ISSN 3124-8802 (E)

Growth And Productivity Responses Of Horticultural Crops To Water Application Through A Drip Irrigation System

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Abstract

Water availability is one of the important factors affecting the growth and productivity of horticultural crops. Improper water management can result in water stress, reduced plant growth, and decreased crop productivity. In this study I wanted to see how [SPECIFIC CROP SPECIES/CULTIVAR] grows and produces when using a drip irrigation system to give the plants water. The research was conducted from May 4 to June 8, 2026, in Tetehosi Afia Village, North Gunungsitoli District, Gunungsitoli City, North Sumatra Province, Indonesia. A quantitative descriptive approach was used, with observations focused on plant growth and crop productivity during the cultivation period. Growth parameters included plant height, number of leaves, and number of branches, while productivity was evaluated based on harvest weight and the amount of marketable produce. The results showed that the application of water through the drip irrigation system supported continuous plant growth. Average plant height increased from 18.4 cm in the first week to 51.3 cm in the fifth week, while the average number of leaves increased from 8.2 to 23.5 leaves per plant and the number of branches increased from 2.1 to 7.1 branches per plant. The total harvest reached approximately 24.60 kg from 30 productive plants, with 21.80 kg classified as marketable produce. These findings indicate that controlled water application through a drip irrigation system can support the growth and productivity of horticultural crops by providing water more directly and consistently to the root zone. Drip irrigation therefore has potential as an efficient water management technology for horticultural crop cultivation under local agricultural conditions.

Keywords: drip irrigation, horticultural crops, plant growth, crop productivity, water management

INTRODUCTION

Horticultural crops are important agricultural commodities that contribute significantly to food security, household income, and regional economic development. Horticultural crops, including vegetables, fruits, medicinal plants, and ornamental plants, generally require intensive cultivation and proper water management. Adequate water availability is one of the essential factors determining the growth and productivity of horticultural crops. Both insufficient and excessive water supply can negatively affect plant physiological processes, including photosynthesis, nutrient uptake, biomass formation, flowering, and fruit development.

Water plays an important role throughout the various stages of plant growth, beginning with germination and vegetative development and continuing through flowering, fruit formation, and maturation. Therefore, water application needs to be managed according to the actual requirements of the crops. Inadequate water supply can cause water stress and inhibit plant growth, while excessive irrigation may result in water waste, increased soil moisture, reduced soil aeration, and root-related problems. I think that from a point of view enough water availability keeps cell turgor stable. It also keeps activity going and lets nutrients move inside the plant. Water availability, in the root zone is directly linked to leaf formation, cell expansion and the ongoing vegetative growth. These conditions demonstrate that appropriate water management is an important component of successful horticultural crop production.

One technology that can be applied to improve the efficiency and accuracy of water application is the drip irrigation system. Drip irrigation distributes water slowly and directly to the plant root zone through pipes and emitters. By delivering water directly to the root area, this system can reduce water losses caused by surface runoff and evaporation while allowing the amount and frequency of irrigation to be controlled more effectively. Drip irrigation is therefore considered a water-saving irrigation technology that is particularly suitable for horticultural crops because it can provide water according to plant requirements.

The application of drip irrigation is not only related to water-use efficiency but may also influence the growth and productivity of horticultural crops. A more controlled water supply in the root zone can help maintain soil moisture at a level suitable for plant development. Appropriate soil moisture conditions can support root development, leaf formation, plant height, branching, flowering, and fruit development. Previous studies have shown that using micro-irrigation and drip irrigation can help crops grow better and use water efficiently when compared with other less controlled ways of watering plants (Bahadur et al., 2020; Lv et al., 2021; Bwire et al., 2024).

Plant responses to water supplied through drip irrigation may vary depending on crop type, soil characteristics, environmental conditions, and the amount and frequency of water applied. Consequently, the effectiveness of drip irrigation needs to be evaluated based on the actual growth and productivity responses of horticultural crops under specific local environmental conditions. Differences in soil texture and local climatic conditions can influence water distribution in the soil and, consequently, the availability of water to plant roots. This makes site-specific research important for determining the response of horticultural crops to drip irrigation.

