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IMPACT OF GA3 AND IAA ON SEED GERMINATION AND SEEDLING GROWTH IN VIGNA RADIATA L.

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ABSTRACT

Vigna radiata L.. is an important and cheap source of food protein across Asia, especially for the poor, thus plays an imperative role in the alleviation of protein malnutrition especially in the developing countries. It contains a relatively high proportion of easily digestible good quality protein (24%) with low flatulence and is also rich in iron contents (40–70 ppm), making it an ultimate choice for balanced diets. Vigna radiata L. is indigenous to India or Indo-Burma region The present study was carried out to see the effect of different treatments of growth regulators viz. GA3 and IAA on seed germination and seedling growth in Vigna radiata L.. Seed moisture content was determined and found optimum for seed testing. The seeds were soaked in different concentrations (10, 50, and 100 ppm) of GA3 and IAA for 24 hours. Four replicates of each treatment with 20 seeds per replicate were arranged for analysis. T2 (GA3) 10 ppm showed the highest germination percentage as well as the higher radicle and plumule length in contrast to other treatments.

Keywords: GA3, IAA, germination, radicle, plumule.

1. INTRODUCTION

Plants hormones are produced within the plant and are indicator molecule occur in tremendously stumpy concentrations. Hormones standardize and regulate all major types of cellular processes in targeted cells locally and, when signaled to other locations in the plant. Hormones are vital to plant growth and development and in their absence plants would be a cluster of undifferentiated cells. The growth and development of flowers, stems, leaves, the shedding of leaves, and the maturity and ripening of fruit also find out and standardize by hormones. In plant growth hormones plays important role in seed germination, hormones like ABA, gibberellic acid, ethylene, IAA and cytokines [1].

The foliar relevance of plant growth regulators like IAA, NAA and Kinetin helped the plant to refurbish retardation in water content in mung bean plants subjected to water stress [2]. GA_3 used to overcome the unpleasant possessions in mung bean plants [3]. The evidence for hormone involvement comes from the correlation of hormone application with specific maturity stages, effects of applied hormones and the relationship of hormones to metabolic activities. The major plant hormones include auxins, cytokinins, gibberellins, abscisic acid, and ethylene [4,5]. Increased germination rate and uniformity have been attributed to metabolic repair during imbibition [6], buildup of germination enhancing metabolites, osmotic adjustment and for seeds that are not redried after treatment, a simple reduction in imbibitions lags time [7]. The general improvement of plant is brought by the effect of hormones, various ecological factors and nutrient uptake. They may vary in their essential germination requirements. This study with growth hormones will help in determining that which concentration on hormonal application is most suitable for seed germination and seedling growth. This study is significant as since the favorable effect of presoaking treatment of seeds with IAA and GA_3 growth regulators and other substances have been reported in the literature repeatedly.

2. MATERIALS AND METHODS

The experiment was carried out at the Department of Botany, Dr. L.K.V.D. College, Tajpur, Samastipur, India, during the year 2020-2021. With an objective to determine the seed germination percentage and seedling growth, which influenced by various concentrations of growth regulators in *Vigna radiata* L.. Seeds were obtained from the Rajendra Agricultural University, Pusa, Samastipur. Seeds were surface sterilized in 1% sodium hypochlorite solution for 3 min, then rinsed with sterilized water and air-dried. Moisture content of seed was determined by using oven at 103^0C for 12 hrs and 9.5 were found as recommended value. The seeds were treated under different concentrations of 10, 50 and 100 ppm of GA_3 and IAA with a separate control set. These were soaked for 24 hours in the above concentrations and only double distilled water for the control set.

The seeds were sown on moist filter papers in 9 cm well labeled Petri dishes. Four replicates of each treatment with 20 seeds to each replicate were placed in seed germination at 20^0C. Observation aspects like germination count (recorded for 7 days), measurement of radicle and plumule length was measured. The mean germination percent, radicle and plumule length of each treatment were calculated, and for quantitative evaluation of the effect of various treatments, the values were used to compare with the control treatment observation values. The experiment was laid out in a Randomized Block Design (RBD) with 7 treatments. Data collected were analyzed statistically using coefficients of variability and least significant difference (LSD) test at 0.05 probability level [8]. GA3 can be used for crop growth, maintaining high relative water content, good stand establishment and reducing electrolyte leakage [9].

