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# Effect of PGR on different stages of chick pea (*Cicer arietinum* L.)

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**Abstract**
Plant growth regulators are one of the most important factors for increasing higher yield in leafy pulses. Application of growth regulators has good management effect on growth and yield of field crops. An experiment was conducted at the experimental field of Student instructional Farm (SIF), Nawabganj, C. S. Azad University of Agriculture & Technology, Kanpur, during the two consecutive years i.e. 2014-15 and 2015-16. A chick pea variety 'Uday' was given foliar spray of GA3, Kinetin, NAA, CCC and IAA as treatment variables to study the growth parameters of chickpea variety. Plant growth characters like crop growth rate (CGR), Relative Growth rate (RGR), net assimilation rate, days to flowering and days to maturity were significantly influenced with different treatment combinations of growth regulators. The maximum increase in CGR was observed by application of IAA 40ppm closely followed by CCC 2000ppm. Maximum RGR observed with application of IAA 20ppm. Maximum assimilation rate was obtained by the treatment of IAA 20ppm.

**Keywords:** effect, PGR morpho-physiological traits, chick pea, *Cicer arietinum* L

## Introduction
Chickpea is the third most important Legume in the world which is grown almost all the countries except Antarctic. This crop is immense of importance in Asia which are growing more than 90 percent of chickpea mainly in the fragile and rainfed ecosystem. India is the largest producer of chickpeas approx 80-90% supply of chickpeas to the world from India. Chana or chickpea is one of the major Rabi pulses crop grown in India. It contributes about 71% to Rabi pulse production and 46% of the total pulse production in India.
Chickpea (*Cicer arietinum* L.) is the world's second largest food legume crop in terms of total production (10.9 million tonnes), which is only next to dry beans (FAO STAT, 2012) [3].
The area under pulses are 24.8 million hectares, production 17.38 million tones. (Economic Survey of Indian Agriculture 2014-15). The important pulse growing states are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh and Andhra Pradesh with together account for 82 % of the production from an area of 74%. Looking at the acreage scenario as of 7th February 2014, the area under which chana has been sown is 102.12 lakh hectares, which is higher than the previous year's figure of 95.07. Also, the current year acreage is 124.30% higher than the normal area of 82.18 lakh hectare. Chickpea production has been rising for the past three years while consumption has been mostly stable in the range of 11 to 12 million tons, According to the Ministry of Agriculture (MOA), the chickpea production in 2013-2014 is estimated to be around 8.66 million tons.
In the year 2013-2014 the likely pulses production is around 18.01 million tons while the Rabi pulse production is expected to decline from 12.54 million tons to 12 million. Chana production is also expected to decline to 8.66 million tons from its previous production of 8.88 million according to the Ministry of Agriculture, India.

## Materials and Methods
The experiments were conducted under field conditions during two rabi seasons viz. 2014-15 and 2015- 16 at Student instructional Farm (SIF), Nawabganj, C. S. Azad University of Agriculture & Technology, Kanpur to examine the effect of applied growth regulators on growth parameters. District Kanpur is situated between rivers Ganga and Yamuna in the central Uttar Pradesh. Geographically it is located at 26.280 North latitude, and 80.250 East longitudes at an elevation of about 127 meters above mean sea level. In the present study, chickpea variety, 'Uday' was taken as experimental materials to find out the response of GA3, Cytokinins, NAA, CCC and IAA on growth parameters of chickpea. The variety was collected from Seed Farm, Kalyanpur, C.S.A.U.A. & T. Kanpur. The experiment was laid out in Ramdomised Block Design (RBD) with 3 replications and 11 treatment combinations.