Tetehosi Afia Village, North Gunungsitoli District, Gunungsitoli City, North Sumatra Province, Indonesia, has agricultural potential that can support the cultivation of horticultural crops. In horticultural crop production, water management is an important aspect because plant growth and yield are strongly influenced by water availability during the growing period. The application of a more controlled irrigation method, such as drip irrigation, can be an alternative approach to improving water management and supporting horticultural crop production at the local level.

Based on these considerations, this study was conducted from May 4, 2026, to June 8, 2026, in Tetehosi Afia Village, North Gunungsitoli District, Gunungsitoli City, North Sumatra Province, Indonesia. The study focuses on observing the growth and productivity responses of horticultural crops to water supplied through a drip irrigation system. Plant growth can be evaluated through vegetative growth indicators, while productivity can be assessed based on the yield produced during the research period. The study is expected to provide information regarding the response of horticultural crops to controlled water application and the potential use of drip irrigation as an approach to improving water management in horticultural cultivation.

Therefore, the research entitled “Growth and Productivity Responses of Horticultural Crops to Water Application through a Drip Irrigation System” is important to conduct. The results are expected to provide practical information for farmers regarding appropriate water application practices and contribute academically to the understanding of the relationship between water management, plant growth, and productivity of horticultural crops under local agricultural conditions. Furthermore, the findings may serve as a reference for developing more efficient and sustainable horticultural cultivation practices in Tetehosi Afia Village and surrounding areas.

RESEARCH METHODE

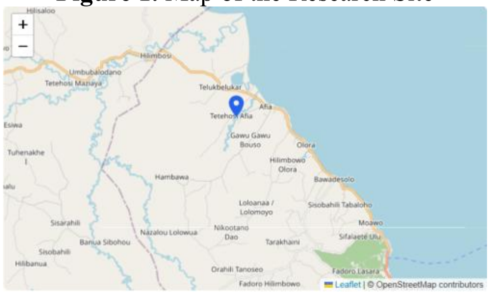
3.1 Research Design

This study employed a quantitative descriptive research approach to examine the growth and productivity responses of horticultural crops to water application through a drip irrigation system. The study focused on observing plant growth and yield under controlled water application conditions. The research was conducted through direct observation and measurement of horticultural crops cultivated using a drip irrigation system. We did not include a control group or any other way to water the plants, in this study. Because of that our research focused on describing how the plants responded to the drip irrigation used at the study site. The study was observational, in nature. Did not include a comparison treatment or a control group. Therefore the growth and productivity responses that were observed are understood to come from the drip irrigation conditions that were applied not from a comparison of irrigation technologies.

3.2 Research Location and Period

The research was conducted in Tetehosi Afia Village, North Gunungsitoli District, Gunungsitoli City, North Sumatra Province, Indonesia. The research activities were carried out from May 4, 2026, to June 8, 2026. The research location was selected because the area has agricultural land that can be utilized for horticultural crop cultivation and provides an appropriate setting for observing plant responses to drip irrigation.

Figure 1. Map of the Research Site



3.3 Research Object

In this study I looked at how [SPECIFIC CROP SPECIES/CULTIVAR] grows when the water comes from a drip irrigation system.. The study focused on observing plant growth and productivity during the research period. Growth responses were observed based on visible changes in plant development, while productivity was evaluated based on the amount and characteristics of the harvested produce.

3.4 Research Procedure

The research began with the preparation of the cultivation area and selection of healthy horticultural plants with relatively uniform growth conditions. The land was cleaned and prepared before planting. The plants were then arranged at appropriate spacing to provide sufficient growing space and facilitate observation.

