

## Original Research Article

### **EFFECT OF ROW SPACING AND GIBBERELIC ACID ON GROWTH AND YIELD OF CHICKPEA (*Cicer arietinum* L.) UNDER RAINFED CONDITIONS**

**ABSTRACT-** A field experiment on chickpea was conducted during *Rabi, 2021* at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). **INDIA**. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.9), organic carbon (0.71%), available N (273.54 kg/ha), available P (31.14 kg/ha), and available K (327 kg/ha). The treatments comprised of spacing (25cm x 10cm, 35cm x 10cm, 45cm x 10cm), and foliar application of *Gibberellic acid* (15, 30, & 45ppm/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated **three times**. The results showed that *viz.* **plant height** (68.91 cm), number of branches per plant (28.19), plant dry weight (27.48 g/plant) were recorded significantly higher with 35 x10 cm + GA3 45ppm/ha. Whereas, crop growth rate (17.68 g/m<sup>2</sup>/day), relative growth rate (0.023 g/g/day) recorded higher in 25 x 10cm + GA3 30ppm/ha. Number of pods per plant (60.04), number of seeds per pod (1.93), seed yield (246.67 kg/ha), haulm yield (5064.53 kg/ha) were recorded significantly higher.

Higher gross returns (1,08,022.50 ₹/ha), net returns (75,676.47 ₹/ha), and benefit-cost ratio (3.33) were obtained with the application of 35 x10 cm + GA3 45ppm/ha. Thus, spacing with foliar application of *Gibberellic acid* (**15, 30 and 45ppm**) could be a promising option for yield enhancement in **chickpea**.

**Keywords:** Row Spacing, *Gibberellic acid*, Chickpea, Growth, and Yield.

## **1. INTRODUCTION**

Pulses are an important part of the Indian diet and provide a significant amount of protein. It is the dried seeds of leguminous plants that are edible. They are nutritionally and economically significant since they contribute to the diets of millions of people around the world. Chickpea (*Cicer arietinum*) is a diploid (2n=16) grain legume crop that grows in a variety of locations, including the Mediterranean, South and West Asia, North America, and North and East Africa. "Chickpea is the fourth largest grain legume crop in the world. In India with a total production of 11.09 million tons from an area of 14.56 million ha and a productivity of 1.31 t/ha. Major producing countries include India, Pakistan, and Iran" (FAO, 2019). Chickpea requirement in India is projected to be around 10.18 million tones by the year 2030, which needs a 4.2% increase in the annual growth rate.

Chickpeas have a specific place in the diet and are used in a range of dishes. It is used in a variety of food dishes as "whole seed," "dal" (decorticated dry split cotyledons), and flour powdered (Besan). Boiling or roasting the whole grain is also an option. Vegetables are made from tender leaves. Cattle feed is made up of the husk and shattered fragments of dried chickpea. The glandular hairs are gathered in an unpleasant liquid state by draping a cloth

over the crop at night to absorb the dew; it contains malic and oxalic acid and is used therapeutically and as vinegar. Due to its high protein content, health benefits, and various domestic uses, there is a wide scope for the production of chickpea for small-scale industries.

“To get rid of protein malnutrition a minimum of 50 g pulses per capita per day should be available in addition to other sources of proteins. To make the nation pulse sufficient, productivity level of pulses, should be increased substantially to 1200 kg per ha” 1. (**Ali and Kumar, 2005**).

Row spacing is one of the important that ultimately affect- nutrient uptake growth and yield of plants. An increase in spacing decreases the total population, but with more nutrition, the individual plants grow better and yield more and vice-versa. The increases or decreases of plant population have a definite pattern about the yield. Row spacing is one of the important characters which can be manipulated to attain the maximum production per unit land area. The optimum row spacing with proper geometry of planting is dependent on variety, its growth habit, and Agro-climatic condition.

