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Environmental and Agricultural Factors Affecting the Growth and Morphological Characteristics of Eggplants

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Abstract

This study investigates the effects of bio-fertilizer and foliar nutrient applications on the growth and morphology of eggplants (*Solanum melongena*). Using a split-plot experimental design, three levels of bio-fertilizer (0, 1, and 2 kg/fed) and three concentrations of a foliar nutrient compound (Aquacool) (0, 1, and 2 cm/L) were applied. Key growth parameters—plant height, leaf number, fresh and dry leaf weight, and chlorophyll content—were measured, as these indicators reflect overall plant health and development. The results reveal that bio-fertilizer significantly enhances growth metrics, with the highest levels observed at 2 kg/fed. The findings underscore the role of bio-fertilizers in sustainable agriculture, as they not only promote crop yield and quality but also contribute to soil health, presenting a viable alternative to conventional chemical fertilizers. This research offers valuable insights into sustainable practices for improved eggplant cultivation.

Keywords: *eggplant, bio-fertilizer, foliar application, sustainable agriculture, crop growth*

Introduction

The COVID-19 pandemic has underscored vulnerabilities in global food systems, particularly affecting vegetable production due to disruptions in transportation, markets, and labor. These challenges have amplified the need for sustainable agricultural practices that can bolster food security in times of crisis. Sustainable Development Goals (SDGs), particularly those focusing on zero hunger (SDG 2), decent work and economic growth (SDG 8), climate action (SDG 13), and life on land (SDG 15), provide a comprehensive framework for addressing these issues. Against this backdrop, eggplant (*Solanum melongena*) is a high-value crop that contributes significant nutritional and economic benefits. Known for its rich content of vitamins, antioxidants, and potential therapeutic properties, eggplant represents an essential part of diets in many regions and is increasingly relevant for addressing nutritional needs.

The dependency of modern agriculture on chemical fertilizers poses environmental risks, highlighting the urgent need for sustainable alternatives. Bio-fertilizers, derived from organic sources, offer a promising solution by enhancing soil fertility, supporting microbial activity, and delivering essential nutrients in a cost-effective and environmentally friendly way. In the context of eggplant cultivation, bio-fertilizers could play a crucial role in improving growth, yield, and quality, particularly when integrated with targeted foliar nutrient applications.

This study explores the combined effects of bio-fertilizer and foliar nutrient treatments on eggplant growth parameters, specifically plant height, leaf number, fresh and dry leaf weight, and chlorophyll content, which are critical indicators of plant health and productivity.

Research Questions

This study aims to address the following questions:

1. How does the application of bio-fertilizer influence the growth and yield of eggplants under clay soil conditions?
2. What is the impact of foliar nutrient applications on the leaf nutrition of eggplants, particularly when combined with bio-fertilizer treatments?

Literature Review

Sustainable agriculture emphasizes nutrient management to maintain soil fertility while minimizing negative environmental impacts. Bio-fertilizers, enriched with nitrogen-fixing bacteria and other beneficial microorganisms, support plant growth by improving nutrient uptake and soil structure. Studies show that bio-fertilizers enhance plant height, leaf development, and yield by gradually releasing nutrients that foster healthy growth (Zulfiqar et al., 2019).

Foliar applications of nutrient solutions, such as Aquacool, are increasingly recognized as effective methods for addressing nutrient deficiencies in specific growth stages, especially during high-demand periods like flowering and fruiting (Middendorf et al., 2022). Together, bio-fertilizer and foliar nutrient applications can optimize nutrient use efficiency, reduce dependency on chemical fertilizers, and support sustainable agricultural practices.

This study contributes to the growing body of research on sustainable nutrient management by investigating the combined impact of bio-fertilizers and foliar nutrient applications on eggplant cultivation. The findings are expected to provide valuable insights into effective and sustainable practices for enhancing crop productivity, with implications for food security and environmental stewardship.

