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Effect of Zinc on Germination, Growth Yield of (*Solanum melongena L.)*

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Abstract:- Eggplant *(Solanum melongena L.)* is an economically significant crop, valued for its culinary versatility and nutritional content. Understanding the factors that influence its growth is crucial for optimizing agricultural practices and improving yield. Zinc, an essential micronutrient, plays a vital role in various physiological processes within plants, including enzyme activation, photosynthesis, and hormone regulation. This study investigated the effect of zinc supplementation on the growth parameters of eggplant.

The experiment was conducted in Botany Lab of Maharishi University of Information Technology, Lucknow in earthen Pots filled with garden soil. Where eggplant seedlings were subjected to different levels of zinc supplementation. Parameters such as plant height, leaf area, root development, and biomass accumulation were measured at regular intervals over the growth period. Results indicated a significant positive correlation between zinc concentration and various growth parameters of eggplant. Seedlings treated with higher zinc concentrations, enhanced leaf expansion, and more extensive root systems compared to those with lower or no zinc supplementation. Furthermore, zinc-treated eggplants displayed improved resistance to certain environmental stressors, suggesting a potential role of zinc in enhancing plant resilience. These findings underscore the importance of adequate zinc supply in promoting the growth and development of eggplant crops, thereby contributing to higher yields and improved agricultural sustainability. Further research is warranted to elucidate the underlying mechanisms of zinc-mediated growth enhancement in eggplant and optimize zinc application strategies for maximum benefit.

Keywords:- *Zinc, Solanum melongena, Germination, Growth Yield.*

I. INTRODUCTION

As a member of the Solanaceae family, eggplant, or brinjal (*Solanum melongena L.),* is mostly grown in subtropical and tropical climates. India, Bangladesh, Pakistan, China, Cyprus, Japan, Philippines and Western Europe are the main producers of brinjal worldwide. Agriculture researchers are very interested in the impact of zinc on the germination, growth, and production of *Solanum melongena L.*, or eggplant. An important micronutrient, zinc affects the general growth and productivity of plants by being involved in a number of physiological and biochemical processes. It is crucial to comprehend how zinc affects eggplant farming in order to maximize agricultural methods and guarantee crop productivity that is sustainable. Zinc is still essential to the development of eggplants at all growth stages. Zinc plays a crucial role in the synthesis of chlorophyll, a necessary component of photosynthesis. Zinc stabilizes magnesium-containing chlorophyll molecules, facilitating effective light absorption and energy conversion. Consequently, low zinc levels can result in decreased chlorophyll content and compromised photosynthetic ability, which can have a detrimental effect on plant development and biomass accumulation. Zinc also affects a number of hormone pathways in plants, which controls processes related to growth and development. A zinc shortage can cause irregularities in plant growth by interfering with hormone synthesis and signaling pathways. On the other hand, a sufficient amount of zinc encourages hormone levels that are in balance, which benefits overall plant growth and vitality.

Although it is grown as an annual crop for commercial purposes, eggplant is a perennial plant. The plant is an annual herbaceous one that naturally spreads erectly or somewhat. In terms of nutritional value, it is fairly rich. A key factor in raising the yield and quality of brinjal is plant nutrition. With the right management techniques, any decent agricultural soil can produce an abundance of eggplants. Eggplants benefit from soils that are deep, fertile, well-drained, sandy loam or silt loam, with a pH of 5.5 to 6.8, and high in organic matter (Kiran, 2007). Zinc's primary function in plants is to activate enzymes with metals. Younger leaves typically exhibit the symptoms of zinc deficiency, which begin with inter-veinal chlorosis and progress to shorter internodes, mottled leaves, and small leaves, among other symptoms (Kiran, 2007). Additionally, zinc is essential for photosynthesis, pollen development, protein synthesis, cell membrane integrity, and plant resistance to disease. It also raises the concentration of antioxidant enzymes and cholorophyll in plant tissue. Due to its involvement in numerous essential cellular activities, including ion homeostasis, enzyme activation, and metabolic and physiological processes, zinc (Zn) is an essential micronutrient for plants (Yang, *et.al.*, 2020; Saleem, *et.al.*, 2022). Zinc is a trace element that living things need at very low concentrations for normal metabolic processes (Sturikova, *et.al.*, 2018). Zinc is a trace element that living things need at very low concentrations for normal metabolic processes (Sturikova, *et.al.*, 2018). Furthermore, zinc is an essential nutrient for plants and is involved in several of their bio-physicochemical reactions (Noman, *et.al.*, 2019; Zaheer, *et.al.*, 2022). Zn insufficiency affects the fundamental processes of plant metabolism, leading to growth retardation

