International Journal of Biology Sciences

ISSN Print: 2664-9926
ISSN Online: 2664-9934
Impact Factor: RJIF 5.45
IJBS 2022; 4(1): 20-25
www.biologyjournal.net
Received: 12-01-2022
Accepted: 20-02-2022

Sanjeev Lal
Assistant Professor,
Department of Botany, R.C.U. Govt. P.G. College Uttarkashi, Uttarakhand, India

Vipin Chandra
Assistant Professor,
Department of Botany, R.C.U. Govt. P.G. College Uttarkashi, Uttarakhand, India

Aaradhna Chauhan
Assistant Professor,
Department of Botany, R.C.U. Govt. P.G. College Uttarkashi, Uttarakhand, India

Corresponding Author:
Sanjeev Lal
Assistant Professor,
Department of Botany, R.C.U. Govt. P.G. College Uttarkashi, Uttarakhand, India

Promontory effects of IAA and GA3 on seed germination, survival & mortality percentage of the *Phaseolus vulgaris* & *Abelmoschus esculentus* over the control

Sanjeev Lal, Vipin Chandra and Aaradhna Chauhan

DOI: https://doi.org/10.33545/26649926.2022.v4.i1a.37

Abstract
The experiment was conducted in the field with and without treatments of two concentrations of plant growth hormones, were treated daily on the germinating seeds of *Phaseolus vulgaris & Abelmoschus esculentus* respectively. After seven days, the germinating seeds were counted till to ten days and observed germination, survival and mortality percentages of the both crops. The efficiency of plant growth hormones such as IAA & GA3 in their physiological ranges were studied and compared to the control. In the control condition, observed seed germination, survival and mortality percentages of the *Phaseolus vulgaris*. When growth regulator was given to the germinating seeds, the germination, survival and mortality percentages were amounted with IAA (10-2 M) concentration, but best germination percentage, survival and less mortality percentages were recorded with the concentration of IAA (10-3M) as compared to control. In control condition of *Abelmoschus esculentus*, observed seed germination, survival and mortality percentage. When the plant hormone concentration was given to the germinating seeds, the germination, survival & mortality percentages were amounted with the GA3 (10-2) concentration, but best germination percentage, survival and less mortality percentage were recorded with the concentration of GA3 (10-3) as compared to the control..

Keywords: *Phaseolus vulgaris*, *Abelmoschus esculentus*, IAA and GA3

Introduction
The present study was based on two crop plant species such as *Phaseolus vulgaris* & *Abelmoschus esculents*, because these provide not only the good nutrition, but also possible therapeutic benefits for the human kind. It has been well established that the plant growth regulators influence the growth and development of plants. These chemical substances are able to coordinate growth among different plant parts or different physiological & biochemical processes. The main naturally occurring plant growth hormones *viz*. IAA, Kn and GA3 are able to control many physiological processes that involved in the plant development. Plant growth regulators have been tried to improve growth and ultimately yield (Ram *et al*., (1973) [22]; Patil *et al*., (1987) [21] and Kumar *et al*., (1996) [11], 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 enhanced due to the application of plant growth regulators (Buckovac & Wittwer, (1957) [2] & Chnonkar & Jha, (1963) [36].
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.
Gibberellins are generally used to promote stem elongation, flowering and breaking dormancy of seeds, buds & bulbs. There are over 90 forms of gibberellins, but GA3 is the most commonly used form. 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) [8].

Plant growth hormones are signal molecules, produced at the specific location in the plant in the extremely low concentrations. Hormones are naturally produced within plants, though very similar chemicals are produced by fungi and bacteria that can affect plant growth (Srivastava *et al.,* 2002) [26]. The concentration of hormones required for plant responses at the very low concentrations (Srivastava *et al.,* 2002) [26]. Phytohormones play a regulatory role in the imposition of seed dormancy, in the release of seed from dormancy and in the reserve mobilizations during seed germination and in the subsequent development.