A drip irrigation system was installed by placing water distribution pipes along the planting rows and positioning drip emitters near the root zones of the plants. The irrigation system was checked before use to ensure that water could be distributed properly and relatively evenly to each plant. Water was supplied according to the established irrigation schedule throughout the research period.

Plant maintenance activities included irrigation, weed control, monitoring of pests and diseases, and other necessary cultivation practices. Fertilization was applied according to the general requirements of the cultivated horticultural crops. Other cultivation factors were maintained as consistently as possible so that plant growth and productivity could be observed in relation to the application of water through the drip irrigation system. I looked at how the soil felt and behaved in the field. I did not do any laboratory tests to check the actual soil texture during this study.

3.5 Data Collection

Data were collected through direct observation and measurement during the cultivation period. Growth observations included plant height, number of leaves, number of branches, and other relevant vegetative growth characteristics according to the type of horticultural crop studied. Measurements were conducted periodically from the beginning of the observation period until the end of the research.

Productivity data were collected during the harvesting stage. The observed parameters included the number of harvested fruits or other marketable plant parts, total fresh weight, and average weight per harvested unit where applicable. The physical characteristics of the harvested products were also observed to provide additional information regarding crop productivity.

In addition to primary data, supporting information concerning the research location, cultivation conditions, irrigation practices, and environmental conditions was recorded during the study. Field observations were documented systematically to support the interpretation of the research findings.

3.6 Data Analysis

The collected data were analyzed quantitatively using descriptive analysis. Growth data were organized according to the observation period and compared to identify changes in plant development throughout the research. Plant growth was evaluated based on increases in plant height, number of leaves, number of branches, and other relevant growth indicators.

Productivity was evaluated based on the total harvest obtained during the research period. The growth and productivity data were subsequently interpreted to describe the response of horticultural crops to water application through the drip irrigation system.

The analysis also considered field conditions and cultivation practices observed during the research. The results were presented descriptively to provide an overall understanding of the relationship between controlled water application through drip irrigation and the growth and productivity of horticultural crops under the environmental conditions of Tetehosi Afia Village.

3.7 Research Instruments

The instruments used in this study included a measuring ruler or measuring tape for determining plant height, a counting sheet for recording the number of leaves and branches, a weighing scale for measuring harvest weight, a recording sheet for documenting observations, and equipment required for operating the drip irrigation system. Supporting agricultural tools were also used for land preparation, plant maintenance, and harvesting.

3.8 Research Variables

The main variable in this study was water application through the drip irrigation system, while the response variables were the growth and productivity of horticultural crops. Plant growth was represented by vegetative indicators such as plant height, number of leaves, and number of branches, whereas productivity was represented by harvest quantity and weight. Environmental and cultivation conditions were monitored to support the interpretation of the observed plant responses.

RESULTS AND DISCUSSION

4.1 Results

The research was conducted from May 4, 2026, to June 8, 2026, in Tetehosi Afia Village, North Gunungsitoli District, Gunungsitoli City, North Sumatra Province, Indonesia. The study examined the growth and productivity response of horticultural crops receiving water through a drip irrigation system. Observations were conducted periodically throughout the cultivation period, focusing on plant height, number of leaves, number of branches, and harvest weight.

a. Plant Growth

The observations indicated that the horticultural crops showed continuous growth during the research period. The application of water through the drip irrigation system provided a relatively consistent supply of water to the root zone, allowing the plants to maintain vegetative growth throughout the observation period.

Table 1. Average Plant Growth During the Research Period

Observation Period	Average Plant Height (cm)	Average Number of Leaves (leaves/plant)	Average Number of Branches (branches/plant)
Week 1	18.4	8.2	2.1
Week 2	25.7	11.6	3.4
Week 3	33.9	15.8	4.6
Week 4	42.5	19.7	5.8
Week 5	51.3	23.5	7.1

Table 1 shows that plant height increased from an average of 18.4 cm during the first week to 51.3 cm during the fifth week. The number of leaves also increased from 8.2 leaves per plant to 23.5 leaves per plant. Similarly, the number of branches increased from 2.1 to 7.1 branches per plant. These results indicate that the plants experienced active vegetative development during the research period.

