PROMOTORY EFFECTS OF SOME PLANT GROWTH REGULATORS (PGR_S) ON MORPHOLOGICAL PARAMETERS OF CICER ARIETINUM

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Abstract: The present study deals with the promotory effects of plant growth regulators on *Cicer arietinum.* Plant hormones play a crucial role in controlling the way in which plants grow and develop.While metabolism provides the power and building blocks for plant life. Plant growth hormones are set of biochemical secretions inside the plant and its parts which regulate the growth, enlargement, multiplication of the tissues and cells. They control the rate and extent of plant growth starting from seed germination, after growth, flowering, fruit formation, ripening, wilting, falling of leaves etc. However, the marked mitigatory impacts have been noted upon exposure to treatments.

Keywords: *Cicer arietinum, IAA, GA3, cytokinin.*

Introduction: Hormones are chemical signals that coordinate the different parts of an organism. The word hormone comes from a Greek word that means to excite. These chemicals are produced in very small amounts in one area of a plant and are then sent to another part where a response is triggered. It has been well established that the plant growth regulators (PGRs), influence the growth and development of plants. These chemical substances are able to coordinate growth among different plant parts or different physiological & biochemical processes. These are chemical substances known as hormone or phytohormone. The PGRs have been found to play a central role in the integration of the responses expressed by plants. The main naturally occurring plant growth hormones viz. IAA, Kn and GA_3 are able to control many of the physiological processes involved in the plant development. Plant growth regulators

have been tried to improve growth and ultimately yield (Ram *et al*., (1973); Patil *et al*., (1987) and Kumar *et al*., (1996), tried to various growth regulators to obtain better yield of good quality heads in cabbage and obtained encouraging results. The maturity of the vegetable crops is hastened, due to the application of plant growth regulators (Buckovac & Wittwer, (1957) & Chnonkar & Jha, (1963). The importance of plant growth regulators also in the plant tissue culture is well documented. Auxin is tested for the enhancement of callus growth or root initiation *in vitro*. Cytokinin is tested for stimulation of shoot production. Auxins are generally also used in plant cell culture. When added in the appropriate concentrations they may regulate cell elongation, tissue swelling and cell division, formation of adventitious roots and inhibition of adventitious and axillary shoot formation, callus initiation, growth & induction of embryogenesis. Cytokinins are generally stimulating auxiliary and adventitious shoot proliferation, regulate differentiation, stimulate root formation, activate RNA synthesis and stimulate protein & enzyme activity. Gibberellins are generally used to promote stem elongation, flowering and breaking dormancy of seeds, buds & bulbs. There are over 90 forms of gibberellins, but GA_3 is the most commonly used form (*Phyto*-Technology Laboratories (2011). Hormones such as Cytokinins, Gibberellins & Auxins are chemicals that regulate and stimulate the plant growth. As such, they shape the plant and affect seed growth, time of flowering, sex of flowers and the senescence of leaves and fruits. Also, they affect the tissues that grow upward and downward, the formation of the leaf and the growth of the stem (Helgi-opik and Stephen, 2005). Cytokinins which include 6-Benzylamino Purine (BAP) and Zeatin are group of the chemicals that influence cell division & shoot formation. Plants need hormones at very specific times, during the plant growth and at specific locations (Helgi-opik & Stephen *et al.*, 2005)

Materials and methods: Certified seeds used to generate study plants were collected from Seed centre of Indian Agriculture research Institute (IARI), PUSA New Delhi India. The field for the cultivation was prepared before sowing of the seeds, as proposed by Dhasmana (1984). The pre-soaked were sown in the experimental field plots. The general experimental Studies of different treatments were laid after complete germination of Cicer arietinum crop as reported by Kumar (1981), N. Bhatt (2004) and Gupta A (2011) . The s.d was also taken and measured.

Seed Germination and seedling Growth: For the studies of seed germination and seedling growth patterns, uniform seeds of *Cicer arietinum were* selected and surface sterilized by absolute ethyl alcohol and then 0.1% $HgCl_2$ for the one minute each thoroughly rinsed with distilled water. Total seeds of both the species of leguminous crops were divided into twenty six sets separately, except control. Two sets of both species were treated as control and placed in the incubator, without any treatment. Each species of leguminous crop viz. *Cicer aritinum was* treated with GA_3 and Kn concentrations of (10^{-2} to 10^{-7}M) respectively.