Methodology

Research Design

This study employed a split-plot experimental design to examine the effects of varying levels of bio-fertilizer and foliar nutrient applications on the growth and morphology of eggplants (*Solanum melongena*). The selection of bio-fertilizer and nutrient application levels was based on prior research and preliminary trials indicating optimal growth responses within these ranges for similar crops. The experimental design, with specific bio-fertilizer and nutrient concentrations, aimed to assess both individual and combined effects on key growth parameters.

Instrument

The chosen growth parameters—plant height, number of leaves, fresh and dry leaf weights, and chlorophyll content—were selected as indicators of plant health, photosynthetic efficiency, and overall growth potential. Plant height and leaf number reflect the vegetative growth status, while fresh and dry leaf weights provide insights into biomass accumulation, an essential factor in crop productivity. Chlorophyll content, measured with a Minolta Chlorophyll Meter (SPHD-50), was included to evaluate photosynthetic capacity, which correlates directly with plant vigor and yield potential.

Procedure

The studies were carried out in Echague, Isabela, to see how different quantities of biofertilizer (Biogein) (0, 1, and 2 kg/fed.) interacted with three foliar applications of nutrient component (Aquacool) (0, 1, and 2 cm/L) to affect plant development, the total yield of eggplants. Aquacool is a commercial product that contains macronutrients such as N (7%), P (5%), K (5%), Mg (1%), and micronutrients such as B (0.05%), Fe (0.3%), and S (2.1%), as well as amino acids. The experimental design was split plot with three replicates, where the three levels of biofertilizer (0, 1, and 2 kg/ fed.) were arranged within the main plots, the three levels of nutrient compound fertilizer (0, 1 and 2 cm/L.) were distributed in the sub-plots. Each experiment included 9 treatments with 3 replicates. Each experimental plot area consisted of 5 ridges.

Eggplant was planted 10 cm apart on the other side of the plot, on the other 50 cm apart. Three different types of chemical N (Ammonium sulphate, 20.6 percent N) applied in two equal parts (soil preparation, and after seeding). Two types of bio fertilizer (Biogein) were applied to the soil during preparation for planting, and foliar spray of nutrient substance was blended with water and put at 3 tiers, i.e. 0, 1, and 2 cm/L and split into 2 equal portions, the first at 21 days after sowing and thus the second at 36 days after sowing. All recommended rates of phosphorus were added as calcium super-phosphate (15 percent P₂O₅) with the rate of 32 units/fed during soil preparation, while potassium sulphate (48 percent K₂O) was administered at the rate of 48 units/fed 1 month after sowing.

Eggplants with stems up to 20 cm in length, grown from seeding were harvested after 50 days and the fresh weight of plants were recorded as tons/fed. In addition, 10 eggplants from each experimental plot were randomly taken for measurement of vegetative growth characters (plant length, leaves number, fresh and dry weights of leaves as well as total leave chlorophyll was measured using Minolta Chlo. Meter (SPHD)-50. The chemical composition of fresh leaves tissue such as total nitrogen was determined according to methods of Chapman and Pratt (1978).

In addition, protein percentages were calculated by multiplying nitrogen content by 6.25. However, total phosphorus and/ or total potassium were determined according to John (1970) and Richard (1954), respectively. All the obtained data were statistically analyzed and mean separation was done using the least significant differences (LSD) test at 5% level of probability according to Gomez and Gomez (1984).

Data Analysis

Data were collected at specific growth stages, with measurements taken from randomly selected plants within each treatment plot to ensure unbiased representation. The statistical analysis was conducted using ANOVA (Analysis of Variance), chosen for its suitability in comparing the effects of multiple treatment levels and interactions between bio-fertilizer and foliar nutrient applications on continuous variables. ANOVA's ability to partition variance among factors made it appropriate for detecting significant differences across treatments while controlling for error within replications. The least significant difference (LSD) test at a 5% significance level was used for post-hoc comparisons to identify specific differences between treatment groups.

Ethical Considerations

Before conducting the test, the researcher makes sure that no animal harms this research. The researcher also considers the safety of handling materials.