**Treatment**
**Combination**
**Growth regulators and doses**
V1T1 T1: Control (Unsprayed)
V1T2 T2: GA -20 ppm
V1T3 T3: GA - 40 ppm
V1T4 T4: NAA -20 ppm
V1T5 T5: NAA -40 ppm
V1T6 T6: Kinetin -5 ppm
V1T7 T7: Kinetin -10 ppm
V1T8 T8: IAA -20 ppm
V1T9 T9: IAA- 40 ppm
V1T10 T10: CCC -1000 ppm
V1T11 T11: CCC - 2000 ppm

**Table:** Effect of growth regulators on leaf area ($cm^2$) at different growth stages (2014-15) & (2015-16).

| Treatment | Growth stage (DAS) 2014-15 | | | Growth stage (DAS) 2015-16 | | |
|---|---|---|---|---|---|---|
| | 45 | 70 | 95 | 45 | 70 | 95 |
| Control | 91.45 | 493.77 | 541.21 | 91.55 | 494.48 | 541.92 |
| GA-20 ppm | 101.15 | 519.50 | 561.96 | 101.60 | 519.70 | 562.37 |
| GA-40 ppm | 106.35 | 521.03 | 564.20 | 107.20 | 522.52 | 566.90 |
| NAA-20 ppm | 109.75 | 524.64 | 580.33 | 110.40 | 524.84 | 581.82 |
| NAA-40 ppm | 112.09 | 525.62 | 595.69 | 112.25 | 526.51 | 596.54 |
| Kinetin-5 ppm | 95.18 | 504.34 | 548.84 | 95.50 | 504.87 | 550.22 |
| Kinetin-10 ppm | 98.06 | 514.08 | 556.27 | 98.79 | 514.38 | 557.48 |
| IAA-20 ppm | 113.98 | 528.29 | 640.50 | 114.76 | 529.63 | 642.20 |
| IAA-40 ppm | 122.83 | 573.97 | 681.93 | 123.58 | 574.68 | 681.93 |
| CCC-1000 ppm | 116.33 | 539.00 | 652.40 | 116.94 | 539.44 | 653.24 |
| CCC-2000 ppm | 118.56 | 563.93 | 665.95 | 119.15 | 564.75 | 666.74 |
| SE (d)± | 0.452 | 0.528 | 0.338 | 0.210 | 0.401 | 0.294 |
| CD at 5% | 0.950 | 1.110 | 0.711 | 0.440 | 0.843 | 0.617 |

**Table:** Effect of Growth regulators on total plant dry weight (g) per plant at different growth stages (2014-15).

| Treatment | Growth Stage (DAS) | | | | |
|---|---|---|---|---|---|
| | 45 | 70 | 95 | 120 | 145 |
| Control | 0.70 | 6.45 | 12.55 | 21.90 | 45.50 |
| GA-20 ppm | 0.75 | 7.46 | 13.85 | 24.20 | 48.30 |
| GA-40 ppm | 0.77 | 7.51 | 14.05 | 24.60 | 48.70 |
| NAA-20 ppm | 0.79 | 7.65 | 14.65 | 25.50 | 49.50 |
| NAA-40 ppm | 0.81 | 7.80 | 15.40 | 26.30 | 50.95 |
| Kinetin-5 ppm | 0.84 | 7.30 | 13.20 | 22.50 | 47.20 |
| Kinetin-10 ppm | 0.82 | 7.40 | 13.42 | 22.90 | 47.65 |
| IAA-20 ppm | 0.81 | 8.13 | 16.10 | 29.00 | 51.85 |
| IAA-40 ppm | 0.87 | 8.50 | 16.80 | 30.70 | 54.60 |
| CCC-1000 ppm | 0.85 | 8.22 | 16.45 | 29.35 | 52.35 |
| CCC-2000 ppm | 0.86 | 8.33 | 16.60 | 29.70 | 52.46 |
| SE (d)± | 0.0258 | 0.0816 | 0.0516 | 0.4959 | 0.6703 |
| CD at 5% | 0.0562 | 0.1670 | 0.1101 | 1.0349 | 1.3991 |

**Table:** Effect of growth regulators on net assimilation rate ($mg/dm^2/day$) between different growth stages during (2014-15) and (2015-16).

