy straw mulch (5 t/ha). Although, the minimum number of pods per plant of chickpea crop was calculated from without mulching. Interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on number of primary, secondary and tertiary branches of crop.

The maximum number of seed per pod of chickpea crop was calculated from sowing with narrow bead method which were statistically superior from sowing of crop with Broad bed and furrow method. Although, the minimum number of seed per pod of chickpea crop was calculated from sowing of crop with conventional method. The maximum number of seed per pod of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically much superior than mulching of crop with paddy straw mulch (5 t/ha). Although, the minimum number of seed per pod of chickpea crop was calculated from without mulching. Interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on number of seed per pod of crop.

The maximum 1000- seed weight of chickpea crop was calculated from sowing with narrow bead method which were statistically at par with sowing of crop with Broad bed and furrow method. Although, the minimum 1000- seed weight of chickpea crop was calculated from sowing of crop with conventional method. The maximum 1000- seed weight of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically much superior than mulching of crop with paddy straw mulch (5

t/ha). Although, the minimum 1000- seed weight of chickpea crop was calculated from without mulching. Interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on 1000- seed weight of crop.

The maximum grain yield of chickpea crop was calculated from sowing with narrow bead method which were statistically at par with sowing of crop with Broad bed and furrow method. Although, the minimum grain yield of chickpea crop was calculated from sowing of crop with conventional method. Similarly, the maximum grain yield of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par with mulching of crop with paddy straw mulch (5 t/ha). Although, the minimum grain yield of chickpea crop was calculated from without mulching. Interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on 1000- seed weight of crop.

The maximum straw yield of chickpea crop was calculated from sowing with narrow bead method which were statistically much superior than sowing of crop with Broad bed and furrow method. Although, the minimum straw yield of chickpea crop was calculated from sowing of crop with conventional method. Similarly, the maximum straw yield of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par with mulching of crop with paddy straw mulch (5 t/ha) and Soil mulch. Although, the minimum straw yield of chickpea crop was calculated from without mulching. Interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on straw yield of chickpea crop.

The maximum biological yield of chickpea crop was calculated from sowing with narrow bead method which were statistically much superior than sowing of crop with Broad bed and furrow method. Although, the minimum biological yield of chickpea crop was calculated from sowing of crop with conventional method. Similarly, the maximum biological yield of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par with mulching of crop with paddy straw mulch (5 t/ha). Although, the minimum straw yield of chickpea crop was calculated from without mulching. Interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on biological yield of chickpea crop.

The maximum harvesting index of chickpea crop was calculated from sowing with narrow bead method which were statistically at par with sowing of crop with Broad bed and furrow method. Although, the minimum harvesting index of chickpea crop was calculated from sowing of crop with conventional method. Similarly, the maximum harvesting index of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par with mulching of crop with paddy straw mulch (5 t/ha). Although, the minimum harvesting index of chickpea crop was calculated from without mulching. Interaction effect of different sowing technique and mulching of chickpea crop don't show significant results on harvesting index of chickpea crop.

The maximum B: C ratio (2.253) of chickpea crop was calculated from sowing with narrow bead method which were more than sowing of crop with Broad bed and furrow method (2.038). Although, the minimum B: C ratio (1.688) of chickpea crop was calculated from sowing of crop with conventional method. Similarly, the maximum B: C ratio (2.043) of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were more than with mulching of crop with paddy straw mulch (5 t/ha) (2.033). Although, the minimum B: C ratio of chickpea crop was calculated from without mulching (1.930).

Discussion

Growth and development studies on crop:

Sowing technique and mulching of soil with crop residue on chickpea crop was exhibited significant variation in plant height of chickpea at 60 and 90 DAS. The maximum plant height at 60, 90 DAS of crop growth was calculated from sowing with narrow bead method which were statistically at par from sowing of crop with Broad bed and furrow method. The maximum plant height at 60, 90 DAS of crop growth was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par from mulching of crop with paddy straw mulch (5 t/ha). The maximum number of primary, secondary and tertiary branches of crop was calculated from sowing with narrow bead method which were statistically superior from sowing of crop with Broad bed and furrow method. The maximum number of primary, secondary and tertiary branches of crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically much superior than mulching of crop with paddy straw mulch (5 t/ha). Mulching of chickpea also improved soil moisture. This might be due to less evaporation from soil surface. Which increase the crop growth and development of crop. Similar result have been reported by Kumar and Singh (2015) [2] Archana *et al.*, (2021), Jadhav *et al.*, (2011) and kumar *et al.*, (2013).

Yield and yield attributes studies on crop:

It is clearly understood from data that sowing technique and mulching of soil with crop residue on chickpea crop was exhibited significant variation in yield attributes *viz*; Number of pods per plant, Number of seed per pod and 1000- seed weight and yield. The maximum number of pods per plant, Number of seed per pod and 1000- seed weight of chickpea crop was calculated from sowing with narrow bead method which were statistically superior from sowing of crop with Broad bed and furrow method. The maximum number of pods per plant of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par with mulching of crop with paddy straw mulch (5 t/ha). Among yield of grain and straw yield, the maximum grain yield of chickpea crop was calculated from sowing with narrow bead method which were statistically at par with sowing of crop with Broad bed and furrow method. Among application of mulching, the maximum grain yield of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par with mulching of crop with paddy straw mulch (5 t/ha). Similarly, the maximum straw yield of chickpea crop was calculated from sowing with narrow bead method which were statistically much superior than sowing of crop with Broad bed and furrow method. The maximum straw yield of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) which were statistically at par with mulching of crop with paddy straw mulch (5 t/ha) and Soil mulch. Similar result could be reported by Archana, B. *et al* (2021). Narendra *et al* (2010), Kumar *et al* (2015) [2], and Komal *et al* (2018) [1].