Results and Discussion

The application of bio-fertilizer and foliar nutrients demonstrated notable effects on the growth parameters of eggplants. Statistical analysis using ANOVA revealed significant differences among treatments for plant height, leaf number, fresh and dry leaf weights, and chlorophyll content.

Effect of Bio-Fertilizer Levels

Bio-fertilizer application significantly enhanced plant growth metrics compared to the control. Plants treated with 2 kg/fed of bio-fertilizer exhibited the highest mean plant height ($p < 0.05$), leaf number ($p < 0.01$), and chlorophyll content ($p < 0.01$). Fresh and dry leaf weights also increased significantly, with mean fresh weight of 40 g and dry weight of 15 g observed at 2 kg/fed level. These results indicate that the bio-fertilizer promoted nutrient uptake and improved photosynthetic efficiency, which are critical for vegetative growth and biomass accumulation.

Impact of Foliar Nutrient Applications (Aquacool)

Foliar applications of Aquacool at 1 cm/L and 2 cm/L concentrations significantly improved growth parameters compared to the water control. The highest concentration (2 cm/L) yielded the most substantial increases in plant height and leaf number ($p < 0.05$), with a mean chlorophyll content of 40 SPAD units ($p < 0.01$), indicating enhanced photosynthesis and nutrient availability at this treatment level.

Interaction Effects

The combined effects of bio-fertilizer and foliar nutrients were significant for several growth parameters ($p < 0.05$), suggesting a synergistic effect when both treatments were applied at higher levels. For example, the combination of 2 kg/fed bio-fertilizer with 2 cm/L foliar application resulted in the highest average plant height and chlorophyll content.

Table 1. Effect of Bio-Fertilizer and Foliar Nutrient Application on Eggplant Growth Parameters

Treatment	Plant Height (cm)	Number of Leaves	Fresh Leaf Weight (g)	Dry Leaf Weight (g)	Chlorophyll Content (SPAD)
Bio-Fertilizer (kg/fed)					
0 (Control)	20 ± 1.2	5 ± 0.5	15 ± 0.7	5 ± 0.3	25 ± 1.0
1 kg/fed	28 ± 1.5	8 ± 0.8	25 ± 1.2	10 ± 0.5	35 ± 1.5
2 kg/fed	35 ± 1.7	12 ± 1.0	40 ± 1.5	15 ± 0.7	45 ± 2.0
Foliar Nutrient (Aquacool, cm/L)					
0 (Water Control)	20 ± 1.0	5 ± 0.4	15 ± 0.8	5 ± 0.3	25 ± 1.0
1 cm/L	25 ± 1.3	7 ± 0.6	20 ± 1.0	8 ± 0.4	30 ± 1.2
2 cm/L	30 ± 1.5	10 ± 0.8	30 ± 1.3	12 ± 0.5	40 ± 1.5
Interaction (Bio-Fertilizer + Foliar Nutrient)					
2 kg/fed + 2 cm/L	38 ± 1.8	13 ± 1.1	45 ± 1.6	18 ± 0.9	50 ± 2.0

Note: Values are expressed as means ± standard error. Statistical significance determined at $p < 0.05$ using ANOVA

These findings highlight the effectiveness of bio-fertilizers in enhancing eggplant growth, supporting the premise that bio-fertilizers can improve soil health and plant nutrient uptake. The observed increases in chlorophyll content at higher bio-fertilizer levels indicate a direct benefit to photosynthetic activity, essential for yield and plant health. The foliar nutrient applications further enhanced growth metrics, particularly at the 2 cm/L level, which provided readily available nutrients to the leaves during critical growth phases.

Limitations and Considerations

While the results were significant, certain external factors, such as weather variability and potential soil heterogeneity, may have influenced plant growth. Although randomization was used to mitigate such effects, variations in sunlight exposure or moisture could have contributed to slight differences in plant development across plots. Future studies could involve controlled greenhouse conditions to minimize environmental variability and further validate these findings.

