Original Research Article

Effect of plant growth regulators and spacing on growth and yield of Chickpea (*Cicer arietinum* L.).

ABSTRACT

The field experiment was conducted *Rabi* season 2021-2022 to study the "Eeffect of Pplant Ggrowth rRegulators and Sspacing on growth and yield of Cchickpea (*Cicer arietinum*)". At at the Central Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sSandy loam in texture nearly neutral in soil reaction (PH-7.1), low in organic carbon (0.36%) available N (171.49 kg ha^{-1}), available P (15.3 kg ha^{-1}) and available K (232.4 kg ha^{-1}). Chickpea variety PUSA-362, was used. There were 9 treatments each replicated thrice. Treatments consists of 3 three levels of plant growth regulators and three levels of spacing-. The results revealed that growth parameters *viz*., plant height (78.38 cm), no of nodules (4.66), plant dry weight (26.64 g) at harvest were recorded superior with applicated application of GA_3 at 10 ppm + 30 cm x 10 cm Spacingspacing. The yield parameters *viz* No number of pods/plant (65.50), No number of seeds/pod. (1.84), seed yield (2.07 t/ha), stover yield (3.11 t/ha), were recorded with the application of GA_3 at 10 ppm + 30 cm x 10 cm sSpacing.

Key words: *Chickpea, Plant Growth Regulators, Seed yield, Dry weight.*

Introduction

Chickpea (*Cicer arietinum* L.) is one of the most important pulse crops. India has the largest area under pulses. On a global basis, Cchickpea is the third most important pulse crop after …. and ….. (Ref). During 2017-18, gGlobally, it was grown on 149.66 lakh ha area, with the total production of

162.25 lakh tonnes and average productivity of 1252 kg/ha during 2017-18 (Ref). Out of which, 71 per cent of global area with 70 per cent of global production of Cchickpea is contributed by India as it ranks 1st in area and production (Ref) but lags behind several countries in terms of productivity because of poor adoption of improved varieties and production technologies by farmers.

Plant Ggrowth Regulators regulators (PGRs) are the chemicals used to modify plant growth such as increasing branching, suppressing shoot growth, removing excess fruit or altering fruit maturity. Tthey are expected to play an important role in rectifying the hurdles

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in manifestation of biological productivity even in pulse crops. Naphthalene acetic acid (NAA) when it is applied in significant concentrations, promotes adventitious root formation and ~~promotes~~ better rooting activities, thus increasing nutrient absorption (Ref). ~~i~~It also works to promote cell division and cell enlargement, thus enhancing plant growth. Gibberellic acid (GA_3) application increases the plant and first node height and increases cell elongation and division and inter nodal elongation (Islam *et al*. 2021). S~~s~~alicylic acid (SA) promotes reduction in the harmful effects of a biotic and stress, which reflects in the increase in germination percentage, seedlings height, and many physiological processes of plant including flowering, (**Samah *et al.* 2018**).

Optimum plant population density is an important factor to realize the potential yields as it directly affects plant growth and development of chickpea (Gan *et al*. 2003), and different crops like sesame (Islam *et al*. 2008) and groundnut (Islam *et al*. 2011). Earlier studies show that chickpea yields are remarkably stable over a wide range of population densities. The plants are able to fill available space by initiating lateral branches and, thus, can compensate for poor emergence and thin stands. Increasing row spacing significantly influenced of growth, yield attributes and yield characters. Number of plants per unit area influenced plant size, yield components and ultimately the seed yield. Both over and under plant densities resulted significant yield decrease (**Rabish *et al.* 2017**).

However, a very limited works have been carried out regarding the use of plant growth regulators and plant spacing especially in chickpea in our country. To study the effects of plant growth regulators and plant spacing in our climatic condition could provide useful information for the yield improvement of chickpea. Therefore, the present study was under taken to know the effect of plant growth regulators and plant spacing on the growth and yield of chickpea.

