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# Effect of Seed Rate and Seed Spacings on Yield Attributes of Chickpea

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## ABSTRACT

**Background:** Chickpea is a cool season legume crop and is grown in several countries worldwide as a food source. Seed is the main edible part of the plant and is a rich source of protein, carbohydrates and minerals especially for the vegetarian population. The current study aimed to study the effect of seed rate and seed spacing on yield attributes of chickpea.

**Methods:** The research was carried out at Research Farm, Department of Agriculture, Maharishi Markandeshwar University, Sadopur, Ambala during *Rabi* season in 2020-2021. The experiment was laid out in split plot design (SPD), with three replication and 9 treatments with two conditions *i.e.* three different seed rate (60, 75 and 90 kg/ha) and seed rate were design in main plot, where as in sub-plot three spacing (20, 30 and 40 cm) were tested.

**Result:** The result revealed that seed rate of 75 kg/ha with row spacing of 30 cm in chickpea crop recorded maximum seed index (21.70 g), seed yield (23.26 q/ha), straw yield (26 q/ha), biological yield (49.16 q/ha) and harvest index (47%). The maximum number of pods per plant (107.63) and seeds per pod (2.13) were observed when the seed rate of 60 kg/ha and row spacing of 40 cm was used.

**Key words:** Chickpea, Plant height, Seed rate, Spacing, Yield.

## INTRODUCTION

Self-pollinated crop, chickpea (*Cicera rietinum* L.) is one of the most important legume crop belongs to the family Leguminoceaehaving true diploid (2n= 2x= 16) of 738 Mbp genome size (Varshney *et al*. 2013). Chickpea is known by different names in India *viz*. *Channa* or *Gram* or *Bengal gram* or *Chani* in Haryana, Rajasthan, Uttarakhand, Uttar Pradesh, Bihar, Madhya Pradesh, Chhattishgarh, Jharkhand *etc*, *Boot* (Orrissa), *Chole* (West Bengal), *Chhole* (Punjab), *Harbar*(Maharashtra), *Kadale* (Karnataka), *Kadalai* (Tamil Nadu), *Kadala* (Kerala) and *Sanagulu* (Andhra Pradesh) (Singh *et al*. 2014). It is winter season pulse crop cultivated in different parts of the country. Globally, it is cultivated in 131.1 lakh hectare area with the total production of 127.3 lakhtonnes and productivity of 970 kg $ha^{-1}$ (Anonymous, 2019).

It is one of the most essential legume food plants in sustainable agriculture system due to its low production cost, wider adaptation, ability to fix atmospheric nitrogen which fits in various crop rotations and existence prolific tap root system (Yadav *et al*. 2020). Chickpea play significant role in maintaining the fertility of soil by fixing nitrogen upto 140 kg $ha^{-1}$ per year (Flowers *et al*. 2010). Chickpea provides low inputs of nitrogen through biological nitrogen fixation and allows benefits to other cereal crops (Siddique *et al*. 2005) reported that the chickpea also provides significant amount of residual nitrogen to the soil and adds chickpea has high economic and nutritive importance but its yield is comparatively low in India. The main reason of low yield is improper population because too low or too high plant population adversely affects the yield of crop.

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## MATERIALS AND METHODS

The experiment was carried outat Research Farm, Department of Agriculture, Maharishi Markandeshwar University, Sadopur, Ambala, Haryana (India) during the *Rabi* season of 2020-21. The experiment was laid out in split plot design where nine treatment combinations and three replications were designed in November, 2020. The chickpea crop was supplemented with 20 kg/ha N, 40 kg/ha $P_2O_5$... and 60 kg/ha K, O as a basal dose as per recommendation given by ICRISAT, India. The wilt resistant variety 'HC-5' of CCS Haryana Agricultural University, Hisar was sown in the beginning of first week of November at different seed rate and spacing in each plot. The experimental field was split into three blocks. In between the blocks, two irrigation channels were prepared manually. Plant height, number of branches per plant, number of pods per plant, number of seeds per pod, seed index, seed yield, straw yield, biological yield and harvest index. The weight of total dry matter

accumulation of crop was calculated by using below given formula:

Biological yield (q/ha) =Grain yield (q/ha) + Straw yield (q/ha)

**Harvest index**

It was recorded by dividing the total yield with the total above ground biomass (straw+seed). It was expressed in percentage and was calculated by using formulae given below:

$$\text{Harvest Index (\%)} = \frac{\text{Seed yield}}{\text{Biological yield}} \times 100$$

## RESULTS AND DISCUSSION

The experiment includes different type of seed rate (60, 75 and 90 kg/ha) and row spacing (20,30,40 cm). The plant height showed significant increase with decrease in seed rate at all growth stages (Table 1). The taller plant height at 30 DAS, (15.23 cm) was recorded in 60 kg/ha seed rate, which was followed by 75 kg/ha and 90 kg/ha seed rate, respectively. Similar result attained by Ray *et al*. (2017) whereas, maximum plant height (15.02 cm) at 30 DAS was noticed in 30 cm which was followed by 20 cm and 40 cm, respectively. In case of row spacing, there is increase in value of plant height when spacing between the rows increases. It might be due to more competition for sunlight between the plants (Sharar *et al*., 2001 and Bavalgave *et al*., 2009). The same trend with respect to plant height was followed at 60, 90 and 120 days after sowing in chickpea.

Significant maximum average branches per plant (4.64) were obtained in 60 kg/ha seed rate, which was at par with 75 kg/ha seed rate. Similar results was also reported in which they proved that increase in number of branches was seen with the decrease in seed rate (60 kg/ha). Likewise, the maximum average branches per plant (5.02) were found in plot having row spacing of 40 cm. The study reported that sufficient plant spacing (45 cm) increase the photosynthetic activity and provide more light to plant. Similar study was recorded by Khan *et al*. (2010).

Highest number of pods per plant (100.36) showed significant result in 60 kg seed rate per hectare (Table 2) and the results arein accordance with those who reported

**Table 1:** Effect of seed rate and spacing on plant height and number of branches per plantof chickpea.

| Treatments | Plant height | | | | Branches per plant |
|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | 120 DAS | |
| **Seed rate** | | | | | |
| 60 kg ha$^{-1}$ | 15.23 | 31.31 | 44.47 | 56.11 | 4.64 |
| 75 kg ha$^{-1}$ | 13.97 | 30.74 | 42.60 | 55.02 | 4.41 |
| 90 kg ha$^{-1}$ | 13.43 | 29.87 | 40.45 | 52.60 | 3.85 |
| SEm± | 0.30 | 0.26 | 0.39 | 0.20 | 0.07 |
| C.D.(5%) | 1.20 | 1.06 | 1.55 | 0.78 | 0.28 |
| **Row spacing** | | | | | |
| 20cm | 14.43 | 30.25 | 42.13 | 53.94 | 3.12 |
| 30cm | 15.02 | 31.76 | 44.81 | 51.41 | 4.16 |
| 40cm | 13.18 | 29.91 | 40.58 | 52.36 | 5.02 |
| SEm± | 0.16 | 0.71 | 0.31 | 0.30 | 0.03 |
| C.D.(5%) | 0.52 | 0.53 | 0.97 | 0.94 | 0.011 |

**Table 2:** Effect of seed rate and spacing on pods per plant, seeds per pod, seed index (g) and protein content (%) of chickpea.