The overall growth of plant was improved by the plant growth regulator treatments, when it was compared to the control, because these treatments significantly, increase all plant growth parameters. The increased vegetative growth of the plants nourished and developed in a better manner, than without treatment plants. IAA, Kn & GA3, which are most important plant growth regulators 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 Modern plant biotechnology has held promise over the years to improve outputs from plants. The hormones like auxins, cytokinines & gibberellins could be made available at reduced cost to users for rapid multiplication of cultivated crops (Gana, A. S, 2010) [6]. There are numerous studies on the effect of growth hormones on plants (Jawanda *et al.,* (1979) [10]; Mishra *et al.,* (1986) [15] and Reis *et al*., (2000) [23]. Some of these studies have shown physiological and the morphological parameters have found promotion in these traits in response to increased growth hormone treatments. Mahmud *et al.,* (1983) [14] evaluated that the effect of various growth regulators on growth, development and yield of various varieties of oil-seed crops well documented. The treatments of different growth substances have given remarkably encouraging results in promoting seed germination in tomato, radish, lettuce, watermelon, brinjal, carrot and a number of other vegetables have been studied by Swaminathan *et al.,* (1987) [35]. Auxins in particular are implicated in developmental processes like elongation growth, photo and gravitropism, apical dominance and lateral root initiation (Normanly *et al.,* 1997) [18]. Both IAA & GA3 are produced by the apical bud (Jones & Phillips (1996) [9] & White *et al.,* 1975) [29]. Thus, it is conceivable that internode elongation is modulated by the apex by way of the effects of GA3 and IAA on cell division on one hand and by their synergistic effects on cell elongation on the other. The effects of GA3 and IAA in dwarf pea, enhanced internode elongation, when applied separately, but when applied simultaneously, IAA did not alter and even promoted the elongation elicited by GA3 (Arney & Mancinelli *et al.,* 1967) [1]. The role of gibberillic acid in the seed germination is also well established. Exogenous GA3 stimulates amylase activity. GA3 also cause release of enzyme amylase and protease. Thus both oxygen and GA3 enhance seed germination.The similar effects of GA3 and IAA on the internode elongation have been reported by Lockhart (1964) [13] and Phillips (1972) [19]. In the dwarf pea (Brian & Hemming *et al.,* (1958) [3] and in cucumber (Sandhu & Kasper Baver *et al.,* (1974) were observed that the IAA and GA3, both hormones are promoted internode elongation. Gibberellin has the characteristics property to improve the yield, plant height and flower induction in the *chrysanthemum* (Mohariya *et al.,* 2003) [17]. Pharis and King *et al.,* (1985) [20] observed that the gibberellins (GA3) play a major role in the development of fruit set. Morever, Yuda *et al.,* (1984) [1] and Zhang *et al.,* (2007) [34] were also reported that the fruit expansion in Japanese pear. Crops like bananas, plantain, ornamentals and tree crops can be multiplied and these will be made available for farmers.

The plant height was increased by GA3, while branch number per plant was increased by all growth regulators. The interaction of plant growth regulators has significant Promontory effect on shoot morphogenesis as reported by Baraldi *et al.,* (1988) [4]. Plant growth regulators play a significant role in the regulation of shoot growth and tuber formation in potato the certain evidences that the IAA promote GA3 biosynthesis in Barley (Wolbang *et al.,* 2004) [30]. During field study, it has been demonstrated that by Yadav *et al.,* (2005) [33] the growth promoters significantly improved growth and yield of rice. Gonge *et al.,* (2005) [7] reported that due to the treatment of growth regulators, production and quality characters like seed yield and germination percentage of *Okra* seeds were
significantly influenced. The similar findings were also reported by Sajjan *et al.,* (2003) [27].