Six sets of seeds of *Cicer arietinum* were soaked in GA_3 solution of (10^{-2} to 10^{-7}M) concentrations as compared to control. Out of total next six sets were treated with Kn (10^{-2} to 10^{-7}M) concentrations with respect to the control. In the laboratory study, all the sets of Petridishes were supplied with appropriate concentrations of these plant growth regulators (PGRs) daily, except control. These sets were supplied with distilled water daily. The germination percentage was recorded on the basis of radicle emergence as 2 mm in length and is considered as germinated.

GERMINATION PERCENTAGE:

The present study was showed to determine the promotory impact of PGRs on the seed germination. It is an estimate of the viability of a population of seeds and a measure of the time course of seed germination. After an interval of 24 hours seeds were counted and at the end of fifteen days the total numbers of seeds were added for the calculation of germination percentage as follows:

$$\mathbf{GP} = \frac{\textbf{Number of germinated seeds}}{\textbf{Total number of sown seed}} \times \mathbf{100}$$

SURVIVAL PERCENTAGE:

Survival is the struggle to remain alive and living. Survival rate is a part of survival analysis, indicating the percentage of seeds in a study group, who are alive for a given period of time after germination.

$$SP = \frac{\text{Number of Seed Survived}}{\text{Total Number of Germinated seed}} \times 100$$

MORTALITY PERCENTAGE:

Mortality is an estimate to account for seeds that germinate, but fails to develop in to viable plants. There are many reasons for seeds mortality including disease, insects and excessive fertilizer into the seed row, improper seedling depth, light, temeperature, frost and drought due to which seedling mortality can vary greatly.

$$MP = \frac{\text{Number of Dead Seed}}{\text{Total number of germinated seed}} \times 100$$

Result:

During laboratory study to evaluate the appropriate concentrations of different plant growth regulators (PGR_S) for the field study and the seeds of species of leguminous crop were grown in Petridishes. The seeds of *Cicer arietinum* were treated with Kn & GA_3, in their appropriate concentrations i.e. (10^{-7}) to (10^{-2} M) individually and it was observed that the GA_3 was found most effective in (10^{-7} M) and Kn in (10^{-3} M) in *Cicer arietinum.* These concentarions were identified on the basis of the maximum germination & survival and reduced mortality percentages with respect to the control. Therefore, for the field studies, only these concentrations were taken to assess the comparative impacts of these PGRs over control. Plot-A was taken as control (untreated). Plot-B was treated daily with GA_3 (10^{-7} M). Plot-C was sprayed daily with Kn (10^{-3} M). Plot-D was sprayed with GA_3 (10^{-6} M) and Plot-E was also sprayed with Kn (10^{-3} M) with respect to the control. The above treatments were given to species of leguminous crop such as *Cicer arietinum.*

Seed Germination, survival and Mortality:

Seed germination, survival and mortality percentages of *Cicer arietinum* in control were recorded as ca. 86%, 80% and 20% respectively. When any one of these growth regulator was given to the germinating seeds, the significant germination, survival and less mortality percentage were amounted as ca. 71%, 86% and 14% for GA_3 (10^{-2} M) concentration; 88%, 84% and 16% for GA_3 (10^{-3} M) concentration; 70%, 82% and 18% for GA_3 (10^{-4} M) concentration; 89%, 79% and 21% for GA_3 (10^{-5} M) concentration; 72%, 88%

and 12% for GA_3(10^{-6} M) concentration and maximum germination, survival and minimum mortality percentages were noted to be ca. 92%, 78% and 22% for GA_3 (10^{-7} M) concentrations respectively, as compared to the control.