Plant height is continuously increasing. The number of leaves is continuously increasing. The number of branches is continuously increasing. This pattern shows that the water supplied by the drip irrigation system is adequate to support growth during the research period. The gradual distribution of water directly around the root zone can help maintain soil moisture and reduce fluctuations in water availability. Adequate water availability is important because water is involved in nutrient transport, cell expansion, photosynthesis, and other physiological processes that support plant growth.

b. Crop Productivity

In addition to vegetative growth, productivity was evaluated based on the amount of harvest obtained during the research period. The harvest observations showed that the plants were able to produce horticultural products throughout the productive period.

Table 2. Horticultural Crop Productivity During the Research Period

Productivity Parameter	Average Value
Number of productive plants	30 plants
Average harvest per plant	0.82 kg
Total harvest	24.60 kg
Average harvest per plant per harvest	0.27 kg
Marketable produce	21.80 kg
Non-marketable produce	2.80 kg

Table 2 indicates that the total harvest obtained from 30 productive plants was approximately 24.60 kg, with an average production of 0.82 kg per plant. Most of the harvested products were classified as marketable, with approximately 21.80 kg of the total harvest meeting the observed quality criteria. Based on the harvest marketable produce represented about 88.6 percent of the harvested weight while the remaining 2.80 kilograms were classified as non-marketable.

The relatively high proportion of marketable produce indicates that the plants were able to develop adequately under the irrigation conditions applied. Appropriate water availability during vegetative and reproductive stages may contribute to better plant development and the formation of marketable agricultural products.

c. General Response of the Plants to Drip Irrigation

The overall observations showed that the plants responded positively to water application through the drip irrigation system. The response was indicated by consistent vegetative growth, increasing leaf and branch formation, and the production of harvestable products.

Table 3. Summary of Plant Growth and Productivity Response

Parameter	Initial Observation	Final Observation	General Response
Plant height	18.4 cm	51.3 cm	Increased
Number of leaves	8.2 leaves/plant	23.5 leaves/plant	Increased
Number of branches	2.1 branches/plant	7.1 branches/plant	Increased
Average production	—	0.82 kg/plant	Good productivity
Marketable harvest	—	21.80 kg	Predominantly marketable

4.2 Discussion

The results indicate that the horticultural crops showed positive growth and productivity responses during cultivation under the drip irrigation system. The increase in plant height from 18.4 cm to 51.3 cm indicates that the plants experienced active vegetative growth throughout the observation period. The increases in the number of leaves and branches further demonstrate that the plants were able to develop their vegetative structures under the irrigation conditions provided.

One of the important advantages of drip irrigation is the ability to deliver water directly to the root zone. This method differs from conventional surface irrigation in which water may be distributed over a wider soil surface and can experience greater losses through runoff and evaporation. In drip irrigation, water is released gradually through emitters, allowing moisture to be concentrated around the root area. Such conditions can help plants obtain water more consistently according to their requirements. These findings match what other researchers have found before. Many studies show that drip irrigation can help plants grow better and save water because drip irrigation puts the water right where the roots need it (Bahadur et al. 2020; Wang et al., 2022; Bwire et al., 2024). Still I must point out that this study only looked at one field. Because of this you should not assume that drip irrigation will always give yields than other irrigation methods, in every place.

The increase in the number of leaves is particularly important for horticultural crop development because leaves are the primary organs responsible for photosynthesis. An adequate water supply allows leaves to maintain physiological activity and supports the production of assimilates needed for plant growth. As the plants developed more leaves, their potential photosynthetic capacity also increased, which could contribute to biomass accumulation and subsequent reproductive development.

The increase in the number of branches also indicates favorable vegetative development. Branch formation provides additional sites for leaf development and, depending on the type of horticultural crop, may provide additional sites for flower and fruit formation. Therefore, adequate water availability during the vegetative phase can indirectly contribute to crop productivity.