Shah and Samiullah (2006) studied the effect of plant growth regulators on growth and yield of black cumin found to be more effective in promoting shoot length, dry weight, leaf number and seed yield. There are also some reports which indicate that kinetin in combination with GA3 enhanced germination and seedling growth in Chick pea (Kaur *et al.,* 1998) [12]. Moe & Anderson (1987) [16] observed that the variations in irradiance, light quality, photoperiod and radiant exposure, produced changes in the production of endogenous growth factors. The many of these factors are necessary for the success of plant life. On this basis, we have evaluated the Promontory effects of IAA & GA3 (10-2 & 10-3M) hormone on the seed germination, survival and mortality percentage of the *Phaseolus vulgaris* and *Abelmoschus esculentus* species over the control. The aim of this study is to provide information to enhance the potential for successful production of *Phaseolus vulgaris* & *Abelmoschus esculentus* by applied the IAA & GA3 (10-2 & 10-3M) concentration on seed germination, survival and mortality.

Materials and Methods General Experimental Design

Control: Seeds of *Phaseolus vulgaris* and *Abelmoschus esculentus* were soaked for 24hrs. in the distilled water in order to check the good quality of seeds. Those seeds, which floated in water, they are bad quality seeds. Then put the seeds in 0.1% of HgCl2 for sterilization and placed in the petridishes for the sowing in the field plots.

Plant growth hormone: Test solution of IAA and GA were prepared in (10-2) & (10-3) M concentration respectively. The seeds of both species were soaked for 24hrs. in (10-2) & (10-3) M concentration of plant growth gormone and soaked seeds were placed in petridishes for the sowing in the field plots.

Table 1: General experimental may be summarized as

Treatments	**Control**	**IAA**	**IAA**	**GA3**	**GA3**
Concentration		(10-2 M)	(10-3	(10-2 M)	(10-3 M)

For the studies of seed germination and seed ling growth patterns, the uniform seeds of *Phaseolus vulgaris* (Kidney beans) and *Abelmoschus* (Okra) were selected and sterilized

by absolute ethyl alcohol and then 0.1% HgCl2 for the one minute each thoroughly rinsed with distilled water. The seeds of Phaseolus vulgaris were soaked in IAA solution of (10-2 M) & (10-3 M) concentration as compared to control. Seeds of *Abelmoschus esculentus* were soaked in GA3 solution of (10-2 M) & (10-3 M) concentration as compared to control. In the field study, the seeds of both plants were supplied with appropriate concentrations ofplant growth hormone daily. The germination percentage was recorded on the basis of radical emergence as 2 mm in length and it is considered as germinated.

Germination percentage: The present study was showed to determine the effect of plant growth hormone 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 hrs. the seeds were counted and at the end of seven daysthe total numbers of seeds were added for the calculation of germination percentage as follows:

$$GP = \frac{\text{Number of germinated seeds}}{\text{Total number of sowed seeds}} X\ 100$$

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

$$SP = \frac{\text{Number of seed survived}}{\text{Total number of Germinated seeds}} X\ 100$$

Mortality percentage: Mortality is an estimated to account for seed that germinates, but fails to develop in to viable plants. These are many reasons for seedling mortality including diseases, insects and excessive fertilizer into the seed row, improper seedling depth, light, temperature, frost and drought due to seedling mortality can vary greatly.

$$SP = \frac{\text{Number of seed survived}}{\text{Total number of Germinated seeds}} X\ 100$$

Study Site

The study site was located in the college field of R.C.U. Govt. P.G. College Uttarkashi. The present study was conducted during the year 2021 till to 2022. Uttarkashi District is located in the hill state of Uttrakhand, India. The present study was studied the promotry effects of plant growth hormone (IAA & GA3) on the seed germination, survival and mortality percentage of *Phaseolus vulgaris* and *Abelmoschus esculentus* and compared to the control. When the germinating seeds were treated with appropriate concentration of plant growth hormone such as IAA & GA3, the best result was obtained on germination; survival and less mortality percentage were recorded of the *Phaseolus vulgaris* and *Abelmoschus esculentus* as compared to the control.