Growth Regulators: Plant growth regulator was given to seeds, the significant germination and survival percentages were increased and mortality percentage was reduced and amounted to be ca. 84%, 81% and 19% for Kn (10^{-2} M) concentration; maximum germination, survival and minimum mortality percentage was noted to be ca. 95%, 82% and 18% for Kn (10^{-3} M) concentration; ca.72%, 78% and 22% for Kn (10^{-4} M) concentration,70%, 73% and 27% for Kn (10^{-5} M) concentration; ca. 72%, 74% and 24% for Kn (10^{-6} M) concentration and ca. 86%, 83% and 17% for Kn (10^{-7} M) concentrations respectively, as compared to the control. Germination, survival and mortality percentages of *Cicer arietinum* were observed to be ca. 88%, 84% & 16% respectively, during control. When any one of the plant growth regulators (PGR_S) were supplied to the geminating seeds, the significant promotion was observed in case of germination and survival percentages and mortality percentage was reduced to be ca. 94%, 89% and 10% for GA_3 (10^{-2} M); 95%, 88% & 12% for GA_3 (10^{-3} M); 89%, 81% & 19% for GA_3 (10^{-4} M); 91%, 86% & 14% for GA_3 (10^{-5} M); maximum germination, survival and minimum mortality percentages were recorded to be ca. 95%, 90% & 10% for GA_3 (10^{-6} M) and 93%, 89% & 11% for GA_3 (10^{-7} M) concentrations respectively, with respect to the control. Significant values of germination and survival percentage were increased with different concentrations of Kn and it was reduced mortality percentage as compared to the control. The maximum values of seed germination, survival and minimum mortality percentages were observed to be ca. 90%, 82% and 18% for Kn (10^{-2} M) concentration. The significant enhancement of germination, survival and reduced mortality percentages were amounted to be ca. 89%, 81% and 19% for Kn (10^{-3} M); ca. 84%, 81% and 19% for Kn (10^{-4} M); ca. 90%, 79% and 21% for Kn (10^{-5} M); ca. 86%, 82% and 18% for Kn (10^{-6} M) and ca. 80%, 82% & 18% for Kn (10^{-7} M) concentrations respectively, as compared to the control. Therefore in the laboratory condition, when germinating seeds were subjected to these PGRs in its physiological range i.e. GA_3 (10^{-7} M) and Kn (10^{-3} M) concentration, the maximum values of germination and survival percentages were increased and mortality percentage was reduced in *Cicer arietinum*

respectively, as compared to control. In case of GA_3 (10^{-6} M) and Kn (10^{-2} M) concentration. During laboratory condition, after 15 days of seedlings growth to evaluate the significant and maximum promotory effects of different concentrations of plant growth regulators (PGRs) were noted on the seedlings growth of *Cicer arietinum* respectively as compared to control. Therefore, seedlings of *leguminous* species were treated by different concentrations of plant growth regulators from 10^{-2} M to 10^{-7} M; the significant or maximum promotion was recorded in all the parameters such as epicotyl, hypocotyl & radicle of the *Cicer arietinum* respectively. In case of the *Cicer arietinum* (Chick pea), when GA_3 and Kn concentrations were applied, the significant and maximum promotory effects were reported on the epicotyl, hypocotyls & radicle, during the laboratory study, as compared to the control. GA_3 (10^{-2} M) concentration was showed maximum enhancement in term of dry weight of hypocotyls and increased by as ca. 100%; with GA_3 (10^{-3} M) concentration, the dry weight of epicotyl of *Cicer arietinum* was augmented by ca. 33% and GA_3 (10^{-4} M) concentration was taken, it was showed maximum enhancement in the fresh and dry weight of hypocotyl was improved by as ca. 24% & 50% with respect to the control. The seedlings were sprayed with GA_3 (10^{-5} M) concentration, it was showed that the dry weight of hypocotyl of *Cicer arietinum* was increased by ca. 50%; with GA_3 (10^{-6} M) concentration, the dry weight of hypocotyls and length of the redicle was showed maximum promotion to be increased by ca. 50% & 5% and GA_3 (10^{-7} M) concentration was showed maximum enhancement in the dry weight of the hypocotyls to be improved by ca. 50% with respect to the control. The dry weight of epicotyl of *Cicer arietinum* with Kn (10^{-2} M) concentration, it was showed maximum enhancement to be increased by as ca. 33% and dry weight of hypocotyls was increased by as ca. 50%; fresh and dry weight of epicotyl with Kn (10^{-3} M) concentration, it was showed maximum promotory effects to be increased by ca. 25% & 66% respectively, with respect to the control. The fresh and dry weight of epicotyl and dry weight of hypocotyl with the concentration of Kn (10^{-4} M) was showed imperative enhancement to be increased by as ca. 3%, 33% & 50% respectly, with respect to the control. Seedlings of the *Cicer arietinum* were treated with the concentration of Kn (10^{-5}M), the maximum fresh and dry weight of epicotyl & dry weight of hypocotyl was reported to be enhanced by ca. 12%, 50% & 50%; Kn (10^{-6} M) concentration was applied, the maximum fresh and dry weight of epicotyl were increased by as ca. 12% & 66% respectly as compared to the control. The seedlings were spryed with Kn (10^{-7} M)