| Treatments | Pods per plant | Seeds per pod | Seed index (g) | Protein content (%) | |
|---|---|---|---|---|---|
| | | | | Seed | Straw |
| **Seed rate** | | | | | |
| 60 kg ha$^{-1}$ | 100.36 | 1.76 | 20.37 | 22.48 | 5.63 |
| 75 kg ha$^{-1}$ | 98.46 | 1.50 | 21.09 | 22.70 | 5.88 |
| 90 kg ha$^{-1}$ | 96.13 | 1.34 | 19.85 | 22.87 | 5.52 |
| SEm± | 0.42 | 0.03 | 0.06 | 0.33 | 0.04 |
| C.D.(5%) | 1.67 | 0.10 | 0.24 | 1.31 | 0.17 |
| **Row spacing** | | | | | |
| 20 cm | 92.97 | 1.26 | 20.01 | 2155 | 5.44 |
| 30 cm | 97.38 | 1.53 | 20.93 | 22.69 | 5.90 |
| 40 cm | 104.60 | 1.81 | 20.30 | 21.82 | 5.69 |
| SEm± | 0.28 | 0.07 | 0.14 | 0.17 | 0.06 |
| C.D.(5%) | 0.90 | 0.15 | 0.46 | 0.54 | 0.18 |

that highest number of pods per plant were obtained from lower seed rate (60 kg/ha) where utilization of light, space, moisture and nutrition was good (Khan *et al*. 2010). These finding are in accordance with (Aziz *et al*., 1988; Komatsu *et al*., 1989 and Chala *et al*., 2020).

With respect to different row spacing, maximum number of pods per plant (104.60) were recorded superior under row spacing of 40 cm. Singh *et al*. (2019) on his research reported that narrow row spacing in chickpea increased the plant population, which further increased the competition for light, water, nutrition as compared to wider row spacing. Higher number of pods per plant was recorded inwider row spacing (Sonboir *et al*. 2017). Similar results were also attained by Kumar *et al*. (2018).

Seed rate showed significant effect on number of seeds per pod. However, at 60 kg seed per hectare (1.76) were observed, than 75 kg/ha (1.50) and 90 kg/ha seed rate (1.34), respectively. Among different row spacing, the maximum average number of seeds per pod (1.81) was found superior in 40 cm row spacing, which was followed by 30 cm (1.53) and 20 cm (1.26) row spacing. Singh *et al*. (2019) was observed that when seed rate was increased from 60 to 100 kg, the 1% decreased in number of seeds per pod was analyzed. The lower seed rate, increased plant spread, therefore it gave positive relationship between seed rate and number of seeds per pod. Similar study stated that minimum number of seeds per pod is because of closer spacing of plant within row that also increases the competition for light, space, nutrition and water (Khan *et al*. 2010).

Application of 75 kg/ha seed rate, which provided heaviest seeds (21.09 g). The increase in seed rate from 60 to 100 kg/ha, decreases the 7% of seed index. The similar result finding were reported by Khan *et al*. (2010) who observed that seed index decreases when seed rate increases.The data regarding maximum seed index (20.93 g) was reported from the treatments of 30 cm row spacing. It might be due to the fact that reduced intra row spacing competes at 30 cm, increased inassimilate supply to individual plant basis. The similar results were also quoted by Khan *et al*. (2001) and Chala *et al*. (2020).

**Seed yield**

Significantly maximum seed yield (21.97 q/ha) was recorded in plot having75 kg/ha seed rate, (Table 3) followed by 60 kg/ha and 90 kg/ha seed rate. Machado *et al*. (2006) in his study observed that when seed rate was increased from 60 to 75 kg seed rate per hectare, the yield was also increased by 8%. The similar research was undertaken by Nawange *et al*. (2016).The mean of different row spacing gave highest seed yield (22.67 q/ha ) when row spacing of 30 cm was kept, followed by row spacing of 40 cm and 20 cm, respectively. It might be due to inefficient utilization of growth factor in case of wider spacing. The similar study was reported by many authors (Chala *et al*., 2020; Bhowmick *et al*., 2013; Bawalgave *et al.,* 2009 and Venkatachalaphathi *et al*., 2004).