3. RESULTS AND DISCUSSION

The low germination percentage was observed in T_1 (control) treatment. (Table 1). The seeds treated with GA_3 showed significant difference to control. The germination percent of treatment T_2 (GA_3) 10 ppm, was recorded a difference of nearly 3 to 10% for treatment T_3 50 and T_4 100 p.m., in which GA_3 10 ppm was found most suitable because it showed highest germination percent. Both 50 and 100 ppm concentration of GA_3 did not show any major difference in respect of germination which meant the higher concentration was not as good as the lowest concentration rather it decreased the germination percent. Germination percentage under the treatment of T_5 (IAA) 10 p.m. and T6, 50 ppm recorded maximum than control and the highest concentration of T_7 (IAA) 100 ppm showed the least germination percentage (37%) comparison to control. Hence, from above it is observed that in GA_3 and IAA, the germination percentage decreases when the concentration increased, which shows that higher concentration inhibit germination.

Table 1: Effect of GA_3 and IAA on seed germination percentage of *Vigna radiata* L. under different treatment

Treatments	**Concentration (ppm)**	**Seed Germination %**	**Seed soaked time(hrs.)**
T_1(control)	------	65.00	24
T_2 (GA_3)	10	96.50	24
T_3 (GA_3)	50	86.25	24
T_4 (GA_3)	100	85.75	24
T_5 (IAA)	10	79.00	24
T_6(IAA)	50	67.25	24
T_7 (IAA)	100	37.00	24

Any two means differ significantly from each other at P=0.05

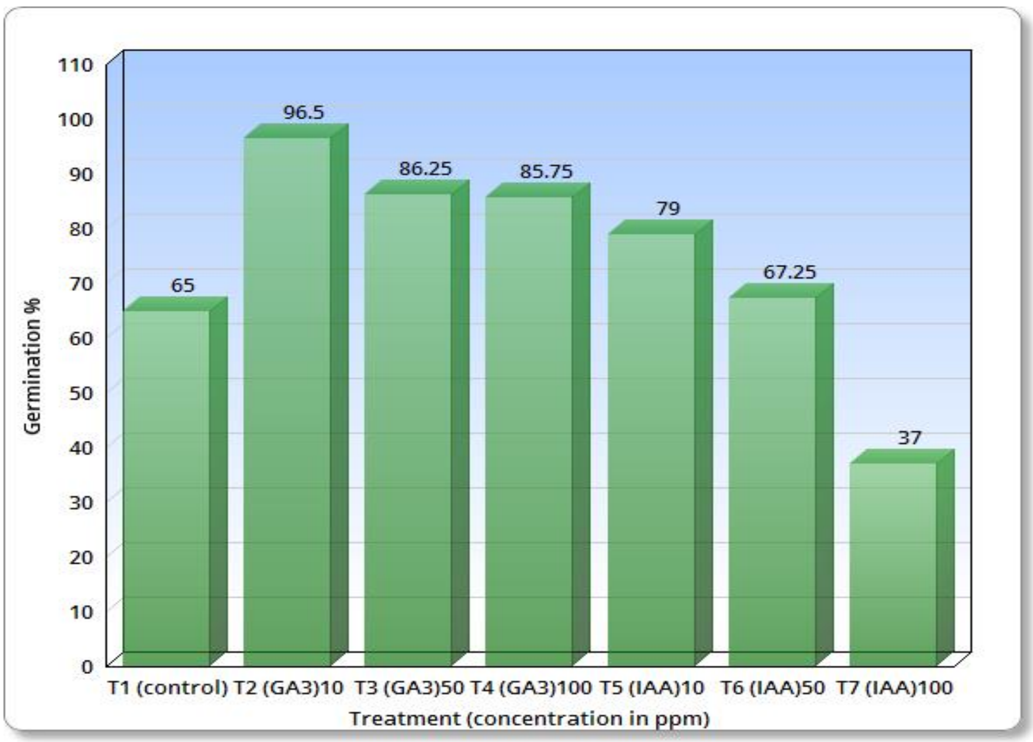

Fig 1: Effect of GA_3 and IAA on seed germination percentage of *Vigna radiata* L. under different treatments