concentration, the maximum promotion was noted in the dry weight of epicotyl, fresh & dry weight of hypocotyl to be enhanced by as ca. 33%, 8% and 50% respectively, with respect to the control. When seedlings were subjected to these PGRs, such as Kn and GA_3 concentrations, the values of length, fresh and dry weight of epicotyls, hypocotyls and radicle were identified significant and maximum with different concentrations of the plant growth regulators (PGRs) in *Cicer arietinum* respectively, as compared to the control.While the plants of plot-(D) were sprayed to GA_3 (10^{-7} M) concentration, the maximum promotion was observed on length, fresh and dry weight of roots of the *Cicer arietinum* were noted at the 15th, 30th, 45th, 60th and at the 75th day stage of growth and an increased by ca. 30%, 46%, 25%; 65%, 81%, 28%; 9%, 8%, 21%; 35%, 22%, 16% and at the maturity 55%, 13%, 9% respectly, with respect to the control plot. The root growth patterns was also carried out from the 15th day stage up to maturity, in terms of length, fresh and dry weight (g/pl) and data were depicted in the table 4.4 and fig. 4.4. In the control plot, the value of length, fresh and dry weight of root was found at the 15th day stages of growth and recorded as ca. 6.02, 0.21, 0.02 respectively and observed to be increased continuously up to maturity. When these plants were sprayed to plant growth regulators such as GA_3 and Kn daily, the promotion were also found in these considered parameters with respect to the control condition.

Table 1: **Seed germination, survival and mortality percentage of *Cicer arietinum* (Chick pea) in control and treated by different concentrations of Kn & GA_3 (PGRs), after 15 days of sowing.**

Treatments	Germination %	Survival %	Mortality %
Control	88	84	16
Light exposure	79	73	27
GA_3 (10^{-7}) M	93	89	11
GA_3 (10^{-6}) M	95	90	10
GA_3 (10^{-5}) M	91	86	14
GA_3 (10^{-4}) M	89	81	19
GA_3 (10^{-3}) M	95	88	12

GA_3 (10^{-2}) M	94	89		11	
Kn (10^{-7}) M	89	80		20	
Kn (10^{-6}) M	87	80		20	
Kn (10^{-5}) M	90		79	21	
Kn (10^{-4}) M	84	81			19
Kn (10^{-3}) M	89	81		19	
Kn (10^{-2}) M	90	82		18	

CONCLUSION:

In the laboratory study, when germinating seedlings were subjected to plant growth regulators (PGRs) in its physiological range i.e. (10^{-2} to 10^{-7} M) concentrations of the GA_3 & Kn, the maximum germination and survival percentages were increased & mortality percentage was reduced in the appropriate concentrations of the GA_3 (10^{-6} & 10^{-7}M) on the *Cicer arietinum* and Kn (10^{-2} & 10^{-3}M) as compared to control.The seedlings of the *Cicer arietinum* were treated with the GA_3 (10^{-3} M) concentartion, it was showed that the maximum fresh and dry weight of the epicotyls were increased by ca. 2% & 33% with respect to control. In the concentration of GA_3 (10^{-4} M), it was noted that the maximum enhancement in the fresh and dry weight of hypocotyls and radicle was improved as 33% & 56% respectively, with respect to the control. Maximum

promotion was recorded in the fresh & dry weight of epicotyls with the concentrations of Kn (10^{-3} M) & (10^{-5} M) and augmented by as ca. 45% 66% respectively, with respect to the control. The maximum promotion was also observed in the length of radicle with the concentration of GA_3 (10^{-5} M), it was improved by ca. 5% with respect to the control. In case of Kinetin (10^{-3} M) concentration, the fresh & dry weight of epicotyl was enhanced by as ca. 25% & 50% respectively, over control. The maximum promotions were reported in the fresh & dry weight of the epicotyls and improved by as ca. 25%, 50%, 8% and 50% with the concentrations of the Kinetin viz. (10^{-3} M) and (10^{-7} M) respectively, with respect to the control. The further experiments were conducted in the field plots by sprayed different concentrations of plant growth regulators, which showed maximum germination percentage and reduced mortality percentages in the laboratory conditions i.e. GA_3 (10^{-7}M) and Kn (10^{-3} M) concentrations on Cicer arietinum respectively. The two plots for the control, two plot for the GA_3 (10^{-6} & 10^{-7}) M concentration and two plots were selected for the Kn (10^{-2} and 10^{-3}) separately.

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