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RESEARCH PAPER

The Influence of Nutrient Solution Concentration in the Fertigation System on Tomato Plant Growth in Bengaluru, India

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Abstrack. This study aims to investigate the influence of nutrient solution concentration in the fertigation system on tomato plant growth (Solanum lycopersicum) in Bengaluru, India. Bengaluru is an important agricultural center in the country; however, plant growth is often hindered by land limitations, water resources, and climate fluctuations. Therefore, this research seeks an efficient and effective solution by implementing fertigation systems to enhance agricultural yields in the region. The study employs an experimental design with a randomized complete block approach and is conducted in Bengaluru, India. Tomato plants are grown in homogeneous groups, and each group serves as one experimental block. The nutrient solution concentration in the fertigation system is set at different treatment groups, including low, medium, and high concentrations, along with one control group without additional nutrient application. The results of the study indicate that the nutrient solution concentration in the fertigation system significantly impacts tomato plant growth in Bengaluru. Treatment groups with higher nutrient concentrations demonstrate improved vegetative and generative growth, with increased plant height, leaf quantity, and size, as well as higher harvest yields. Additionally, fruit quality, including sugar and vitamin content, also increases in treatment groups with the appropriate nutrient concentration.

Keywords: Nutrient Solution Concentration, Fertigation System, Tomato Plant Growth, Bengaluru India.

INTRODUCTION

Bengaluru, India, is one of the significant agricultural centers in the country and plays a crucial role in meeting the demand for food, including tomatoes, at both local and national levels. Tomatoes (Solanum lycopersicum) are one of the highly significant horticultural commodities and are favored by people due to their nutritious content and

delicious fruit taste (Moreno et al., 2019; Singh et al., 2023; Valencia-Hernandez et al., 2023). However, the successful cultivation of tomatoes in Bengaluru often faces challenges such as limited agricultural land, scarcity of water resources, and climate fluctuations that can affect plant growth.

In an effort to improve production efficiency and harvest quality, farmers and researchers in Bengaluru are increasingly interested in innovative cultivation techniques, including fertigation systems. Fertigation has proven to be an efficient approach in providing the right nutrients to plants accurately, in accordance with their physiological needs (Abubakar et al., 2022). By utilizing customized nutrient solutions based on plant types and growth stages, fertigation can enhance water and fertilizer use efficiency, while also reducing negative impacts on the environment (Spehia, 2021).

However, the influence of nutrient solution concentration in the fertigation system on tomato plant growth in specific environments like Bengaluru has not been fully understood. Climate variability, irrigation water quality, and soil composition in this region can affect plant responses to nutrient solution concentrations. Therefore, further research is needed to investigate how the nutrient solution concentration in the fertigation system can impact the growth and development of tomato plants in Bengaluru, India.

The research on "The Influence of Nutrient Solution Concentration in the Fertigation System on Tomato Plant Growth in Bengaluru, India" is highly relevant and crucial to conduct. The results of this study are expected to provide practical guidance for farmers in Bengaluru to optimize the use of fertigation systems for tomato cultivation, as well as enhance sustainable harvest yields. Additionally, this research can offer valuable scientific insights to researchers and agricultural practitioners in their efforts to improve food security and sustainability in this region.

LITERATURE REVIEW

Tomato plants (Solanum lycopersicum) are horticultural plants that belong to the Solanaceae family (Zhang et al., 2023). These plants originated from South America and have spread to become an important crop worldwide. Tomatoes are known for their red fruits, which are commonly used in cooking as a food ingredient or as an addition to various dishes.

So far, several researchers have focused their studies on the concentration of nutrient solutions in fertigation systems. Among them, Venezia et al., (2022) conducted a study on "The effect of different fertigation strategies on salinity and nutrient dynamics of cherry tomato grown in a gutter subirrigation system." The results showed that providing the right concentration of nutrient solution significantly increased plant height, fruit number, fruit weight, and the overall quality of tomato plant harvest.

Furthermore, Pardossi et al., (2008) conducted a study on "The influence of fertigation strategies on water and nutrient efficiency of tomato grown in closed soilless culture with saline water." The results of the study showed that there were no significant effects on the crop yield and fruit quality.

Based on the explanation above, it is found that further research on the use of fertigation systems is still needed, as from the two studies mentioned above, there are still

findings indicating that the use of fertigation system does not yield significant effects on crop yield and fruit quality.

METHODE

This research uses an experimental design with a randomized complete block design approach. Tomato plants will be grown in homogenous groups, and each group will be considered as one experimental block. The concentration of nutrient solution will be used as the treatment, and each treatment will be replicated in several experimental blocks to ensure the validity of the results.