The observations revealed both the growth response uniformly to radicle elongation (Table 2). The length of the radicle for control treatment on the terminating day of the experiment was observed to be 5.35 cm. The longest radicle length was observed under T_3 (GA_3) 50 ppm (6.2 cm). A uniform plumule elongation was observed in the treatment of GA_3 to indicating good response. But IAA treatments showed great variation among the treatments and moderate difference to GA_3 treatments. When we compared the T_1 (control) treatment to T_5 (IAA) 10 ppm treatments, particularly to the maximum length, observation showed not any significant difference which meant there was not great effect of the treatment of growth hormones. All the treatments were recorded more effective and in the IAA treatments, plumule elongation was found in decreasing trend with the increase of hormonal concentration. It was observed that for plumule elongation, both these hormones did not show any significant effect. When the two hormones were compared, Gibberellic acid (GA_3) was observed more effective and responsive to the regulation of radicle and plumule elongation [10]. With the more effectiveness of low concentration of GA_3 (that is ratio of growth hormone and water) could restore retardation in water content, this may able to tolerance to water stress. The result was considered in parallel to the findings[1]. As from the (Table 2) information has shown that GA_3 could overcome the adverse effects than the IAA in the seed physiological activity[2]. The role of plant growth regulators in overcoming the harmful effects on growth may be due to the change in the endogenous growth regulators [11]. Although varied in seed germination and root shoot elongation by different treatments, the pre-soaking with different treatments evident that soaked seed could improve in germination and seedling establishment [12, 13]. The soaking period of 24 hrs increased the total uptake of water, which help the maximum imbibitions rate. This in turn aids, to the quick biochemical changes and the time period was found suitable for seed germination. The same experiment was conducted in Black gram and Horse gram [14].

Table 2: Effect of GA_3 and IAA on seedling growth of *Vigna radiata* L. under different treatment

Treatments	Concentration (ppm)	Radicle length (cm)	Plumule length (cm)
T_1(control)	------	5.35	7.56
T_2 (GA3)	10	4.93	7.98
T_3 (GA_3)	50	6.20	7.28
T_4 (GA_3)	100	5.43	7.72
T_5 (IAA)	10	5.68	6.67
T_6(IAA)	50	4.25	4.83
T_7 (IAA)	100	3.47	4.35