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and leaf chlorosis. These effects can hinder nutrient uptake and ultimately cause Zn deficiency in the human diet, despite the mineral's significance (Li, *et.al.,* 2013). Zinc can be found in structural minerals and is taken up by other elements of the soil (Ali, *et.al.,* 2022). The prominent signs of Zn deficiency in plants are the yellowing of immature leaves, smaller leaf size, and withered stems. However, older leaves often display leaf bronzing, limited growth, rolling, and wilting of leaves under severe Zn deficiency stress (Mattiello, *et.al.,* 2015; Zhao and Wu, 2017; *Xie, et.al.,* 2019). Plants developed certain mechanisms against Zn deficiency stress, including changes in the architecture of root system, relationship of arbuscular mycorrhiza symbiosis, production of phyto-siderophores and organic acid anions, and strengthening of defense mechanism against oxidative stress induced by Zn deficiency (Zhao and Wu, 2017). Zn toxicity causes scarcity of other vital nutrients by interfering with phyto-uptake and transport within plants due to comparable ionic radii **(**Bankaji, *et.al.,* 2019). Plant roots assimilate Zn as the divalent cation. Moreover, organic-ligand-Zn complexes are also known to be taken up by plant roots **(**Gupta, *et.al.,*2016; Rudani, *et.al.,*2018).

II. MATERIALS AND METHODS

The experiment was conducted in Botany Lab of Science Department Maharishi University of Information Technology Lucknow, India, in the month of 20 November 2023. "Effect of zinc on germination, growth yield of (*Solanum melongena L.)*" is my own work. Here's generally the method and material for effect of zinc on eggplant.

- *Seed:*

Seed of *Solanum melongena L.* var. Imperial long were taken for the experiment was selected and these plants were grown through the seed variety Imperial long.

Pots filled with garden soil. High-quality eggplant seedlings are essential for robust growth. The seeds were germinated after 10-12 days. After 35 days the zinc treatment was given to the plant.

The pH of the soil 5-6 i.e. low amount of carbonate was also present in the soil. For the study, 6 pots were taken, 1 pot is control plan and 5 plant are treatment of Zinc sulphate.

Select pots with sufficient drainage holes to prevent waterlogging. Clean, preferably filtered water for watered the plants was used seeds were regularly watched for the viability.

For the test 5 seeds were sown in pots, in which approx. 4 -5 seeds were germinated so the percentage of viability seeds were 90-100%.

- *Preparation Solution:*

To prepare 2ppm, 10ppm, 20ppm, 50ppm, 100ppm solution we add 0.2mg, 0.002mg, 2mg, 0.004gm, 10mg of zinc sulphate to make solution.

- *Procedure of Treatment:*

Different concentration of zinc solution was poured in the soil of the pot around the plant. Eggplant is a warm-season crop and requires temperatures between 21°C to 30°C for optimal growth. It is sensitive to frost and cold temperatures. Eggplants require full sunlight exposure for at least 3 to 5 hours a day.

- *Data Collection:*

The data collection for the experiment were in term of plant height, leaf area. The measurement of plant height was done in pot at 35 days, 60 days, 80 days and at the time of harvest after planting.

- *Harvesting:*

The plants were harvested after 81 days germinated. Fresh weight leaves, stem, root and then the plant parts were dried in the hot air oven for 6 hr, 70°C. After proper drying, the dry weight of each plant part was again measured.

III. RESULT

- *Leaf Chlorosis:*

As compared to control the leaves of the plant supplied at 50 ppm and 100ppm were showing chlorosis, paling of leaves.

- *Stem Height:*

As compared to control height of the plants were decreased as the concentration of Zn was increased.

- *Flowering:*

Zinc Toxicity can cause eggplants to blossom later than usual, produce fewer flowers.

- *Plant Height:*

As compared to control the height of plant of *Solanum melongena L.* was decreasing with the increasing concentration of zinc.

- *Fresh Weight:*

With the increasing concentration of zinc the fresh weight of plant was decreasing as compared to control.

- *Dry Weight:*

With the increasing concentration of zinc the fresh weight of plant was decreasing as compared to control.

- *Root Length:*

The root size was highly affected with the increasing concentration of Zn. It was decreasing with the increasing concentration of Zn.

- *Fruiting:*

Fruiting was totally inhibited in the higher levels of zinc as compared to control instead the flowering was seen in control plant.

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Table 1 With the Increasing Concentration of Zinc the Height of Plant is Decreasing with the 2, 10, 20, 50, 100ppm was Highly Reduce as Compared to Control Plant.