Table 1: Effect of different sowing technique and mulching on Plant population, Plant height, Number of Primary, Secondary and Tertiary branches, and Number of Nodules.

Treatment	Plant population m^{-2}	Plant Height			Number of Branches			Number of Nodules	
		30 DAS	60 DAS	90 DAS	Primary	Secondary	Tertiary	45 DAS	60 DAS
A. Sowing technique									
Conventional method	24.245	10.630	27.663	31.045	2.930	7.955	10.975	13.668	29.033
Broad bed and furrow method	24.233	10.633	29.658	36.050	3.463	8.787	12.645	13.695	29.063
Narrow bead method	24.220	10.635	30.095	37.913	4.050	10.038	14.069	13.783	29.180
C.D.	N/A	N/A	1.352	1.679	0.173	0.427	0.613	N/A	N/A
SE(m)	0.272	0.119	0.335	0.416	0.043	0.106	0.152	0.171	0.338
SE(d)	0.385	0.169	0.474	0.589	0.061	0.150	0.215	0.241	0.479
B. Mulching									
Control	24.223	10.643	28.237	33.867	3.203	8.550	12.140	10.137	26.673
Soil mulch	24.237	10.623	28.917	34.637	3.413	8.833	12.347	12.597	28.253
Paddy straw mulch (5 t/ha)	24.230	10.627	29.623	35.393	3.587	9.083	12.699	15.680	30.193
Maize stubble mulch (10 t/ha)	24.240	10.637	29.777	36.113	3.720	10.240	13.067	16.447	31.247
C.D.	N/A	N/A	1.23	1.519	0.151	0.389	0.543	0.637	1.311
SE(m)	0.361	0.158	0.429	0.507	0.050	0.130	0.181	0.213	0.438
SE(d)	0.510	0.224	0.607	0.717	0.071	0.184	0.256	0.301	0.619
Interaction (AxB)									
SE(d)±	0.884	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C.D at 5%	N/A	0.388	1.051	1.243	0.124	0.318	0.444	0.5210.143	1.073

Table 2: Effect of different sowing technique and mulching on Number of Pod/plant, Seed/plant, 1000 seed weight, Grain yield, Straw yield, Biological yield and B:C ratio.

Treatment	Yield Attributes			Grain yield	Straw yield	Biological yield	B: C ratio
A. Sowing technique	**Pod / Plant**	**Seed/pod**	**1000- Seed weight**				
Conventional method	48.155	1.300	179.605	13.60	17.193	30.805	1.688
Broad bed and furrow method	54.525	1.438	187.543	16.443	19.685	36.060	2.038
Narrow bead method	57.003	1.540	190.750	18.223	20.893	39.114	2.253
C.D.	2.530	0.068	3.771	4.801	0.923	1.722	N/A
SE(m)	0.627	0.017	2.176	0.199	0.229	0.427	N/A
SE(d)	0.887	0.024	1.277	1.281	0.324	0.604	N/A
B. Mulching							
Control	51.450	1.387	175.083	15.217	18.643	33.770	1.930
Soil mulch	52.593	1.410	179.223	15.703	19.097	34.817	1.963
Paddy straw mulch (5 t/ha)	54.130	1.437	183.223	16.483	19.507	35.989	2.033
Maize stubble mulch (10 t/ha)	54.737	1.470	187.667	16.950	19.780	36.730	2.043
C.D.	2.121	0.01	5.853	0.693	0.80	1.530	N/A
SE(m)	0.775	0.021	3.709	0.231	0.395	0.511	N/A
SE(d)	1.096	0.029	2.623	0.327	0.280	0.722	N/A
Interaction (AxB)							
SE(d)±	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C.D at 5%	1.8990	0.318	0.444	0.567	0.685	1.251	N/A

Economics

The maximum net return of chickpea crop was calculated from sowing with narrow bead method (Rs. 67,396 /ha) which were more than sowing of crop with Broad bed and furrow method (Rs. 59,115 /ha). Although, the minimum net return of chickpea crop was calculated from sowing of crop with conventional method (Rs. 45,526 /ha). The maximum net return of chickpea crop was calculated from mulching of crop with maize stubble mulch (10 t/ha) (Rs. 60,509 /ha) which were more than with mulching of crop with paddy straw mulch (5 t/ha) (Rs. 59,162 /ha). Although, the minimum net return of chickpea crop was calculated from without mulching (Rs. 53,764 /ha). Similar, finding has reported by Jadhav *et al.* (2011).

Conclusion

On the basis of our finding it is concluded that the Factor (S_3) Narrow bed method and (M_4) Maize stubble mulch (10 Tonns /ha) were found best in the terms of plant height, number of primary, secondary and tertiary branches and yield attributing characture *viz*; Number of pods per plant, Number of seed per pod and 1000-seed weight of chickpea and grain and straw yield and Economics.

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