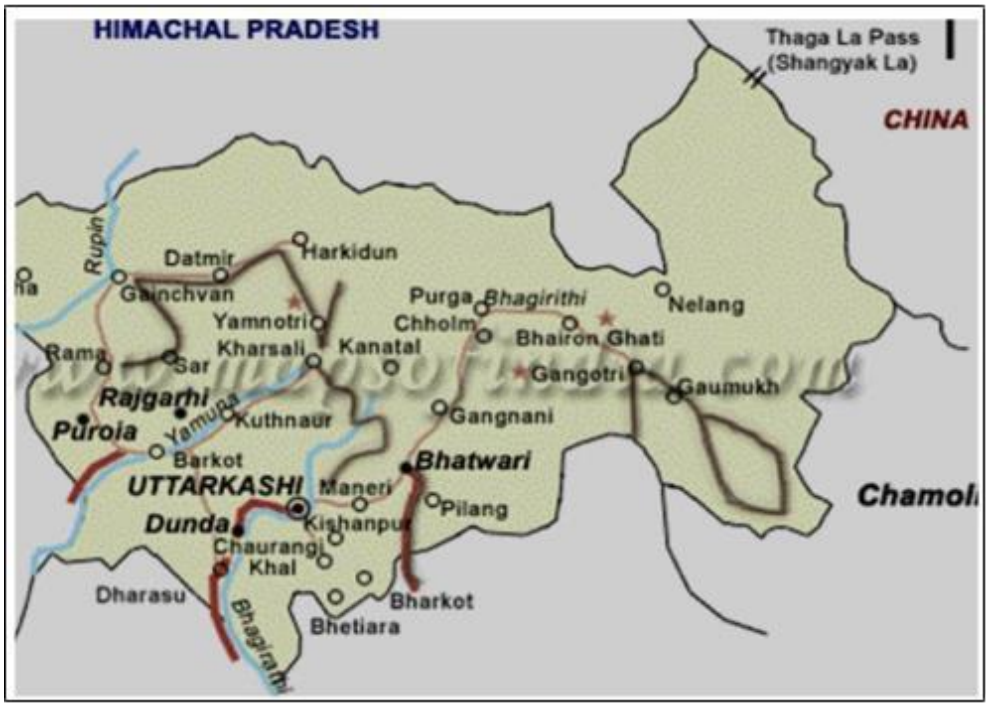

Fig 1: Map of study area

Results and observations

The experiment was conducted in the field with and witout treatment of two concentrations of plant growth hormones were treated daily on the germinating seeds of *Phaseolus vulgaris* & *Abelmoschus esculentus* respectively. After seven days, the germinating seeds were counted till ten days (10) and observed germination, survival & mortality percentages of both as *Phaseolus vulgaris* & *Abelmoschus esculentus* respectively. The efficiency of plant growth hormones *viz.* IAA and GA3 in their physiological ranges were studied and compared to the control.

In the present research work studies for the seed germination, survival and mortality percentages were noted with and witout two concentrations of plant growth hormones *viz.* IAA (10-2 & 10-3 M) and GA3 (10-2 & 10-3 M) concentrations in the *Phaseolus vulgaris* & *Abelmoschs esculentus* respectively were observed during the field conditions. The seed germination, survival and mortality percentage were recorded for two concentrations of these plant growth hormones, alone to assess the appropriate concentrations of plant growth hormones were applied for the further studies and data are presented in tables 1.1, 1.2 &

fig. 1.1 & 1.2. The results presented in table 1.1 & fig. 1.1 in the control condition; indicate that the seed germination, survival & mortality percentages of the *Phaseolus vulgaris* were recorded as ca. 77.5%, 88.70% and 11.29% respectively. When growth regulator was given to the germinating seeds, the germination, survival & mortality percentage were amounted as ca. 68.75%, 98.18% & 1.81% for IAA (10-2 M) concentration, but best germination percentage, survival and less mortality percentage were recorded with the concentration of IAA (10-3 M) as ca. 91.25%, 95.89% & 4.10% respectively.