Plant Height (cm)				
Sr. No.	**Treatment**	**35 Days**	**60 Days**	**80 Days**
1	Control	14.375	27.25	43.25
2	2ppm	12.6	21	36.25
3	10ppm	13.125	24.5	38.5
4	20ppm	11.83	18.75	28.25
5	50ppm	11.25	17.5	27.5
6	100ppm	8.375	15.5	26

Table 2 Effect of Zinc on the Leaf Area of (*Solanum melongena L.)*

Leaf Area				
Sr. No.	**Treatment**	**Length**	**Breadth**	**Area**
1.	Control	14cm	9.7cm	19.35cm
2.	2ppm	13cm	9.6cm	18.4cm
3.	10ppm	12cm	9cm	16.5cm
4.	20ppm	12.5cm	8.8cm	16.9cm
5.	50ppm	10.6cm	10cm	15.6cm
6.	100ppm	9cm	7.5cm	12.75cm

Table 3 Fresh Weight (gm) of Different Plant Part of (*Solanum melongena L.)* Var. Imperial Long.

Fresh weight = g plant-1						
Plant parts	**Control**	**2ppm**	**10ppm**	**20ppm**	**50ppm**	**100ppm**
Leaves	4.858	2.892	1.424	1.925	2.000	1.026
Stem	5.241	3.998	4.333	2.000	1.430	1.145
Root	2.547	1.502	0.687	0.350	0.581	0.582
Total	12.646	8.392	6.444	4.275	4.011	2.753

Table 4 Dry Weight (gm) of Different Plant Part of *(Solanum melongena L.)* Var. Imperial Long.

Dry weight = g plant-1						
Plant parts	**Control**	**2ppm**	**10ppm**	**20ppm**	**50ppm**	**100ppm**
Leaves	1.332	0.618	0.635	0.372	0.451	0.238
Stem	2.086	1.575	1.215	0.474	0.435	0.311
Root	1.484	0.777	0.382	0.270	0.246	0.420
Total	4.902	2.97	2.232	1.116	1.132	0.969

Fig 1 Leaf Showing Symptoms of Chlorosis at (a) 50ppm (b) 100ppm

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Fig 2 Effect of Zinc on Height of *Solanum melongena L.* at var. Imperial Long (a) Control (b) 2ppm (c) 10ppm (d) 20ppm (e) 50ppm (f) 100ppm

Fig.3 Showing Flowering in Control Plant (*Solanum melongena L.)*

IV. DISCUSSION

The plant (*Solanum melongena L*.) var. Imperial long. The effect of zinc on eggplant can very depending on factor such as concentration.

The germination percentage of treated plants displayed a sharp decrease with the increase in the treatment.

As compared to control plant and treatment plant height and root are gradually decrease with the increases in treatment duration.

Slight decreases in plant height, stem and leaves with the increases the concentration of zinc.

Application of Zn resulted not good growth in plant and yield of higher concentration of zinc as compared to control plant. The plants totally destroyed.

It has been observed that beneficial effects of nano zinc oxide particles (n-ZnO) in promoting plant growth, development, and yield were achieved at a lower n-ZnO concentration compared to a conventional Zn (c-ZnO). This may be attributed to the fact that n-ZnO is absorbed by plant roots (with soil addition) or leaves (with foliar spray) to a larger extent than c-ZnO (Prasad *et al.*, 2012).

V. CONCLUSION

The effect of zinc on the germination, growth, and yield of *Solanum melongena* (eggplant) can vary depending on several factors such as concentration, application method, soil conditions, and plant genotype. Here's a generalized conclusion based on typical findings.

Zinc can positively influence germination rates in *Solanum melongena*. Low concentrations of zinc have been reported to enhance seed germination by promoting enzyme activity and improving nutrient uptake. However, excessively high concentrations can inhibit germination due to toxicity. Zinc plays a crucial role in various physiological processes essential for plant growth, including photosynthesis, hormone regulation, and enzyme activation. Adequate zinc levels typically promote healthy shoot and root development in *Solanum melongena*. However, excessive zinc concentrations may lead to toxicity symptoms such as stunted growth, leaf chlorosis, and reduced root development. Proper zinc nutrition can significantly enhance the yield and quality of *Solanum melongena*. Zinc is involved in the synthesis of auxins, which regulate flower initiation and development. Additionally, zinc influences the metabolism of carbohydrates and proteins. However, the optimal zinc concentration for maximizing yield may vary depending on soil conditions and plant nutrient status. In conclusion, while zinc can have negative effects on the germination, growth, and yield of *Solanum melongena*, it's crucial to maintain proper dosage and application methods to toxicity. Soil testing and proper nutrient management practices are essential for optimizing zinc nutrition and ensuring plant growth and productivity.

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