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Full Length Research Paper

Promotory Effects of Some Phytohormone on the Stem Growth Patterns of *Pisum sativum* (Pea) over the Control

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Abstract

Seeds of Pisum sativum (Pea) were treated in the laboratory by different concentrations of Kn (10^{-7} M), (10^{-6} M), (10^{-5} M), (10^{-4} M), (10^{-3} M), (10^{-2} M)) & GA_3 (10^{-7} M), (10^{-6} M), (10^{-5} M), (10^{-4} M) & (10^{-3} M) respectively & observed maximum result as compared to control petridish. In which, the concentrations of GA_3 (10^{-6} M) & Kn (10^{-3} M) were showed maximum germination, survival & reduced mortality percentage of Pisum sativum as compared to control petridish. For the further field studies, the seeds of Pisum sativum were sown in sandy loam soil in different plots for the treatments of such appropriate concentrations such as GA_3 (10^{-6} M) & Kn (10^{-3} M) in the field plots. For the growth analysis the plants of Pisum sativum, were taken regularly and randomly at the 15 days interval from the seedling emergence stage till to maturity. The length of Pisum sativum stem (Pea) was observed with these two concentrations of plant hormones showed the maximum stem length of the Pisum sativum as compared to the control plot.

Keywords: *Pisum sativum, Stem, GA_3 and Kn hormone.*

Introduction

The earth is surrounded by a cover of gases as atmosphere; this atmosphere allows most of the electromagnetic radiation to pass through, which reaches the surface of earth. This light or rays from the sun is absorbed by the earth surface & converts it into heat energy. This heat energy is re-emitted by the surface of the earth during night. Due to excessive presence of some gases in the atmosphere, this escape of heat from earth surface is prevented, resulting in heating of earth called global warming. The gases which are responsible for causing global warming are called green-house gasses. The harmful effects of green-house gasses in the atmosphere are causing global warming, climate change, ozone depletion, sea level rise, adverse effects on agricultural crop as well as on the whole biological system. This is very useful information provided as it will help people to get aware of environmental problems & issues being faced worldwide. Though there are certain people that are helping to preserve environment. But only few people can't do anything (Partha Das Sharma'S *et al.,* 2008).

Inrease in penetration of ultraviolet radiation to terrestrial surface as a consequence of depletion of the stratospheric ozone layer has received much globle concern 10% depletion in stratospheric ozone corresponds to a 20% increase in the flounce of biological damaging UV-radiation (Baker & Allen *et al.,* 1994). Enhanced UV-radiation can deleteriously affect overall growth and biomass accumulation of the plant species (Tevini, 2000). The plants contain a large number of ultraviolet exposure sensitive targets such as nucleic acids, lipids, proteins (Jordon, 1996), which must be protected to ensure the normal growth & development of plants.

Plant growth hormonoes influence the growth and development of plants; these chemical substances are able to coordinate growth among different plant parts or different physiological & biochemical processes are known as phytohormone. Cytokinins (Kn) are generally stimulating auxiliary & adventitious shoot proliferation, regulate differentiation, stimulate root formation, activate RNA synthesis & stimulate protein & enzyme activity. Gibberellins are generally used to promote stem elongation, flowering & 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). The plant growth hormones are affect seed growth and development, time of flowering, sex of flowers and senescence of leaves & fruits. Also, they affect the tissues that grow upward & downward, the formation of the leaf and the growth of 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 plant growth and at specific locations (Helgi-opik & Stephen *et al.,* 2005). A large number of related chemical compounds synthesized in the laboratory that function as hormones are called plant growth regulators.The concentration of hormones required for plant responses at the very low concentrations (Srivastava *et al.,* 2002). Plant hormones affect gene expression and transcription levels, cellular division and growth. The hormones have positive and inhibitory functions, and they often work in tandem with each other (Rost and Eliot *et al.,* 1979). Function of cytokinin in seed germination was also observed by Khan and Tao *et al.,* (1978). The overall growth of plant was

improved by the plant growth hormone treatments, when it was compared to the control, because these treatments significantly, increase all plant growth parameters. Increased vegetative growth of the plants nourished and developed in a better manner, than without treatment plants. Kn & GA_3, which are important plant growth hormones and has a thoughtful effect on the crop production, through increase in the stem length, leaf area, flower induction, yield, weight & size of the crops. Kinetin used as seed treatment or foliar spray individually or in combination, increased the seed yield by 26%, while foliar spray increased it by 43.6% over control. Kinetin (Kn) also affected two important plant processes viz. photosynthesis and nitrogen metabolism. Net photosynthetic rate and nitrate reductase activity are significantly increased in the plant treated with kinetin. Significant increase in the content of the total chlorophyll with kinetin application as also reported by (Khalil & Mandurahi *et al.,* (1989) may also be responsible for the increase of photosynthesis (Gzik *et al*., 1987).