“Plant growth regulators are organic compounds which, in small amounts, somehow modify a given physiological plant process. *Gibberellins* (GAs) play an essential role in many aspects of plant growth and development, such as seed germination, stem elongation and flower development” 11 (**Yamaguchi and Kamiya, 2000**). “GA treatments showed an increase in shoot and root length, fresh and dry weight of chickpea, and most florigenic of known plant growth regulators. Plant growth regulators play vital roles in drought tolerance of plants. Under water stress conditions, internal contents of gibberellins, auxins, and cytokinin usually decrease, while those of abscisic acid and ethylene increase” 8. (**Nilsen and Orcutte, 1996**). Gibberellic acids (*Gibberellins*) are naturally occurring plant hormones that are used as plant growth regulators to stimulate both cell division and elongation that affects leaves and stems. Gibberellic acid is a simple gibberellin, a pentacyclic diterpene acid promoting growth and elongation of cells. It affects decomposition of plants and helps plants grow if used in small amounts, but eventually plants develop tolerance to it.

## 2. MATERIALS AND METHODS

The experiment was conducted during the *Rabi* season 2021, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) India which is located at 25° 30' 42" N latitude, 81° 06' 56" E longitude and 98 m altitude above the mean sea level. during *rabi* season 2021 on sandy loam soil, having nearly neutral in soil reaction (pH 7.7), organic carbon (0.44), available nitrogen (171.48 kg/ha K), available phosphorus (27 kg/ha) and available potassium (291.2 kg/ha). The climate of the region is semi- arid subtropical. Under rainfed conditions Treatments comprised of T1– 25 x 10 cm + GA<sub>3</sub> 15 ppm/ha, T2 – 25 x 10 cm + GA<sub>3</sub> 30 ppm/ha, T3 – 25 x 10 cm + GA<sub>3</sub> 45 ppm/ha, T4 – 35 x 10 cm + + GA<sub>3</sub> 15 ppm/ha, T5 - 35 x 10 cm + GA<sub>3</sub> 30 ppm/ha, T6 – 35 x 10 cm + + GA<sub>3</sub> 45 ppm/ha, T7 – 45 x 10 cm + + GA<sub>3</sub> 15 ppm/ha, T8– 45 x 10 cm + GA<sub>3</sub> 30 ppm/ha and T9 – 45 x 10 cm + +

GA<sub>3</sub> 45 ppm/ha. These were replicated **three times** in Randomized Block Design. The recommended dose of fertilizer is **20-40-20** kg/ha NPK. Recommended dose of fertilizer was applied at the time of sowing in the form of Urea, SSP and MOP. **The recommended dosages of urea ,ssp and mop at the of sowing is 14.99gms,86.25gms,11.48gms.**

### 2.1 Chemical analysis of soil

“Composite soil samples are collected before layout of the experiment to determine the initial soil properties. The soil samples are collected from 0-15 cm depth and were dried under shade, powdered with wooden pestle and mortar, passed through 2 mm sieve and were analyzed for organic carbon by rapid titration method” by **7. Nelson (1975)**. Available nitrogen was estimated by alkaline permanganate method by Subbiah and Asija (1956), available **phosphorus** by Olsen’s method as outlined by Jackson (1967), available potassium was determined by using the flame photometer normal ammonium acetate solution and estimating by using flame photometer (ELICO Model) as outlined by **5. Jackson (1973)** and available ZnSO<sub>4</sub> was estimated by Atomic Absorption Spectrophotometer method as outlined by **Lindsay and Norvell (1978)**.

### 2.2 Statistical analysis

“The data recorded were subjected to statistical analysis by adopting Fishers the method of analysis of **variance** (ANOVA) as described” by **Gomez and Gomez (2010)**.

Critical difference (CD) values were calculated the ‘F’ test was found significant at 5% level.

## 3. RESULTS AND DISCUSSION

### 3.1 Plant Height:

There was an increasing in plant height **was** recorded 20,40,60,80,100 DAS and at harvest (**Table 1**) was progressively increased with the advancement during the experimentation. The analysis on plant height was significantly higher in all the different growth intervals with the application of row spacing and gibberellic acid. At harvest, maximum plant height (68.91 cm) was recorded with **the** application of 35×10 cm + GA<sub>3</sub> 45 ppm/ha. which was significantly superior over all other treatments and statistically at par with treatment of spacing 35 x 10 cm + GA<sub>3</sub> 30 ppm/ha (68.82 cm). **4. Iqbal et al. (2001) and Nabi et al.(2006) on spraying with gibberellic acid in chickpea support the result of the present study regarding plant height.**

### 3.2 Number of branches per plant:

There was an increasing in plant height recorded 20,40,60,80,100 DAS and at harvest (**Table 1**) was progressively increased with the advancement during the experimentation. The analysis on number of branches per plant was significantly higher in all the different growth intervals with the application of row spacing and gibberellic acid. At harvest, maximum branches per plant (28.19) was recorded with application of 35×10 cm + GA<sub>3</sub> 45 ppm/ha. which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + GA<sub>3</sub> 45 ppm/ha (28.00).