The result also presented in table 1.2 & fig. 1.2 in the control condition; indicated that the seed germination, survival and mortality percentages of *Abelmoschus esculentus* were recorded as ca. 62.5%, 90% & 10% respectively. When plant hormone was given to the germinating seeds, the germination, survival & mortality percentage were amounted as ca. 60%, 83%, and 16.6% for GA3 (10-2) concentration, but best germination percentage, survival and less mortality percentage were recorded with the concentration of GA3 (10-3) as ca. 81.25%, 96.92% and 3% respectively.

Table 2: Seed germination, survival and mortality percentage of *Phaseolus vulgaris* (Rajma) in control and treated by IAA (10-2) & (10-3) after 7 days of sowing.

Treatments	Germination %	Survival %	Mortality %
Control	77.5	88.70	11.29
IAA (10-2)	69.12	75.25	5.00
IAA (10-3)	91.25	95.89	4.10

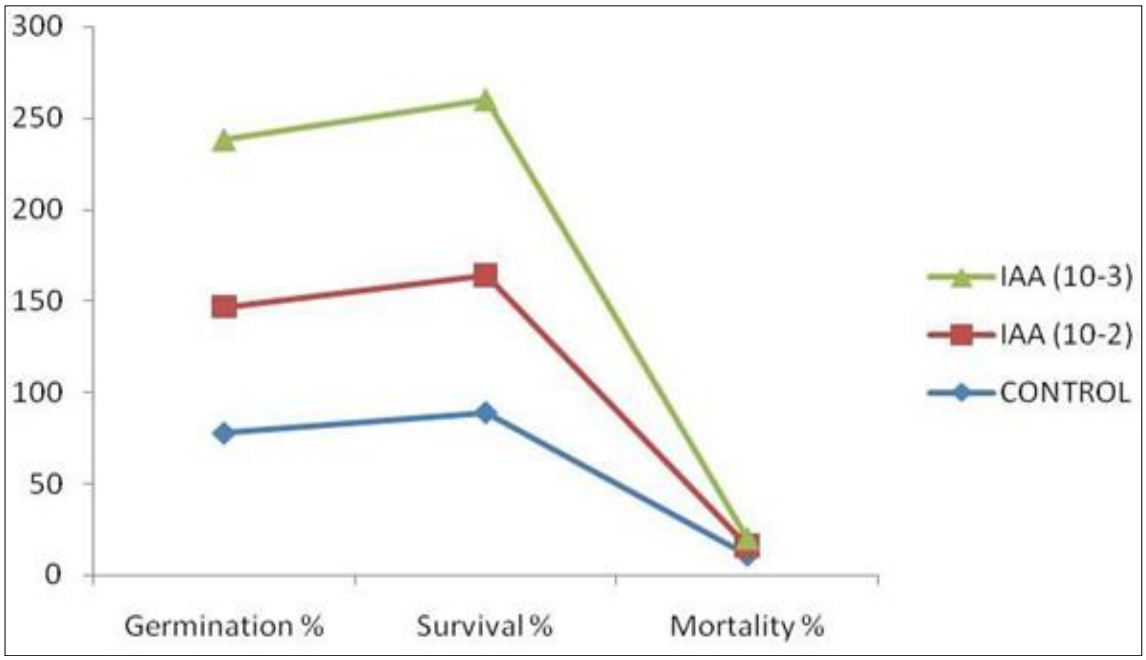

Fig 2: Seed germination, survival and mortality percentage of *Phaseolus vulgaris* (Rajma) in control and treated by IAA (10-2) & (10-3) after 7 days of sowing.

