Eco. Env. & Cons. 28 (December Suppl. Issue) : 2022; pp. (S103-S107)

ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i08s.018

Performance evaluation of different seed bed configurations in chickpea cultivation in Malwa region of Madhya Pradesh, India

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(Received 10 June, 2022; Accepted 30 August, 2022)

ABSTRACT

The field trials were conducted during the three consecutive years Rabi 2018-19, Rabi 2019-20 and Rabi 2020-21 at farmer's field in the adopted villages of Krishi Vigyan Kendra, Mandsaur, Madhya Pradesh to assess the effect of different seed bed configurations on growth characters and yield of chickpea crop. The experiment consists of three seed bed configurations i.e., flat bed sowing by conventional seed drill (T1), broad bed sowing by broad bed furrow seed drill (T2) and raised bed sowing by furrow irrigated raised bed seed drill (T3) with ten replications. The treatment T3 was found significantly superior in terms of nodulation (nodules per plant), number of pods/plant, grain yield, straw yield and biological yield as compared to treatments T1 and T2. The grain yield was found significantly higher in treatment T3 (19.24 q/ha) followed by treatment T2 (16.85 q/ha) and treatment T1 (14.08 q/ha). The treatment T3 was found most economical with highest B:C ratio of 2.21 as compared to lower B:C ratio of 1.96 and 1.69 for treatment T2 and T1 respectively. The results of the study indicated that the cultivation of chickpea on furrow irrigated raised bed is economically feasible.

Key words : *Chickpea, BBF, FIRB, Grain yield, B:C ratio*

Introduction

All over the world, especially in the Afro-Asian countries, chickpea (*Cicer arietinum* L.) is an important pulse crop grown and consumed. In India, chickpea is mainly grown during rabi season which accounts for about 45% of total pulses production under diverse production systems including both rainfed and irrigated, but its maximum area and production is mostly confined to Madhya Pradesh, Rajasthan, Maharashtra, Karnataka, Andhra Pradesh and Uttar Pradesh. The package of improved implements and machines play important role for improvement of agricultural productivity besides high yielding varieties, fertilizer, irrigation and plant protection practices. Agricultural mechanization has anticipated greater significance for increasing agricultural production and productivity by efficiently and effectively utilizing scarce resources and costly farm inputs, improving timeliness factor, reducing manpower and human drudgery etc. for chickpea cropping system. Most of the farmers used conventional seed drill for sowing of chickpea on flat bed system which resulted to lower down the crop yield. Chickpea is also susceptible to water stagnation due to flood irrigation or rainfall

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even for a shorter period during the crop growth. The planting of crops on furrow irrigated raised bed are found effective in mitigating the adverse effect of water stress and improvement in soil physical and biological environment.

In recent years, raised bed system has proved to be one of the important components of low cost sustainable production system. The raised bed system of planting enables mechanical weed control, increased water use efficiency, reduced crop lodging and has lower seed requirement (Sayre, 2000). Land treatments (raised sunken bed system, ridges and furrows, broad bed and furrows) increased in-situ soil moisture conservation, minimized runoff, and soil erosion (Singh *et al.*, 1999). By transforming the growing crops in flat bed to ridge-furrow system of planting crops on broad bed or raised bed alters the crop geometry and land configuration, provide more effective control over irrigation and drainage as well as their impacts on transport and transformations of nutrients. Practice of raised bed as well as broad bed planting have potential agronomic advantages which include improved soil structure due to reduced compaction through controlled trafficking, reduced water logging and timely machinery operations due to better surface drainage. Raised beds as well as broad beds also create the opportunity for mechanical weed control and improved fertilizer placement (Singh *et al.*, 2002). The Higher biological yield and maximum net return from improved land configuration treatment as compared to conventional system as reported by Jat and Singh, 2003. During seed development stage, the crop experiences terminal drought as it is invariably grown on residual soil moisture after a preceding kharif crop(s), thereby making the terminal moisture stress as the major constraint in achieving potential productivity of chickpea (Singh *et al.*, 2010). Therefore, a judicious management of available soil moisture through in-situ conservation is required viz., broad bed and furrow irrigated raised bed system (FIRBS) which improves the crop productivity (Panwar and Basu, 2003). In broad bed and furrow irrigated raised bed systems water moves horizontally from the furrows into the beds and is pulled upwards in the bed towards the soil surface by capillarity, evaporation and transpiration, and downwards mostly by gravity. On an average, it is reported that raised bed planting of cereals, pulses and vegetables, increased the crop yield by 24.2% and saving of irrigation water by 31.2% (Connor *et al.*, 2003). Hence, to save the crop from moisture stress during the crop growth period and to minimize the cost of cultivation without compromising with sustainability, the present investigation was, therefore conducted at farmer's fields to study the performance evaluation of different seed bed configurations in chickpea cultivation in Malwa region of Madhya Pradesh.