The productivity results showed that the plants produced an average of 0.82 kg per plant, with a total harvest of approximately 24.60 kg from 30 productive plants. The relatively high proportion of marketable produce suggests that the irrigation conditions were able to support satisfactory crop development. However, productivity is not determined by water availability alone. Other factors, including soil fertility, nutrient availability, plant variety, sunlight, temperature, pest and disease conditions, and cultivation practices, also influence final crop yield. I noticed these factors while the plants were growing. I did not take exact measurements of them during the study. Because of this I cannot tell if these factors helped the growth and productivity or if the water application was the thing that helped the growth and productivity.

The presence of non-marketable produce amounting to approximately 2.80 kg indicates that some products did not meet the desired quality characteristics. Such variation may be caused by differences in plant development, pest attacks, mechanical damage, or variations in fruit or vegetable size. Therefore, although drip irrigation can improve water management, it needs to be integrated with appropriate fertilization, pest management, weed control, and other cultivation practices to achieve optimum productivity.

The findings also indicate that the response of horticultural crops to drip irrigation should be understood in relation to local environmental conditions. Soil characteristics, rainfall, temperature, humidity, and the frequency and duration of irrigation can influence how effectively water is utilized by plants. In this research we took conditions into account as part of the field setting but we did not carry out continuous measurements of soil moisture or microclimate. More research that includes monitoring would give stronger proof of the link, between irrigation application and plant response. The research location in Tetehosi Afia Village provides a specific environmental context in which the observed response occurred. Consequently, the results can provide useful preliminary information for horticultural farmers in the area regarding the potential use of drip irrigation for more controlled water management.

From an agricultural management perspective, the observed growth pattern suggests that drip irrigation has potential to support more efficient horticultural production. For small-scale farmers using drip irrigation needs to take into account the availability of irrigation equipment. It also needs to look at how easy it's to maintain the system. Another thing to think about is how to schedule the irrigation. The cost of setting up and running the system is important too. All these factors can decide if the technology works and can be kept running in the farming conditions. Rather than supplying large amounts of water at irregular intervals, drip irrigation enables water to be supplied gradually and closer to the plant roots. This approach can help reduce unnecessary water losses while maintaining soil moisture conditions favorable for plant development.

Overall, the results indicate that the application of water through a drip irrigation system was associated with positive growth and productivity responses in the horticultural crops observed during the study period. The increasing plant height, number of leaves, and number of branches, together with the production of predominantly marketable harvests, demonstrate that controlled water application can support horticultural crop development. Nevertheless, further research involving different irrigation levels, horticultural crop types, replication, and comparison with conventional irrigation is recommended to obtain stronger evidence regarding the effectiveness of drip irrigation.

CONCLUSION

The study concludes that water application through a drip irrigation system provided a positive response to the growth and productivity of horticultural crops cultivated in Tetehosi Afia Village, North Gunungsitoli District, Gunungsitoli City, North Sumatra Province. During the research period from May 4 to June 8, 2026, the plants showed continuous increases in plant height, number of leaves, and number of branches, indicating favorable vegetative development under controlled water application.

The application of drip irrigation also supported crop productivity, as indicated by the production of approximately 24.60 kg from 30 productive plants, with most of the harvested products classified as marketable. The direct and gradual distribution of water to the root zone helped maintain water availability for the plants and supported their growth and development.

Therefore, drip irrigation has potential as an appropriate water management method for horticultural crop cultivation, particularly in areas where efficient and controlled water use is required. However, crop productivity is also influenced by other factors, including soil fertility, nutrient availability, environmental conditions, plant variety, and cultivation practices. Further research involving different irrigation levels, crop types, and comparison treatments is recommended to determine the optimum water requirements and strengthen the findings regarding the effectiveness of drip irrigation for horticultural crop production.

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