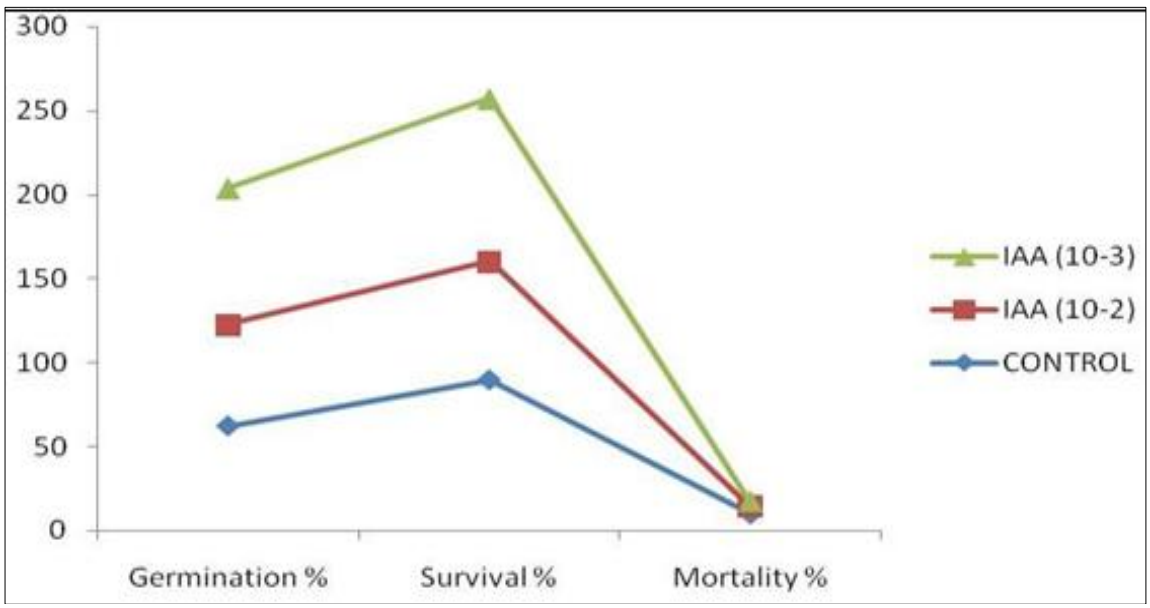

Fig 3: Seed germination, survival and mortality percentage of *Abelmoschus esculentus* (Okra) in control and treated by GA (10-2) & GA (10-3) after 7 days of sowing.

Table 3: Seed germination, survival and mortality percentage of *Abelmoschus esculentus* (Okra) in control and treated by GA (10-2) & GA (10-3) after 7 days of sowing.

Treatments	Germinatio	Survival %	Mortality %
Control	62.5	90	10
IAA (10-2)	60	70.25	4.25
IAA (10-3)	81.25	96.92	3.07

Discussions

The present investigation has been carried out to study the effects of plant growth hormone (IAA & GA), when applied on the some morphological chrecters of *Phaseolus vulgaris* and *Abelmoschus esculentus*. It has been observed that when plant growth hormone were applied to germinating seeds, they enhanced the germination, survival and reduced the mortality percentage as compared to the control. This is the interesting feature of the results is that, when the treatments of plant growth hormone were given to the seeds, the Promontory effects have been observed as compared to control. The similar observation was also identified by Graeberat *et al.*, (2012) and Bialek K, *et al.*, (1991).

Various workers in different crop plants have also been reported that the Promontory effects of plant growth regulators on seed germination and survival percentage respectively. The result of the present study showed that in control condition, indicated that the seed germination, survival and mortality percentages of *Phaseolus vulgaris* were recorded as ca. 77.5%, 88.70% and 11.29% respectively. When growth hormone was given to the germinating seeds, the germination, survival and mortality percentage were amounted as ca. 68.75%, 98.18% & 1.81% for IAA (10-2M) concentration, but the best germination, survival percentage and less mortality percentage were recorded with the concentration of IAA (10-3M) recorded as ca. 91.25%, 95.89% and 4.10% respectively. The similar result was observed by King, R.W. et *al.*, (2003) and Lang (1965). The germination, survival and mortality percentage of *Abelmoschus esculentus* in control condition recorded as ca. 62.5%, 90% and 10% respectively. When plant growth hormone was given to the germinating seeds, the germination, survival and mortality percentages were amunted as ca. 60%, 83% and 16.6% for GA3 (10-2) concentration, but best germination percentage, survival and less mortality percentage were recorded with the concentration of GA3 (10-3) recorded as ca. 81.25%, 96.92% and 3% respectively. These observations are with the conformity of Khan, A.A *et al.*, (1971) and Ranazan-Alli Khavarinega *et al.*, (2014).