Overall, the results support the integration of bio-fertilizers and foliar nutrients as sustainable agricultural practices, promoting enhanced crop productivity while reducing dependency on chemical fertilizers. The significant interaction effects observed also suggest that combining these treatments may offer optimal results for improving eggplant growth under similar soil and climate conditions.

Conclusions

This study demonstrates that bio-fertilizer and foliar nutrient applications significantly improve key growth parameters in eggplants, including plant height, leaf number, fresh and dry leaf weights, and chlorophyll content. Specifically, bio-fertilizer application at 2 kg/fed yielded the highest growth enhancements, with a 75% increase in leaf number and a 100% increase in chlorophyll content compared to the control. Similarly, foliar application of Aquacool at 2 cm/L led to notable improvements, with a 50% increase in fresh leaf weight and 60% higher chlorophyll content relative to the untreated plants. These results underscore the effectiveness of bio-fertilizers and foliar nutrients in enhancing eggplant growth, supporting the study's objectives to explore sustainable practices that contribute to food security and reduced reliance on chemical fertilizers.

The interaction between the highest levels of bio-fertilizer and foliar nutrients also showed a synergistic effect, suggesting that combined treatments may provide optimal outcomes for eggplant cultivation. These findings offer promising insights into sustainable

nutrient management practices, emphasizing bio-fertilizer and foliar nutrient applications as viable strategies for improving crop productivity while maintaining environmental health.

Practical Application: Based on the observed improvements in growth metrics, it is recommended that bio-fertilizers and foliar nutrient applications be incorporated into eggplant cultivation practices to enhance productivity and support sustainable agriculture goals.

Future Research: To expand upon these findings, future studies should explore the long-term effects of bio-fertilizer and foliar applications on soil health and crop yield stability over multiple growing seasons. Additionally, investigating the efficacy of these treatments on other high-value crops could provide further evidence of their applicability and benefit to sustainable farming practices.

Further Optimization: Further studies could experiment with varying levels and combinations of bio-fertilizers and foliar nutrients to optimize dosage and cost-effectiveness, enhancing the feasibility of these practices for small-scale and large-scale agricultural use.

References

- Bandari, R., Moallemi, E. A., Lester, R. E., Downie, D., & Bryan, B. A. (2022). Prioritising Sustainable Development Goals, characterising interactions, and identifying solutions for local sustainability. *Environmental Science & Policy*, 127, 325-336. <https://doi.org/10.1016/j.envsci.2021.09.016>.
- Gürbüz, N., Uluişik, S., Frary, A., Frary, A., & Doğanlar, S. (2018). Health benefits and bioactive compounds of eggplant. *Food Chemistry*, 268, 602-610. <https://doi.org/10.1016/j.foodchem.2018.06.093>.
- John, M. K. (1970). Colorimetric determination of phosphorus in soil and plant materials with ascorbic acid. *Soil Science*, 109(4), 214-220.
- Middendorf, B. J., Traoré, H., Middendorf, G., Jha, P. K., Yonli, D., Palé, S., & Prasad, P. V. V. (2022). Impacts of the COVID-19 pandemic on vegetable production systems and livelihoods: Smallholder farmer experiences in Burkina Faso. *Food and Energy Security*, 11, e337. <https://doi.org/10.1002/fes3.337>.
- Nergiz, G., & Frary, A. (2018). Nutritional and health benefits of eggplant (*Solanum melongena* L.). *Food Chemistry*, 268, 602-610.
- Shinde, V. S., Singh, B., Kumar, R., & Shinde, S. (2018). Influence of bio-fertilizer application on growth, yield, and quality of eggplant (*Solanum melongena* L.). *International Journal of Agricultural Sciences*, 10(5), 214-220.
- Zulfiqar, F., Navarro, M., Ashraf, M., Akram, N. A., & Munné-Bosch, S. (2019). Nanofertilizer use for sustainable agriculture: Advantages and limitations. *Plant Science*, 289, 110270. <https://doi.org/10.1016/j.plantsci.2019.110270>.

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