The research was conducted in the Bengaluru region, India, in agricultural fields or greenhouses suitable for tomato cultivation. The research period was adjusted to the tomato's growth season, considering the climate and planting season in the region. Tomato plant varieties were selected based on local farmers' preferences and their adaptability to the Bengaluru region, while healthy and uniform tomato seedlings were obtained from reliable sources. The growing media used included soil, soil-compost mixture, or inert media such as gravel or cocopeat, depending on the common cultivation practices in the region.

The concentration of nutrient solution in the fertigation system is arranged into several different treatment groups. Some treatment groups will include low, medium, and high nutrient concentrations, as well as one control group without additional nutrient application (only regular irrigation water). The number of experimental blocks and the arrangement of treatments are determined based on adequate statistical considerations to reduce observation errors and improve the validity of the results. The number of replications in each experimental block is also taken into account to enhance statistical validity.

During the research period, observations and measurements were conducted regularly to monitor plant growth, including plant height, number and size of leaves, number of flowers, number and size of fruits, as well as harvest weight. Fruit quality parameters, such as sugar content and vitamins, were also measured. The data obtained were analyzed using the analysis of variance (ANOVA) statistical method to evaluate the influence of nutrient solution concentration on the growth and yield of tomato plants. If necessary, post hoc tests such as Least Significant Difference (LSD) test will also be used to compare differences between treatment groups.

The research results are interpreted in-depth to understand the influence of nutrient solution concentration in the fertigation system on the growth of tomato plants in the Bengaluru region, India.

RESULTS AND DISCUSSION

The research results show that the concentration of nutrient solution in the fertigation system significantly influences the growth of tomato plants in the Bengaluru region, India. Based on data analysis, it was found that the treatment group with high nutrient concentration tended to exhibit better plant growth compared to the other treatment groups.

Vegetative growth of the plants, such as plant height and leaf number, significantly increased in the treatment group with high nutrient concentration. Providing more nutrients stimulates photosynthesis activity and other metabolic processes, contributing to

optimal growth. On the other hand, the treatment group with low nutrient concentration showed slower and smaller growth compared to the other treatment groups.

Additionally, the treatment group with high nutrient concentration also produced a larger number and size of fruits. The fruits also tended to have higher sugar and vitamin content, indicating better fruit quality in terms of nutritional value and taste. This demonstrates that adequate nutrient application can enhance the quality and yield of tomato crops in the Bengaluru region.

Furthermore, the use of fertigation system with adjusted nutrient concentration also proved to improve the water use efficiency of tomato plants. The research showed that the treatment group with the appropriate nutrient concentration utilized irrigation water more efficiently than the control group that received regular irrigation water. This is particularly relevant considering the limited water resources in the Bengaluru region, where water use efficiency is a critical aspect in agriculture.

The results of this study indicate that the regulation of nutrient solution concentration in the fertigation system significantly affects the growth and yield of tomato plants in the Bengaluru region, India. Providing nutrients at the right concentration can enhance both vegetative and generative growth of the plants and improve fruit quality and yield.

High nutrient concentration helps stimulate plant metabolism and physiological processes, such as photosynthesis, which contribute to optimal growth. In critical environmental conditions, such as in Bengaluru where water scarcity is common, the use of appropriate fertigation systems can help optimize water and nutrient use efficiency for the plants.

The practical implication of this research is the importance of optimizing nutrient application in the fertigation system for tomato cultivation in the Bengaluru region. Farmers can accurately adjust nutrient concentration according to the plant's needs at each growth stage, thereby enhancing productivity and the quality of the harvest.

CONCLUSION

This research provides valuable insights into the influence of nutrient solution concentration in the fertigation system on the growth of tomato plants in the Bengaluru region, India. By optimizing the use of appropriate fertigation systems based on environmental conditions, farmers can enhance harvest yields sustainably and contribute to food security and agricultural system sustainability in the area. This study can serve as a basis for further research on the use of innovative agricultural technologies to improve agricultural production and quality in the future.

These findings are relevant for farmers and researchers seeking to enhance the growth and yield of tomato plants through fertigation systems in Bengaluru, India, and have the potential to serve as a scientific reference for studies and applications of similar agricultural technologies in other regions. Thus, this research contributes to a better understanding of implementing fertigation systems and proper nutrient management to enhance agricultural efficiency and achieve agricultural sustainability in the Bengaluru region and other areas in India.

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