**Straw yield**

On the mean basis, the maximum straw yield (24.82 q/ha) was obtained, when 75 kg/ha seed rate was used and was statistically at par with 60 kg/ha seed rate and the same result was quoted by Kumar *et al*. (2020). Regarding different row spacing, the increase in straw yield (25.45 q/ha) was obtained under 30 cm row spacing, it was at par with 40 cm row spacing. Similar studies declared that the highest straw yield is because of wider row spacing between the plant, which reduces the competition for light, space, nutrition and water (Khan *et al*. 2010).

**Biological iield**

The highest biological yield was observed superior (46.73 q/ha) in case of 75 kg/ha seed rate, which was at par with 44.77 q/ha seed rate. This is due to the reason that with higher plant population, the yield component increases on individual plant basis whereas in lower plant population, the yield component decreases. Similar research was quoted by Khan *et al*. (2010). On the basis of row spacing, increase in biological yield of 45.72 q/ha at 30 cm row spacing was

**Table 3:** Effect of seed rate and spacing on seed yield, straw yield, biological yield (q $ha^{-1}$) and harvest index (%)of chickpea.

| Treatments | Seed yield (q/ha) | Straw yield (q/ha) | Biological yield (q/ha) | Harvest index (%) |
|---|---|---|---|---|
| **Seed rate** | | | | |
| 60 kg $ha^{-1}$ | 20.13 | 23.92 | 44.77 | 46.25 |
| 75 kg $ha^{-1}$ | 21.97 | 24.82 | 46.73 | 46.80 |
| 90 kg $ha^{-1}$ | 19.91 | 23.81 | 43.52 | 45.72 |
| SEm± | 0.29 | 0.22 | 0.69 | 0.17 |
| C.D.(5%) | 1.20 | 0.91 | 2.78 | 0.70 |
| **Row spacing** | | | | |
| 20 cm | 19.55 | 22.93 | 42.36 | 45.90 |
| 30 cm | 22.67 | 25.45 | 45.72 | 46.57 |
| 40 cm | 20.91 | 24.17 | 45.04 | 46.29 |
| SEm± | 0.38 | 0.41 | 0.75 | 0.13 |
| C.D.(5%) | 1.19 | 1.28 | 2.35 | 0.40 |

found at par with 40 cm spacing (45.04 q/ha) between the rows was recorded.

**Harvest index**

On the basis of seed rate, the significant increase in harvest index of 46.80% was calculated from plots in which seed rate of 75 kg $ha^{-1}$ was used, which was statistically at par with 60 kg $ha^{-1}$ seed rate. Similar findings were undertaken by Ray *et al*. (2017).On the basis of row spacing, the maximum harvest index (46.57%) 30 cm it was at par with 40 cm row spacing. The similar results were recorded by Mekuaniant *et al*. (2018). The reason may be in case of low seed rate, the seed to biological yield ratio was higher whereas in case of higher seed rate, seed to biological yield ratio was low. As harvest index value is positively correlated with seed yield but has negative correlation with biological yield. Therefore, harvest index was higher in lower seed rate Khan *et al*.(2010).

**Gross return and net return**

The data of present study represented on Table 4 revealed thathighest gross return (Rs. 93040 $ha^{-1}$) and net return (Rs.75882.88 $ha^{-1}$) was noticed significant interaction effect between 75 kg/ha seed rate and spacing of 30 cm between the rows. Likewise, the minimum gross return (Rs. 75320 $ha^{-1}$) was found in 60 kg/ha seed rate and 20 cm row spacing while minimum net return (Rs. 58674.88 $ha^{-1}$) in case of 90 kg/ha seed rate at a spacing of 20 cm.With regards to seed rate, the average highest gross return (Rs.87893 $ha^{-1}$) and net return (Rs. 70735.88 $ha^{-1}$) was found when plot sown at 75 kg seed rate per hectare followed by seed rate of 60 kg/ha and 90 kg/ha, respectively. Similar results were reported by Kumar *et al*. (2020). With regards to row spacing, the average highest gross return (Rs. 86880 $ha^{-1}$) and net return (Rs. 68601.56 $ha^{-1}$) was observed in plot having 30 cm row spacing followed by 40cm and 20 cm row spacing, respectively. It might be due to the fact that maximum yield was observed from the same treatment that is 30 cm spacing (Verma and Pandey, 2008).