Conclusions

The present investigation was investigated the Promontory effects of Indole Acetic acid & gibberellic acid with apprpriate concentrations of IAA 10-3 (M) and GA 10-3 (M) were noted on the seed germinatin, survival and mortalty percentages of *Phaseolus vulgaris* and *Abelmoschus esculentus* in the field study. In the field study, when germinating seedlings were subjected to plant growth hormone such as IAA and GA3 in its physiological range i.e. (10-2 to 10-3 M) concentrations, the maximum germination and survival percentages were increased & mortality percentage was reduced in the appropriate concentrations of the IAA (10-3 M) on the *Phaseolus vulgaris* and GA (10-3) on the *Abelmoschus esculentus* as compared to the control.

References

1. Arney SE, Mancinelli PA. Surgical investigations of the role of IAA and GA in elongation of “Meteor” pea internodes. *New phytol*,1967:66:271-283.
2. Buckovac MJ, Wittwer SH. GA and higher plants, III induction of flowering in biennials. Quart Bull. Mich. Agric expt. Sta. 1957:39:650-660.
3. Brian PW, Hemming HG. Complementary action of gibberellic acid and auxins in pea internodes extension. Ann. Bot. 1958:22:1-17.
4. Baraldi RF, Rossi, Lercari B. *In vitro* shoot development of *prunus* GF6652: interaction between light and benzyl adenine. Plant Physiol,1988:74:440-443.
5. Begna T, Asrat Z. Evaluation of improved common bean (*Phaseolus vulgaris* L.) Varieties for yield and yield components at West Hararghe, Eastern Ethiopia. Int. J Res. Agron. 2021;4(2):50-54.
6. Gana AS, The effect of plant growth hormones in micro-propagation and somatic embryogenesis. Plant Biotechnology; c2010.
7. Gonge VS, Birjees Hameed SG, Bharad AD. Warade, Kale SN. Effect to plant growth regulators on yield and quality of Okra Seed. PKV Res. J. 2005:29(1):7-9.
8. Opik H, Stephen A, Rolfe. The physiology of flowering plants published, Cambridge University Press Plant Physiology; c2005. p. 191.
9. Jones RL, Phillips IDJ. Organs of gibberellins synthesis in light grown sun-flower plants. Plant physiol. 1966:43:1381-1386.
10. Jawanda JS, Josan JS, Singh SN. Propagation of *Prunus* Species by cuttings. I. Effect of IBA and the type of
11. Peach cutting on rooting. Journal of Research, India. 1979:16:408-412.
12. Kumar DKD, Paliwar R, Kumar D. Yield and yield attributes of cabbage as influenced by GA and NAA. Crop Res. Hisar. 1996:12(1):120-122.
13. Kaur SAK, Gupta, Kaur N. Gibberillic acid and Kinetin partially reverse the effect of water stress on the germination and seedling growth in chick pea. Plant growth Requlators. 1998:25(1):29-33.
14. Lockhart JA. Physiological studies on the light sensitive stem growth. Planta. 1964:62:97-115.
15. Mahmud BS. The Effects of two Chemical Growth Regulators on Oilseed Rape. Ph.D. Thesis, University of London, Wye College, Ashford; c1983.
16. Mishra RS, Tewari JP, Joshi KR. Effect of IBA, Boron and Catechol of the rooting of commercial cultivars of Plum Grown in U.P. Hills. Prog. Hort. 1986:18:24-28.
17. Moe R, Anderson AS. Effects of stock plant environment on subsequent adventitious rooting of cuttings. In: Adventitious Root Formation on cuttings. T.D. Davis *et al*. (Eds.); c1987.
18. Mohariya AD, Patil BN, Wankhede SG, Band PE, Reena K. Effect of GA3 and TIBA on growth, flowering and yield of different varieties of Chrysanthemum. Ad. Plant Sci. 2003:16(1):143-146.
19. Normanly J. Auxin metabolism, Physiol. Plant. 1997:100:431-442.
20. Phillips IDJ. Endogenous gibberellin transport and biosynthesis in relation to geotropic induction of excised sun-flower shoot-tip. Planta. 1972:105:234-224.