Any two means differ significantly from each other at P=0.05

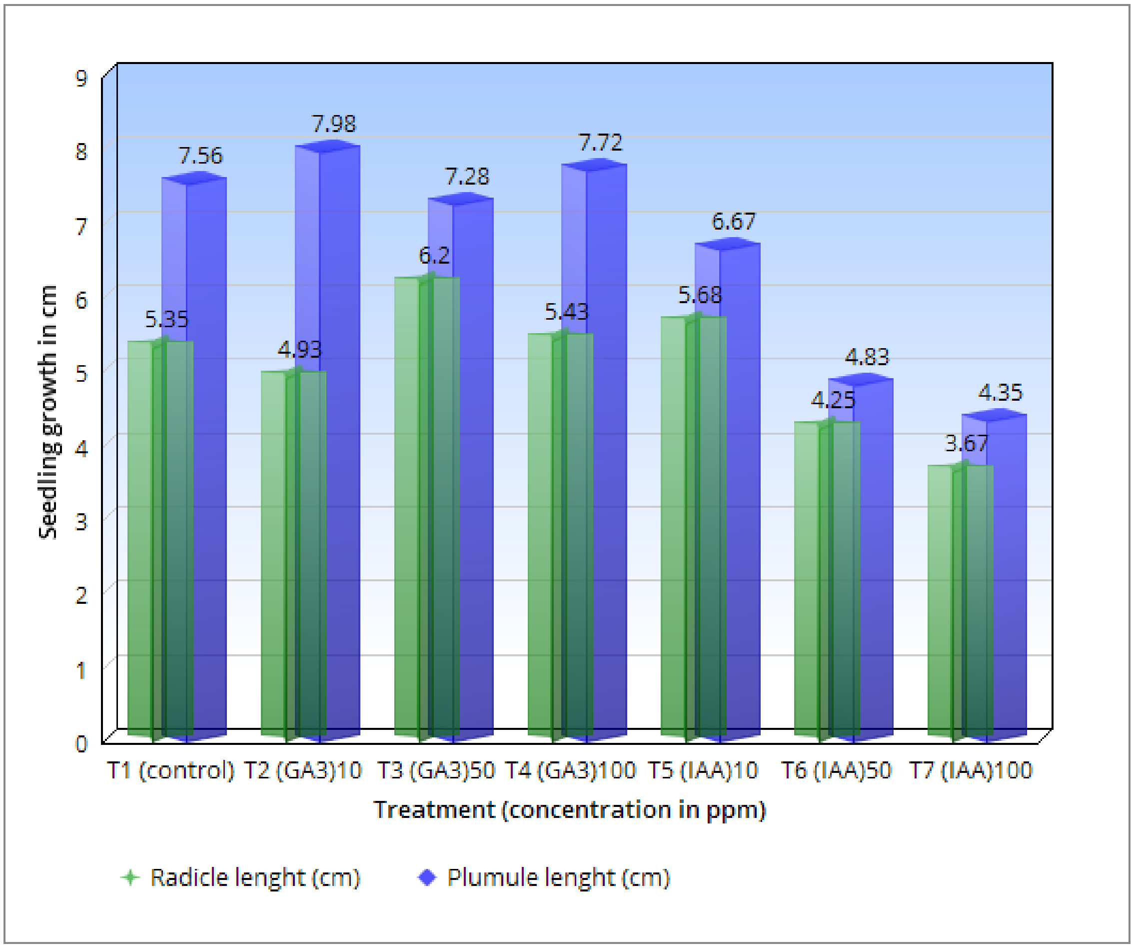

Fig 2: Effect of GA3 and IAA on Seedling Growth of *Vigna radiata* L. under different treatments

4. CONCLUSION

The findings of this study revealed that a higher concentration of T_7 (IAA) showed very least elongation of plumule as this higher concentration always inhibited the plumule elongation. T_2 (GA_3) 10 ppm showed the highest germination percentage as well as the higher radical and plumule length in contrast to other treatments. But in the case of radical and plumule elongation, these hormones did not show any significant effect in *Vigna radiata* L... This indicates that the lower concentration of growth regulators favors the increased enzymatic activity which leads to the favorable environment for the germination as well as the growth of the radical and plumule.

REFERENCES

[1] Miransari, M., & Smith, D. L. 2014. Plant hormones and seed germination. *Environmental and experimental botany*, 99, 110-121.

[2] Das Gupta P, Das D and Mukherji S, 1994. Role of phytohormones in the reversal of stress-induced alteration in growth turgidity and proline accumulation in mungbean (*Vigna radiata L.* Wilczek) plants, *Ind Biol.*, 26, 343-348.

ISSN: 2456-8643

[3] Chakrabarti N and Mukherji S, 2002. Effect of phytohormone pretreatment on metabolic changes in *Vigna radiata* under salt stress, *J Environ. Biol*., 23, 295-300.
[4] P H Raven and G B Johnson, 2005. Biology. Seventh Edition. McGraw-Hill, a business unit of *The McGraw-Hill Companies, Inc.*, New York, NT.
[5] Farooq M, Basra SMA, Rehman H, Ahmad N and Saleem BA, 2007. Osmopriming with salicyclic acid improves the germination and early seedling growth of melons *(Cucumis melo* L.), *Pakistan Journal of Agricultural Science*., 44, 529–533.
[6] Basra SMA, Farooq M and Tabassum R, 2005. Physiological and biochemical aspects of seed vigor enhancement treatments in fine 48 December 2005 rice (*Oryza sativa* L.), *Seed Science Technology*., 3, 29-33.
[7] Bradford K J, 1986. Manipulation of seed water relations via osmotic priming to improve germination under stress conditions, *Horticulture science*., 21, 1105-12.
[8] Steel R G D and Torrie J H, 1984. Principles and Procedures of Statistics. A Biometrical Approach. 2nd Ed. McGraw Hill Book Co. Inc., Singapore, 172-177.
[9] Aziz, T., & Pekşen, E. 2020. Seed priming with gibberellic acid rescues chickpea (Cicer arietinum L.) from chilling stress. Acta Physiologiae Plantarum, 42(8), 1-10.
[10] Chakrabarti, N and Mukherji S, 2003. Effect of Phytohormone pretreatment on nitrogen metabolism in *Vigna radiata* under salt stress. *Biol. Plant*., 46, 63-66.
[11] Izumi Y and Hirasawa E, 1996. Gibberellin induces endopeptidase activity in detached cotyledons of Pisum sativum. *J. Plant Growth Regulation*., Volume 19 (i), 55-60
[12] Ahmad, S., Anwar, M., and Ullah, H, 1998. Wheat seed pre-soaking for improved germination. *J. Agron. Crop Sci.*, 181, 125-127.
[13] Harris, D., Joshi, A., Khan, P. A., Gothkar, P. and Sodhi, P.S, 1999. On-farm seed priming in semi-arid agriculture: development and evaluation in maize, rice and chickpea in India using participatory methods. *Exp. Agric*., 35, 15-29.
[14] Mohanty, S. K., Sahoo, N. C, 2000. Effect of soaking period, seed size and growth regulators on imbibition and germination of seeds of some field crops. *Orissa Journal of Agricultural Research.*, Pub. CAB Abstracts.