| Treatment | Growth Stage (DAS) | | | |
|---|---|---|---|---|
| | 2014-15 | | 2015-16 | |
| | 45-70 | 70-95 | 45-70 | 70-95 |
| Control | 97.97 | 48.73 | 98.72 | 47.65 |
| GA-20 ppm | 107.20 | 49.18 | 106.97 | 47.85 |
| GA-40 ppm | 105.54 | 49.66 | 105.71 | 48.71 |
| NAA-20 ppm | 105.11 | 46.35 | 104.84 | 50.97 |
| NAA-40 ppm | 106.42 | 52.31 | 106.61 | 54.18 |
| Kinetin-5 ppm | 107.58 | 55.96 | 107.86 | 45.05 |
| Kinetin-10 ppm | 105.91 | 46.51 | 105.60 | 45.29 |
| IAA-20 ppm | 110.45 | 57.13 | 109.62 | 55.45 |
| IAA-40 ppm | 106.21 | 54.48 | 105.95 | 53.12 |
| CCC-1000 ppm | 109.54 | 56.27 | 109.08 | 54.10 |
| CCC-2000 ppm | 106.93 | 55.42 | 106.71 | 41.27 |
| SE (d)± | 0.040 | 0.701 | 0.059 | 0.050 |
| CD at 5% | 0.084 | 1.463 | 0.124 | 0.106 |

## Results and Discussion

Application of growth regulators considerably increased leaf area per plant at all the growth stages during both the years of experimentation. At all growth stages, maximum leaf area per plant was obtained by the treatment of IAA 40ppm followed by CCC 2000ppm. Whereas, kinetin 5 ppm had least position in this respect.

Dry matter production of whole plant at successive stages of growth showed favourable effect of all the growth regulator treatments during both the years of experimentation. Maximum dry matter accumulation was recorded under the treatment of IAA 40ppm closely followed by CCC 2000ppm. Whereas, kinetin 5 ppm was found to be least responsive. Maximum leaf and stem dry weight was recorded with IAA 40 ppm at successive growth stages followed by CCC 2000ppm.

Data indicated that treatments showed a significant increase in net assimilation rate activity, at all the stages of observation over control. Thus maximum increase in net assimilation rate was obtained by the treatment under IAA 20ppm was closely followed by CCC 1000ppm branching and flowering stage during both the years of experimentation.

The maximum increase in total chlorophyll intensity was recorded with IAA 40ppm followed by kinetin 10ppm at pre and post anthesis stages, with the advancement content showed a general decline under all treatments. On the other hand, GA 20ppm gave least response in this respect.

Growth regulators showed significantly superior leaf area in all the concentrations as compared with kinetin 5 and 10 ppm. Leaf area affected by the different concentrations of phytohormones in chickpea. Maximum leaf area found in IAA 40 ppm, it improves the transport mechanism and utilization process for stimulation of leaf growth. The effect of IAA 40 ppm was found more significant than cycocel 1000 and 2000 ppm. All the growth regulators stimulated significantly the leaf area at successive stages of growth. Similar findings are reported by Alam, Haider, 2006, Zajac *et al.*, 2005; Yasari, Patwardhan, 2006).

Vegetative growth of the plant (dry weight of whole plant, leaf and stem) did not show any remarkable effect at early stage, but with the advancement of plant age, all the plant organs, were influenced by the application of these growth regulators. IAA 40 ppm gave maximum dry weight in all plant parts at every stage, which indicates that the

photosynthetic efficiency of leaves had been augmented and increase in the rate of transport of dry matter from the above ground plant parts to grains by the treatments. This was followed by CCC 2000 ppm and CCC 1000 ppm gave least response during both the years of experimentation.

The higher dry biomass achieved with foliar application of IAA 40ppm at all stages of crop which might be due to stem elongation, increase in cell size of leaves and another possible growth factors as influenced by CCC application. Foliar spray of growth regulators enhanced the cell division, higher chloroplast development and protein synthesis that may increase photosynthetic activity and other metabolites which in turn increased total dry biomass per plant. This is further supported by Neelam *et al.* (2006) reported that there was reversal effect of salinity stress on moth bean seedlings by gibberellic acid and IAA.

Net assimilation rate is high at the early vegetative stages and sharply declines as the plant experiences increasing age (Fig. 5.9). When all leaves are exposed to full sunlight NAR remains to be highest. It also remains high when plants are small and there are few leaves to get the maximum sunlight without shading effects. Thus maximum net assimilation rate was obtained by the treatments under IAA 20ppm was closely followed by CCC 1000ppm at branching and flowering stage during both the years of experimentation.

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