Materials and Methods

The field trials were conducted during the three consecutive years Rabi 2018-19, Rabi 2019-20 and Rabi 2020-21 at farmer's field in the adopted villages of Krishi Vigyan Kendra, Mandsaur, Madhya Pradesh namely, Chillod pipliya and Gogarpura to assess the effect of different seed bed configurations on growth characters and yield of chickpea crop. The villages Chillod pipliya and Gogarpura are situated in western part of Madhya Pradesh which falls under agro-climatic zone of Malwa plateau. The study area belongs to sub-tropical climate having a mean temperature range of minimum 5 ^{o}C and maximum 44 ^{o}C in winter and summer, respectively. The topography of the villages is uniform and levelled. The soil of selected fields is clayey in texture with 45 to 50 cm depth with pH 7.5 to 7.8, organic carbon 5.7 to 6.1 g/kg soil, EC 0.39 to 0.43 dS/m at the start of experiment. The area normally receives annual rainfall ranging of 826 mm per annum out of which about 85 to 90 per cent is received during June and September.

The experiment consists of three seed bed configurations i.e., flat bed sowing by conventional seed drill (T1), broad bed sowing by broad bed furrow seed (BBF) drill (T2) and raised bed sowing by furrow irrigated raised bed seed drill (T3) with ten replications. The field was prepared and trapezoidal shape raised beds/broad beds were made mechanically by tractor driven furrow irrigated raised bed planter and BBF planter respectively. The recommended dose of seed rate 80 kg/ha was used for sowing along with recommended package of practices including use of fertilizers and appropriate Rhizobium inoculation. The required plant protection measures as per recommendations were taken as and when found essential. On the basis of destructive plant sampling, observations on number of nodules per plant at 60 and 90 DAS, root-shoot ratio at 60 and 90 DAS, plant height, number of branches per plant, number of pods per plant, grain yield, straw yield and harvest index were recorded for all the treatments and analyzed statistically. The economics of the present study was also worked out for all the experimental years, i.e., Rabi 2018-19, Rabi 2019-20 and Rabi 2020-21.

Results and Discussion

The pooled data of three years i.e., Rabi 2018-19, Rabi 2019-20 and Rabi 2020-21 on parameters related to nodulation, shoot dry weight, root dry weight and root:shoot ratio at 60 and 90 DAS as influenced by different seed bed configurations in chickpea production are presented in Table 1.

Nodulation: The number of nodules per plant at 60 DAS and 90 DAS significantly influenced by different seed bed configurations. The increase in number of nodules per plant at 60 DAS and 90 DAS was maximum under treatment T3 i.e., raised bed sowing (65% and 37.8% respectively) followed by treatment T2 i.e., broad bed sowing (29.9% and 15.36% respectively) in comparison to treatment T1 i.e., flat bed planting. This may be due to better root development as treatment T3 and treatment T2 provided better physical condition of soil and lower penetration resistance to roots (Lupwayi *et al.*, 1997).

Shoot and root partitioning: The shoot and root dry weight at 60 DAS were found maximum in treatment T3 (4.39 g and 0.88 g respectively) followed by treatment T2 (4.28 g and 0.84 respectively) and treatment T1 (4.01 g and 1.01 g respectively). Similar trends were also observed for shoot and root dry weight at 90 DAS. Significant variation in shoot and root dry weight was observed due to different seed bed configurations. Similarly, improvement in root: shoot ratio was recorded under treatment T3 over treatment T1 and T2 during the study period (Table 1). The better root: shoot ratio under treatment T3 and T2 over treatment T1 is mainly due congenial soil environment and better soil depth (Pramanik *et al.*, 2009).

The pooled data of three years study period on parameters related to plant height, number of branches per plant, number of pods per plant and crop yield as influenced by different seed bed configurations in chickpea production are presented in Table 2.