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Materials And Methods

The experiment carried out during *Rabi* season of 2021 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.), India. which The site is located at 25° 39' 42''N latitude, 81° 67' 56" E longitude and 98 m altitude above the mean sea level (MSL). The soil texture in the experimental plot was sandy loam, with a practically neutral soil reaction (PH 7.1), low in organic carbon (0.36%), available N (171.49 kg ha^{-1}), available P (15.3 kg ha^{-1}) and available K (232.4 kg ha^{-1}) (Jackson, M.L. (1967). The crop was sown on 25 October 2021 using variety PUSA-362. The experiment was set up in a Randomized Block Design with three replications and nine treatments in total of 27 plots *Viz.*, T_1: NAA at 50 ppm + 20 cm x 10 cm, T_2: NAA at 50 ppm + 30 cm x 10 cm, T_3: NAA at 50 ppm + 30 cm x 10 cm, T_4: GA3 at 10 ppm + 20 cm x 10 cm, T_5: GA3 at 10 ppm + 30 cm x 10 cm, T_6: GA3 at 10 ppm + 40 cm x 10 cm, T_7: Salicylic acid at 100 ppm + 20 cm x 10 cm, T_8: Salicylic acid at 100 ppm + 30 cm x 10 cm and T_9: Salicylic acid at 100 ppm + 40 cm x 10 cm. Urea, single super phosphate (SSP), and muriate of potash (MOP) were applied as a basal dose in all plots, and the treatments were applied as foliar spray at 20 and 40 days following sowing in the corresponding plots. The growth Pparameters were measured at 20, 40, 60, 80, 100, 120 days intervalsafter sowing (DAS), as well as at harvest stage, from randomly selected plants in each treatment. A statistical analysis was performed, and the mean was compared at a 5% probability level of significance (Fisher , R.A. and Yates, F. (1963).

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RESULTS AND DISCUSSION

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Growth parameters

Plant Hheight (Ccm)

At 100 DAS, treatment with GA_3 at 10 ppm + 30 cm x 10 cm was recorded significantly highest plant height (56.84 cm). However, SA at 100 ppm + 20 cm x 10 cm (56.32 cm) was statistically at par with treatment GA_3 at 10 ppm + 30 cm x 10 cm.

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The increase in plant height might be due to the fact that as the spacing among plants decreased the interplant competition for light increased ,while sparsely populated plants intercepted sufficient sunlight that enhanced the lateral growth which were in conformation with the results of **Bavalgave *et al.* (2009), Melak (2018)**.

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Number of nodules per plant (No.)

PGRs and plant spacing significantly influenced the number of nodules per plant. However, the highest number of nodules per plant (23.33) was recorded ~~At 100 DAS, treatment~~ with the treatment of GA_3 at 10 ppm + 30 cm x 10 cm ~~was recorded significantly~~ at 100 DAS, which was statistically similar (22) with~~highest No of nodules/plant (23.33) However,~~ the SA at 100 ppm + 20 cm x 10 cm ~~(22) was statistically an par with treatment GA3 at 10 ppm + 30 cm x 10 cm~~.

The ~~a~~Application of GA_3 increased nodule number in all chickpea varieties at 40, 60 and ~~80 days after sowing~~DAS compared to control condition. From the results of the present study, it was observed that the number of nodules per plant~~-1~~ was higher in all chickpea varieties at 60 ~~days after sowing~~DAS than at 40 ~~days after sowing~~DAS **(Reja *et al.* 2020).**

Dry weight (g/plant)

The ~~At 100 DAS,~~ treatment with GA_3 at 10 ppm + 30 cm x 10 cm ~~was~~ recorded ~~significantly~~ the highest plant dry weight (17.45 g) at 100 DAS, ~~However,~~ which ~~SA at 100 ppm + 20 cm x 10 cm (17.4g)~~ was statistically at par with treatment SA at 100 ppm + 20 cm x 10 cm (17.4g)~~GA3 at 10 ppm + 30 cm x 10 cm~~.

The ~~D~~dry matter production increased steadily with advancing growth stages and reached the maximum at harvest. The dry matter production~~DMP~~ (kg/ha) was found to be more with closer spacing, which could be attributed to higher population and accumulation of nutrients~~/~~ per unit area compared to wider spacing. This is in accordance with earlier findings of **Sathyamoorthi *et al*. (2008)**.

Yield ~~A~~attributes

Number of ~~P~~pods/plant

Maximum number of Pods/plant (65.50) were recorded with the treatment GA3 at 10 ppm + 30 cm x 10 cm which was superior over rest of all treatments. However, SA at 100 ppm + 20 cm x 10 cm(64.86) was statistically at par with treatment GA3 at 10 ppm + 30 cm x 10 cm.

Number of seeds/pod

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Maximum Number of seeds/pod (1.84) were recorded with the treatment GA3 at 10 ppm + 30 cm x 10 cm which was superior over rest of all treatments. However, SA at 100 ppm + 20 cm x 10 cm (1.68) was statistically at par with treatment GA3 at 10 ppm + 30 cm x 10 cm.

Test weight (g)

Maximum Test weight (190.84 g) was recorded with the treatment GA3 at 10 ppm + 30 cm x 10 cm which was superior over rest of all treatments and there is significant difference among the treatments.

Yield and harvest index

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Seed yield (t/ha)

Seed yield (2.07 t/ha) was recorded significantly highest with treatment GA3 at 10 ppm + 30 cm x 10 cm which was superior over rest of all treatments SA at 100 ppm + 20 cm x 10 cm (2.06 t/ha) was statistically at par with treatment GA3 at 10 ppm + 30 cm x 10 cm.