### 3.3 Number of nodules per plant:

There was an increasing in crop age plant height recorded 20,40,60,80,100 DAS and at harvest (Table 1) was progressively increased with the advancement during the experimentation. The analysis on nodules per plant was significantly higher in all the different growth intervals with the application of row spacing and gibberellic acid. At harvest, maximum nodules per plant (3.78) was recorded with application of 35×10 cm + GA<sub>3</sub> 30 ppm/ha. which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + GA<sub>3</sub> 30 ppm/ha (3.56).

### 3.4 Yield attributes and Yield

Observations regarding the response of spacing 25 × 10 cm, 35 × 10 cm and 45 × 10 cm and gibberellic acid on yield and yield attributes of chickpea. The observation showed that the yield and yield attributes there was significant difference between treatments. (Table 2)

#### 3.4.1 Number of pods/plant

At harvest, significantly higher pods per plant (60.04) was recorded in 35 x10 cm + GA3 45ppm/ha. However, 25 x 10cm + GA3 30ppm/ha, 25 x 10cm + GA3 45ppm/ha, 35 x 10cm + GA3 30ppm/ha statistically at par with 35 x 10cm + GA3 45ppm/ha. Minimum pods per plant (44.88) was recorded in 45 x10 cm + GA3 15ppm/ha. 5. Mazid et.al., (2004).

#### 3.4.2 Number of seeds/ pod

At harvest, significantly higher seeds per pod (1.93) was recorded in 35 x10 cm + GA3 45ppm/ha. Minimum seeds per pod (1.15) was recorded in 45 x10 cm + GA3 15ppm/ha.

#### 3.4.3 Seed Index

At harvest, significantly higher pods per plant (246.67) was recorded in 25 x10 cm + GA3 45ppm/ha. However, 35 x 10cm + GA3 30ppm/ha, 35 x 10cm + GA3 45ppm/ha statistically at par with 25 x 10cm + GA3 45ppm/ha. Minimum pods per plant (144.33) was recorded in 45 x10 cm + GA3 15ppm/ha. 2. Singh et al.(2013) Danesh et al. (2014). (Table 2)

#### 3.4.4 Seed yield (kg/ha)

At harvest, significantly higher pods per plant (2972.69) was recorded in 35 x10 cm + GA3 45ppm/ha. However, 25 x 10cm + GA3 30ppm/ha, 25 x 10cm + GA3 45ppm/ha, 35 x 10cm + GA3 30ppm/ha statistically at par with 35 x 10cm + GA3 45ppm/ha. Minimum pods per plant (2316.51) was recorded in 45 x10 cm + GA3 15ppm/ha. (Table 2)

#### 3.4.5 Haulm yield (kg/ha)

At harvest, significantly higher pods per plant (5064.53) was recorded in 25 x10 cm + GA3 45ppm/ha. However, 25 x 10cm + GA3 30ppm/ha, 35 x 10cm + GA3 45ppm/ha, 35 x 10cm + GA3 30ppm/ha statistically at par with 35 x 10cm + GA3 45ppm/ha. Minimum pods per plant (4810.52) was recorded in 45 x10 cm + GA3 15ppm/ha. (Table 2)

#### 4. Conclusion

It is concluded that the treatment combination of row spacing 35 x10 cm along with GA3 45ppm/ha along with recommended doses was found to be the best that recorded highest plant height, number of branches, number of nodules per plant, more number of pods per plant, number of seeds per pods, highest test weight, seed yield, stover yield. It also fetched the maximum gross return, net return, and benefit cost ratio.

Table:1 Effect of row spacing and gibberellic acid on growth attributes of chickpea.