21. Pharis RP, King RW. Gibberellins and reproductive development in seed plants. Ann Rev Plant Physiology. 1985:36:517-568.
22. Patil AA, Manipur SM, Nalwadi UG. Effects of GA and NAA on growth and yield of cabbage. South Indian Hort. 1987:35:393-394.
23. Ram K, Varma AN, Sharma PK. Effect of NAA on growth, protein and ascorbic acid content of cabbage. Plant science. 1973:5:150-153.
24. Reis JMR, Chalfum NNJ, Lima Lc-De-O LC. Effect of etiolation and Indole-Butyric-Acid on the rooting of cuttings from the rootstock *Pyrus* (*Alleryana Dcne*). Ciencia-E-Agrotechnologia. 2000:24:931-938.
25. Sandhu MS, RG, Kasperbauer MJ. Localization of stem elongation control in *Cucumis sativas*. Plant physiol. 1974:53:942-943.
26. Taminaw Zewdie Nigatie. Review on effect of N and P fertilizer rates on yield and yield components of common bean [*Phaseolus vulgaris* (L.)] varieties. Int. J Res Agron. 2021;4(1):32-40.
27. Srivastava LM. Plant growth and development; hormones & environment Amsterdam; Academic press; c2002. p. 140.
28. Marajan WA, Idris BEM, Ali KS, Abdalrahman A Muhamud. Effect of different NaCl concentrations on seed germination and early seedling growth of sugar beet (Beta vulgaris L). Int J Res Agron 2021;4(1):41-46. DOI: 10.33545/2618060X.2021.v4.i1a.47
29. Shah SH, Samiullah. Effect of *Phytohormones* on growth and yield of Black cumin (*Nigella sativa L.*). Indian J. Plant *Physiol*,2006:112:(N.S)217-221.
30. White JCGC, Medlow JR, Hillman, Wilkins MB. Correlative inhibition of lateral bud-growth in *Phaseolus- vulgaris*. Isolation of IAA from the inhibitory region. J. Exp. Bot. 1975:26:419-424.
31. Wolbang Carla M, Peter M, Chandler, Jennifer J, Smith, John J Ross. Auxin from the development inflorescence is required for the biosynthesis of active Gibberellins in Barley stems. Plant Physiol. 2004:134:769-776.
32. Yuda E, Matsui H, Nakagawa S, Yukimoto M, Wada K. Effect of 15-β-OH gibberellins on the fruit set and the development of three pear species. J Jpn Soc. Hort. Sci. 1984:53:235-241.
33. Zhang Z, Zhou WLIH. The role of GA, IAA and BAP in the regulation of *in vitro* shoot growth and micro tuberization in potato. Acta Physiol Plant. 2005:27:317-323.
34. Yadav PI, Poornima, Babu Mathew P. Plant growth promoters for sustainable rice (*Oryza sativa* L.) Production. Indian J. Bot. Res. 2005:1(1):73-78.
35. Zhang C, Tanabe K, Tamura F, Itai A, Yoshida M. Role of gibberellins in increasing sink demand in Japanese pear fruit during rapid fruit growth. Plant Growth Regul. 2007:52:161-172.
36. Swaminathan V. Response of Okra (*Abelmoschus esculantus*). Moench to Growth Regulator treatments and foliar fertilization of nitrogen during Summer Season. M.Sc. Thesis, G.B. Pant Univ. Of Agri. And technology, Pantnagar (UP), Indian; c1987.
37. Chhonkar VS, Jha RN. The use of plant growth regulators in transplanting of cabbage and their response on growth & yield. Indian. Hort. 1963:20:123-128.
38. Sajjan AS, Shekhargouda M, Pawar KN. Effect of regulatory chemicals on growth, yield attributes and seed yield of Okra. The Orissa J Hort. Sci, 2003:31(2):37-41.