Concentrations of starch soluble protein & free amino acids were found maximum, when kinetin was applied both as seed treatment and foliar spray. This could be due to kinetin mediated increase in photosynthetic & nitrate assimilation activity, besides decrease in protease activity and immobilization of nutrients and metabolites from Kn treated tissues as observed by Kumari & Bharti *et al.,* (1992). Auxins and gibberellins (White *et* al., 1975; Jones and Phillips, 1966) produced by the apical bud as well as by the leaves and both hormones have been suggested to be growth factors, which might regulate growth (Thimann *et al.,* 1997).

Application of Kn was associated with a high Harvest Index (HI), thereby, indicating partitioning of more photosynthates towards seeds. Significantly higher seed yield in Kn treated plants also led to higher water use efficiency observed by Blackman & Davies *et al.,* (1985). In a series of experiments, Mok (1994) observed that a large number of plant developmental processes have been found to be influenced by the cytokinin effect on cell expansion, inhibition of leaf senescence, chloroplast development, root and shoot branching. Nagel *et al.,* (2001) have evaluated that cytokinin application plays a significant role in the flower production and exerted a positive effect on the yield of soybean, thus increasing the total seed production. Skoog and Miller *et al.,* (1959) evaluated that the ratio of cytokinin in nutrient media profoundly influences the morphogenesis of roots and shoots.

The uses of plant growth hormones as a way of improving plant yield through micro-propagation and somatic embryogenesis. Improved and disease resistant crops could easily be made available to farmers, if the use of synthetic growth hormones for plantlet regeneration is vigorously pursued. The hormones like auxins, cytokinines & gibberellins could be made available at reduced cost to users for rapid multiplication of cultivated crops observed by Gana, A. S, (2010). Cytokinin enhance the cell expension in soyabean and increased stem thickness, while Kinetin reduces shoot length, but increased the fresh weight by increasing stem diameter (Chaudhry and Khan *et al.,* 2000).

GA_3 is produces by the apical bud (Jones & Phillips (1996), thus, it is conceivable that internode elongation is modulated by the apex by way of effects of GA_3 on cell division on one hand and by their synergistic effects on cell elongation on the other. Effects of GA_3 in dwarf pea, enhanced internode elongation, when applied separately (Arney & Mancinelli *et al.,* 1967). Role of gibberillic acid in seed germination is also well established. Exogenous GA_3 stimulates amylase activity. Aleurone layer of endosperm is sensitive to GA_3 hormone. GA_3 also cause release of enzyme amylase and protease, these enzymes participate in the break down of stored starch to simple sugars then sugar translocated to grow in embryo, where they provide energy for growth. Thus GA_3 enhance seed germination. In the dwarf pea (Brian & Hemming *et al.,* (1958) and in cucumber (Sandhu & Kasper Baver *et al.,* (1974) were observed that the IAA and GA_3, both hormones are promoted internode elongation. Gibberellins have been observed to influence the carbohydrate status in many plant species (Canomedrano *et al.,* (1997) and Yim *et al.,* (1997). Gibberellin has the characteristic property to improve the yield, plant height and flower induction in the *chrysanthemum* (Mohariya *et. al.,* 2003). Pharis and King *et al.,* (1985) observed that the GA_3 play a major role in the development of fruit set and plant height was increased by GA_3 hormones.

During field study, it has been demonstrated by Yadav *et al.,* (2005) that the growth promoters significantly improved growth & yield of rice. A lot of work has been done on the effects of growth substances on different parameters of plant growth & development by Bahuguna *et al.,* (1988). Shah and Samiullah (2006) studied the effect of plant growth regulators on growth and yield of black cumin and observed that, these substances were found to be more effective in promoting shoot length, dry weight, leaf number and seed yield. Giberellins are tetracyclic diterpenoid growth factors that are essential regulators of stem elongation and other developmental processes (Hooley *et al.,* 1994). Gibberellin is a well known stimulator of cell expansion, cell elongation & elongation of internodes (Huttly and Phillips *et al.,* 1995). GA_3 induced wall extensibility (Huttly and Phillips *et al.,* 1995) and expantion, elongation of internodes (Morie *et al.,* 1989) and expantion of leaf area which in turn manifestes itself in the form of more dry matter. At the time of cell division, the cells need more nutrients, which are made available by the efficient manipulation, absorption & utilization of available nutrients triggered by the GA_3 spray and increased stem length & number of flower per plant.