Treatments	Plant height	AT HARVEST	
		Branches/plant	nodules/plant
25 x 10cm + GA3 15ppm/ha	64.38	23.64	3.17
25 x 10cm + GA3 30ppm/ha	67.24	27.31	3.56
25 x 10cm + GA3 45ppm/ha	68.02	28.00	4.49
35 x 10cm + GA3 15ppm/ha	65.54	25.30	2.92
35 x 10cm + GA3 30ppm/ha	68.82	27.53	3.78
35 x 10cm + GA3 45ppm/ha	68.91	28.19	3.17
45 x 10cm + GA3 15ppm/ha	61.15	21.93	2.76
45 x 10cm + GA3 30ppm/ha	62.94	22.38	3.06
45 x 10cm + GA3 45ppm/ha	67.18	26.87	2.92
F test	S	S	S

SEm±	1.04	0.93	0.771
CD (P = 0.05)	3.08	2.68	0.26

Table:2 Effect of row spacing and gibberellic acid on yield attributes and yield of chickpea.

TREATMENTS	AT HARVEST				
	Pods/plant	seeds/pod	Seed index	seed yield kg/ha	haulm yield kg/ha
25 x 10cm + GA3 15ppm/ha	52.81	1.32	165.88	2498.90	4842.47
25 x 10cm + GA3 30ppm/ha	58.19	1.52	212.00	2827.53	4919.45
25 x 10cm + GA3 45ppm/ha	59.83	1.71	246.67	2914.08	5064.53
35 x 10cm + GA3 15ppm/ha	55.03	1.38	186.38	2568.12	4852.81
35 x 10cm + GA3 30ppm/ha	58.62	1.67	235.19	2871.50	4955.03
35 x 10cm + GA3 45ppm/ha	60.04	1.93	241.55	2972.69	4983.94
45 x 10cm + GA3 15ppm/ha	44.88	1.15	144.33	2316.51	4810.52
45 x 10cm + GA3 30ppm/ha	47.50	1.25	157.92	241.10	4793.06
45 x 10cm + GA3 45ppm/ha	56.42	1.44	201.03	2784.61	4870.00
F test	S	S	S	S	S

SEm±	1.12	0.07	4.01	56.30	59.99
CD (P = 0.05)	3.33	0.20	11.92	167.27	178.23

## 5. References:

1. Ali, M. and S. Kumar (2005). Pules-Yet to see a break through. *The Hindu Survey*.
2. Danesh TS, Mehrafarin A, Naghdi BH, Khalighi SF. Changes in growth and trigonelline/mucilage production of fenugreek *Trigonella foenum-graecum* L. under plant growth regulators application. *Journal of Medicinal Plants*. 2014;13)51(:15-25.
3. Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for agricultural research 2nd edition. *New York, 680p*.
4. Iqbal MZ, Shafiq M, Syed KA. Toxic effects of lead and cadmium individually and in combination on germination and growth of *Leucaena leucocephala* (Lam.) de wit. *Pakistan Journal of Botany*. 2001;33:551-557.
5. Jackson, M.L. (1973). Soil chemical analysis prentice Hall of India Pvt. Ltd., New Delhi. PP56.
6. Mazid M. Seed priming application of gibberellic acid on growth, biochemical, yield attributes and protein status of chickpea (*Cicer arietinum* L. cv. DCP 92-3). *International Journal of Genetic Engineering and Biotechnology*. 2014;5(1):17-22.
7. Nelson, D.W. and Sommers, L.E. 1975. A rapid and accurate procedure for estimation of organic carbon in soil. *Proceedings of Indian Academy of Science* **64**; 1815-1826.
8. Nilsen, E.T., and D.M. Orcutte (1996). Phytohormones and plant responses to stress, in: physiology of plant under stress: abiotic factors, *John Wiley and Sons, New York*, pp. 183–198.
9. Olsen, S.H., Cole, V.V., Watanbe, F.S. and Deean, L.A. (1954). Estimation of available Phosphorus in Soil by extraction with Sodium bicarbonate. *United states Department of Agriculture, circular*, **939**:1-9.
10. Subbiah, B. and Vand Asija, G.L. 1956. A rapid procedure for estimation of available nitrogen in soils. *Current Science*. **25**: 259-260.
11. Yamaguchi, S., and Kamiya, Y. (2000). Gibberellin biosynthesis: Its regulation by endogenous and environmental signals. *Plant and Cell Physiol.*; **41**:251-257.

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