**Benefit: Cost ratio**

The data pertaining to the benefit cost ratio of different treatment after the end of experiment have been represented in Table 5, which concluded that highest benefit cost ratio (4.42) was recorded by the interaction effect of 75 kg/ha seed rate and row spacing of 30 cm. The lowest benefit cost ratio (3.19) was appeared in case of seed rate of 90 kg/ha with row spacing of 20 cm.

On the basis of seed rate, the overall maximum benefit cost ratio (4.11) under 75 kg/ha seed rate, which was followed by 60 kg/ha and 90 kg/ha seed rate, respectively. Similar results were quoted by Kumar *et al*. (2015).

On the basis of row spacing, the overallhighest benefit cost ratio (4.05) was observed in the treatments in which 30 cm row spacing was kept. However, it was followed by 40 and 30 cmrow spacing. The above findings were in accordance with Waskle (2017) in which he reported that 30 cm row spacing provided maximum benefit cost ratio (1:6.13).

**Table 4:** Effect of seed rate and spacing on Gross return and net return (Rs. $ha^{-1}$) of chickpea.

| Treatments | 20 cm | 30 cm | 40 cm | Mean |
|---|---|---|---|---|
| | | **Gross return (Rs/ha)** | | |
| 60 kg $ha^{-1}$ | 75320 | 83400 | 82800 | 80506 |
| 75 kg $ha^{-1}$ | 80800 | 93040 | 89840 | 87893 |
| 90 kg $ha^{-1}$ | 77040 | 83600 | 78240 | 79626 |
| Mean | 77720 | 86680 | 83626 | |
| | | **Net return (Rs/ha)** | | |
| 60 kg $ha^{-1}$ | 59294.88 | 67380.00 | 66787.88 | 64487.58 |
| 75 kg $ha^{-1}$ | 63634.88 | 75882.88 | 72689.88 | 70735.88 |
| 90 kg $ha^{-1}$ | 58674.88 | 65241.80 | 59886.88 | 61267.85 |
| Mean | 60534.88 | 68601.56 | 66454.88 | |

**Table 5:** Effect of seed rate and spacing on BCR of chickpea.

| Treatments | BCR | | | |
|---|---|---|---|---|
| | 20 cm | 30 cm | 40 cm | Mean |
| 60 kg $ha^{-1}$ | 3.70 | 4.20 | 4.17 | 4.02 |
| 75 kg $ha^{-1}$ | 3.70 | 4.42 | 4.23 | 4.11 |
| 90 kg $ha^{-1}$ | 3.19 | 3.55 | 3.26 | 3.33 |
| Mean | 3.53 | 4.05 | 3.88 | |

## CONCLUSION

The research concluded that interaction effect between 75 kg/ha seed rate and row spacing of 30 cm in chickpea crop provided superior result under different agronomic parameters such as seed index (g) and also increased biological yield (q/ha), grain yield (q/ha), straw yield (q/ha) and harvest index (%). However, pods per plant and seeds per pod were increased with seed rate of 60 kg/ha and row spacing of 40 cm, resulting in improvement of yield components. On the basis of above observations, it was concluded that 75 kg/ha seed rate with 30 cm row spacing is the optimum planting geometry for better growth and development of chickpea cultivation. Preferably, 75 kg/ha seed rate and inter row spacing of 30 cm are positively recommended to the farmers, as it is beneficial to provide better yield and results under given environmental condition.

**Conflict of interest:** None.

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