In the present investigation the promotory effects of plant growth hormone viz. GA_3 and Kinetin has been aimed to study on the on the *Pisum sativum* in laboratory and field plots. Consequently, present study was being proposed to assess the individual effects of two plant growth hormone concentrations to promote the stem growth and development of the *Pisum sativum* as compared to control condition.

Materials and Methods

Laboratory and field experiments were conducted in the Department of Biotechnology, Doon (P.G.) Paramedical College and Hospital, Dehradun (Utttarakhand). Certified seeds of the *Pisum sativum* were procured from Seed centre of Forest Research Institute (FRI) Dehradun (Utttarakhand) for the study.

General experimental design in the laboratory

(A) Control: Seeds of *Pisum sativum* were soaked for 24 hrs. in distilled water and placed on moistened filter paper in Petridishes.

(B) Growth Regulators: Test solution of Kn and GA_3 were prepared in six concentrations of each hormone viz.10^{-2} to 10^{-7} M) (molarities) in *Pisum sativum*. Seeds of *Pisum sativum* were soaked for 24 hrs. in different concentrations of growth regulators, soaked seeds were placed in paired Petridishes lined with moistened filter paper.

Treatments	Control	Kn						GA_3					
Concentration		10^{-7}	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-7}	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}

Treatments of field plots

During field study, crop of *Pisum sativum* was grown in field & plots were divided by black paper sheets into three blocks. On the basis of the maximum germination, survival and minimum mortality percentage of the plant hormone concentrations viz. Kn (10^{-3}) & GA_3 10^{-7} (M) respectively were sprayed during field study. Each field block was given treatments as follows:

(A) One field plot was taken as control. No treatments were given to crop of this plot.
(B) Other field plot was sprayed with GA_3 (10^{-7} M) concentration daily as compared to the control.
(C) Next other field plot was sprayed with Kn (10^{-3} M) concentration daily as compared to control.

CONTROL PLOT	GA_3 (10^{-7}M)	Kn (10^{-3}M)
(Plot-A)	(Plot-B)	(Plot-C)

Field plots sprayed by Kn and GA_3 hormone concentration

Results and Discussion

In the control plot, the values of stem length (cm/pl), fresh and dry weight (g/pl) of the stem were recorded at the fifteen day stage of the growth as 7.42 (cm/pl), 0.28.6 and 0.03 (g/plant) respectively and observed to be increased continuously up to maturity and noticed as ca. 60.5 (cm/pl), 4.79 and 2.23 (g/plant) respectively. When the other plot was sprayed by GA_3 (10^{-7} M) concentration daily, the promotory effect was observed on the stem length, fresh and dry weight with respect to the control condition. The maximum promotion of length, fresh and dry weight was noticed at the 15 day stage of growth and recorded as ca.91%, 51%, 34%; at the 30th day as ca. 27%, 85%, 46%; at the 45th day as ca. 65%, 41%, 28%; at the 60th as ca. 72%, 27%, 24% & at the maturity as ca. 72%, 27%, 24% respectively with respect to the control.

When the next other plot was sprayed by Kn (10^{-3} M) concentration daily, the maximum enhancement was observed to stem length, fresh and dry weight with respect to the control. The maximum promotion of length, fresh and dry weight was noticed at the 15th day stage of growth and recorded as ca. 78%, 34%, 24%; at the 30th day as ca. 68%, 30%, and 22%; at the 45th day as ca. 82%, 42%, 38%; at the 60th day as ca. 74%, 23%, 16% and at the maturity as ca. 86%, 48%, 34% respectively with respective to the control. (Table 1 and fig.1)

Table 1: Stem growth patterns of field grown *Pisum sativum* as increased by some plant growth regulators (PGRs) such as Kn and GA_3 respectively.