Stover yield (t/ha)

Stover yield (3.11 t/ha) was recorded significantly highest with treatment GA3 at 10 ppm + 30 cm x 10 cm which was superior over rest of all treatments. However, SA at 100 ppm + 20 cm x 10 cm (3.07 t/ha) was statistically at par with treatment GA3 at 10 ppm + 30 cm x 10 cm.

Harvest index (%)

Harvest index (40.19 %) was recorded significantly highest with treatment GA3 at 10 ppm + 30 cm x 10 cm which was superior over rest of all treatments SA at 100 ppm + 20 cm x 10 cm (40.15 %) were statistically at par with treatment GA3 at 10 ppm + 30 cm x 10 cm.

Foliar application of GA3 increased biological yield in all chickpea varieties at different magnitude. Foliar application of GA3 during stem elongation positively affected straw dry matter production as GA3 has a positive regulatory effect on vegetative growth of plant. The increased biological yield might be due to increase of leaf area results in increased photosynthesis rate. Findings concluded by **Nabi *et al.* (2016)** support the results of the present study.

It could be stated that the beneficial effect of GA3 on improving yield might be due to the translocation of more photo assimilates to the seeds.

Harvest index was higher at control condition compared to GA3 applied condition because GA3 had more positive regulatory effect on straw dry matter production than seed yield. GA3 increased the both stover yield and seed yield but the increasing rate was more in stover yield than seed yield **(Reja *et al.* 2020).**

Row spacing had significantly effect on yield attributes viz., number of pods per plant, seed yield per plant and seed index. All these yield attributes were remarkably high with closer row spacing than those with wider row spacing. Number of seeds per pod and harvest index vary with row spacing. Increase in yield might be due to sufficient plant population which caused for higher growth and development along with proper utilization of production inputs and ultimate results was maximum yield was reported by **Neeraj and Pandey (2008).**

CONCLUSION

On the basis of one year experimentation the treatment with application of GA3 at 10 ppm + 30 cm x 10 cm Iron was found to be more productive with higher seed yield (2.07 t/ha).

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Table1: Effect of Plant growth regulators and spacing on Growth parameters in Chickpea.

Treatments	Plant ~~H~~height (cm)	No. of ~~N~~nodules/plant	Dry weight (g/plant)
1. NAA at 50 ppm + 20 cm x 10 cm	50.12	19.66	16.32
2. NAA at 50 ppm + 30 cm x 10 cm	51.64	20.00	16.56
3. NAA at 50 ppm + 40 cm x 10 cm	46.14	18.00	15.23
4. GA3 at 10 ppm + 20 cm x 10 cm	52.46	21.33	17.18
5. GA3 at 10 ppm + 30 cm x 10 cm	56.84	23.33	17.45
6. GA3 at 10 ppm + 40 cm x 10 cm	56.01	20.33	16.84
7. Salicylic acid at 100 ppm + 20 cm x 10 cm	56.32	22.00	17.4
8. Salicylic acid at 100 ppm + 30 cm x 10 cm	47.54	18.67	15.64
9. Salicylic acid at 100 ppm + 40 cm x 10 cm	48.48	19.00	15.87
F-Test	S	S	S
Sem±	0.20	0.60	0.02
CD at 5%	0.60	1.79	0.06

Table 2: Effect of Plant growth regulators and spacing on yield attributes in Chickpea.

Treatments	No. of pods/plant	No. of Sseeds/pod	Test weight	Seed yield (t/ha)	Stover yield (t/ha)	Harvest Hindex(%)
NAA at 50 ppm + 20 cm x 10 cm	59.67	1.28	190.23	2.0	3.50	39.60
NAA at 50 ppm + 30 cm x 10 cm	60.67	1.44	189.71	2.0	3.08	39.37
NAA at 50 ppm + 40 cm x 10 cm	56.67	1.47	189.82	2.0	3.09	39.29
GA3 at 10 ppm + 20 cm x 10 cm	63.67	1.49	189.89	2.04	3.05	40.07
GA3 at 10 ppm + 30 cm x 10 cm	65.50	1.84	190.84	2.07	3.11	40.19
GA3 at 10 ppm + 40 cm x 10 cm	63.18	1.59	190.38	2.00	3.05	39.60
Salicylic acid at 100 ppm + 20 cm x 10 cm	64.86	1.68	189.53	2.06	3.07	40.15
Salicylic acid at 100 ppm + 30 cm x 10 cm	57.33	1.48	190.08	2.03	3.09	39.64
Salicylic acid at 100 ppm + 40 cm x 10 cm	58.67	1.46	190.24	2.00	3.07	39.44
F-Test	S	S	NS	S	S	S
Sem±	0.33	0.05	0.66	0.01	0.01	0.01
CD at 5%	0.99	0.16	-	0.04	0.04	0.03

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