Table 1. Comparison of nodulation, shoot dry weight and root dry weight of chickpea cultivation under different seed bed configurations

Parameter	Treatment T1	Treatment T2	Treatment T3	CD(P = 0.05)
No. of nodules/plant at 60 DAS	31.1	40.4	51.3	4.9
No. of nodules/plant at 90 DAS	39.7	45.8	54.7	4.1
Shoot dry weight/plant at 60 DAS (g)	4.01	4.28	4.39	0.03
Shoot dry weight/plant at 90 DAS (g)	8.62	9.45	9.96	1.12
Root dry weight/plant at 60 DAS (g)	0.78	0.84	0.88	0.07
Root dry weight/plant at 90 DAS (g)	1.01	1.12	1.32	0.06
Root : Shoot ratio at 60 DAS	0.19	0.20	0.20	-
Root : Shoot ratio at 90 DAS	0.12	0.12	0.13	-

Table 2. Comparison of yield attributes and economics parameters of chickpea cultivation under different seed bed configurations

Parameter	Treatment T1	Treatment T2	Treatment T3	CD(P = 0.05)
Plant height (cm)	37.5	44.2	45.4	3.1
No. of branches/plant	3.7	4.4	5.6	NS
No. of pods/plant	45.9	50.5	52.4	3.5
Grain yield (q/ha)	14.08	16.85	19.24	1.69
Straw yield (q/ha)	24.13	27.23	29.95	1.83
Biological yield (q/ha)	38.21	44.08	49.19	2.07
Harvest index (%)	36.85	38.23	39.11	2.24
Cost of Cultivation (Rs/ha)	30000	30900	31400	-
Gross Return (Rs/ha)	50688	60660	69264	-
Net Return (Rs/ha)	20688	29760	37864	-
Benefit Cost Ratio (B:C)	1.69	1.96	2.21	-

Plant height, number of branches and pods/plant: The plant height at flowering was found maximum in treatment T3 (45.4 cm) followed by treatment T2 (44.2 cm) and treatment T1 (37.5 cm). The increase in plant height was mainly due to better soil plant water relationship and soil physical condition in treatment T3 as compared to treatment T1 and T2. The statistical analysis showed that there was no significant difference on number of branches per plant due to different treatments. The number of pods/plant were found maximum with treatment T3 (52.4) which was significantly higher than treatment T2 (50.5) and treatment T1 (45.9). The present findings are in close vicinity of Raut *et al.* (2000) and Jha *et al.* (2014).

Crop yield and its attributes: The grain yield, straw yield, biological yield and harvest index was also significantly influenced by the different seed bed configurations in chickpea production (Table 2).

The grain yield, straw yield and biological were found superior in treatment T3 (19.24 q/ha, 29.95 q/ha and 49.19 q/ha respectively) followed by treatment T2 (16.85 q/ha, 27.23 q/ha and 44.08 q/ha respectively) and treatment T1 (14.08 q/ha, 24.13 q/ha and 38.21 q/ha respectively). Superior yield with treatment T3 was observed due to increased number of pods as the results of conserving more rainwater, nutrient and soil resources. The harvest index was also observed maximum in treatment T3 (39.11%) as compared to treatment T2 (38.23%) treatment T1 (36.85%). The improvement in above parameters was mainly due to better plant growth under raised and broad bed system of sowing. Similar results of higher yields in altered land configuration over flat bed method were also reported by Autkar *et al.* (2006) and Selvaraju *et al.* (1999).

Economic indicators: The economics of the present study was worked out for all the experimental years i.e., Rabi 2018-19, Rabi 2019-20 and Rabi 2020-21 (Table 2). The benefit cost ratio (B:C) and net return are the best indices to express the profitability of chickpea cultivation which were calculated on the basis of cost of cultivation and gross return. The highest net return (37864 Rs/ha) with B:C ratio (2.21) were recorded in treatment T3 followed by treatment T2 (29760 Rs/ha and 1.96) and treatment T1 (20688 Rs/ha and 1.69). Similar findings were also reported by Pramanik *et al.* (2009) and Gupta *et al.* (2020).

Conclusion

On the basis of the overall performance of chickpea it was concluded that chickpea sown on raised bed configuration using furrow irrigated raised bed seed drill was superior to other seed bed configurations as it resulted in better yield as well as economically feasible in Malwa region of Madhya Pradesh.

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