Treatments	Parameters	Crop age in days				
		15	30	45	60	75
Control	Length (cm)	**7.42**±0.7302	**9.66**±1.269	**30.2**±4.965	**50.5**±1.331	**59.4** ±1.441
	F.W.(g)	**0.286**±0.0063	**0.27**±0.0141	**1.21**±0.0487	**2.79**±0.206	**4.69**±0.306
	D.W.(g)	**0.03**±0.0032	**0.02**±0.0026	**0.21**±0.0102	**0.686**±0.0631	**0.866**±0.0731
GA_3 (10^{-7}) M	Length (cm)	**14.16**±0.8683	**41.3**±4.166	**74.1**±18.456	**68.4**±12.03	**82.6**±14.03
	F.W.(g)	**0.604**±0.0326	**0.77**±0.0209	**1.71**±0.0352	**3.102**±0.0144	**5.102**±0.0242
	D.W.(g)	**0.22**±0.0126	**0.28**±0.021	**0.48**±0.0121	**0.866**±0.0429	**0.967**±0.0629
Kn (10^{-3}) M	Length (cm)	**13.2**±1.224	**38.9**±4.465	**55.1**±9.101	**87.8**±24.87	**95.7**±28.77
	F.W.(g)	**0.674**±0.0458	**0.83**±0.026	**1.72**±0.206	**3.676**±0.0731	**5.651**±0.0832
	D.W.(g)	**0.246**±0.0102	**0.42**±0.0143	**0.50**±0.0357	**1.058**±0.0337	**3.067**±0.0437

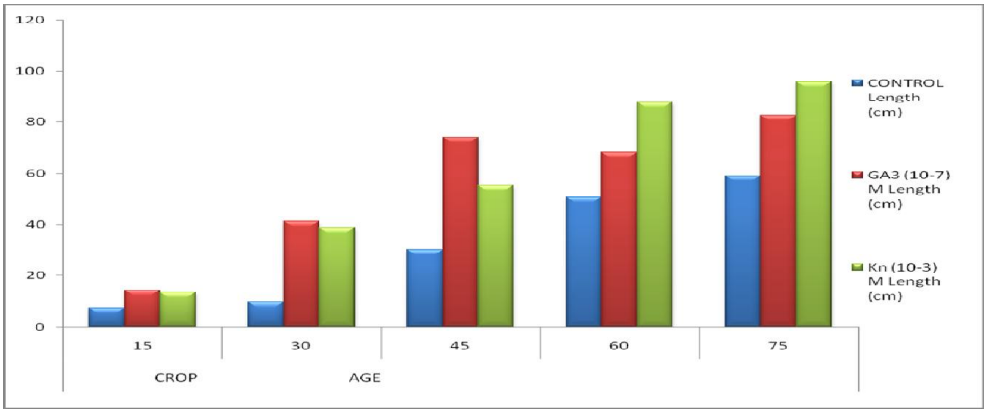

Fig. 1: Stem growth pattern (length) of field grown *Pisum sativum* as increased by some plant growth hormones such as Kn and GA_3 respectively as compared to control.

Present study was carried out in the laboratory & field to observe the promtory effects of the plant growth hormones on the *Pisum sativum* (Pea) as compared to control.Hence for the further studies GA_3 (10^{-7} M) & Kn (10^{-3} M) concentrations were applied in the *Pisum sativum* respectively, for the treatment during field studies.When the crop was sprayed by GA_3 (10^{-7} M) concentration daily, the enhancementr was observed on stem length, fresh & dry weight as compared to the control plot. Maximum promotion of length, fresh and dry weight was noticed at the 15th day stage of growth & recorded as ca.91%, 51%, 34%; at the 30th day as ca. 27%, 85%, 46%; at the 45th day as ca. 65%, 41%, 28%; at the 60th as ca.72%, 27%, 24% and at the maturity as ca. 72%, 27%, 24% respectively with respect to control. Maximum promotion was also noted with the Kn (10^{-3} M) on stem length, fresh & dry weight was noticed at the 15th day stage of growth and recorded as ca. 78%, 34%, 24%; at the 30th day as ca. 68%, 30%, & 22%; at the 45th day as ca. 82%, 42%, 38%; at the 60th day as ca. 74%, 23%, 16% and at the maturity as ca. 86%, 48%, 34% respectively as compared to control. The above studies found support from the work of Gupta *et al*., (2011), Mishra *et al.,* (1986) and Reis *et al*., (2000). Therefore, *Pisum sativum* plants were sparyed with these plant growth hormones such as GA_3 & Kn daily, the promotion were found in considered parameters as compared to the control plot.

Conclusion

The promotory affects of some plant growth hormone was observed on the *Pisum sativum* as compared to the control. The Kn (10^{-3}) & GA_3 ($1O^{-7}$) hormone concentrations were found to promote stem growth of *Pisum sativum* (Pea). This showed that the plant growth hormone cause significant change in the plant morphological, physiological and biochemical parameters and they are increased the yield of crop plants.

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