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Growth Response Of Green Beans (*Phaseolus radiatus*) To Watering Intervals

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ABSTRACT

Green beans (*Phaseolus radiatus)* are one of the commodity of legume plants that are generally grown on dry land, Green beans are included in plants that are tolerant of water shortages, the important thing is that the soil has enough moisture. The problem that is often faced in mung bean cultivation in dry land is the low production achieved by farmers, so it is necessary to conduct research on the resistance of mung beans (*Phaseolus radiatus*) to drought and the effect of watering frequency on productivity. The purpose was to determine the watering interval to the growth response of mung bean plants (*Phaseolus radiatus*). This study used an experimental design using a Group Random Design (RAK) consisting of 4 treatments with 3 replicas of each treatment. F0U1, F0U2, F0U3 : Control Treatment (No Watering), F1U1, F1U2, F1U3 : Watering frequency 1 (one) time a day. F2U1,F2U2, F2U3 : Watering frequency 2 (two) times a day. F3U1, F3U2, F3U3 : Watering frequency 3 (three) times a day. The parameters in calculating the growth response are the length of the plant, the number of leaves and the height of the plant. The best watering interval for plant length is watering once every 1 (one) day, where the highest plant length is 56.16 cm in the F1 treatment. The best watering interval for the number of leaves of the plant is watering (once) a day, where the average number of leaves is 13.11 leaves in the F1 treatment. The best watering interval for plant height is watering once every 1 (one) day, where the average height of the highest plant is 51.16 cm in the F1 treatment.
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Introduction

Green beans are one of the important food crops for the Indonesian population, among others, as a source of vegetable protein and industrial raw materials. According to Dostalova (2009), mung beans (*Phaseolus radiatus)* are one of the commodity of legume plants that are generally grown on dry land. Green beans have great potential as a processed product and mixed food ingredient and have certain competitive advantages over other types of beans.

Green bean seeds contain high nutritional value in the form of B vitamins, minerals, and fiber. An agricultural commodity that has a very good prospect of being developed in Indonesia is mung beans (*Phaseolus radiatus*). Green beans are the third most important legume crop commodity after soybeans and peanuts. The main problem of mung bean cultivation in Indonesia is low productivity (Widiyawati et al., 2016).

Green beans are included in the crop that is tolerant of water scarcity, the important thing is that the soil has enough moisture. Green beans can grow on any type of soil as long as enough moisture and nutrients are available. Green beans have a high potential to be developed when compared to other legume crops, because mung beans have advantages when viewed from an agronomic and economic perspective such as, more resistant to drought, less attacked by pests and diseases, can be harvested at the age of 55-60 days, can be planted in soil with less fertility and easier cultivation methods (Sunantara, 2000). The problem that is often faced in mung bean cultivation in dry land is the low production achieved by farmers, so it is necessary to conduct research on the resistance of mung beans (*Phaseolus radiatus*) to drought and the effect of watering frequency on the productivity and growth of the plant (Rasyid and Soeprapto, 2001). Water stress is a factor that affects the productivity and quality of mung beans because the water needed by plants is not available enough (Rasyid and Soeprapto, 2001).

Drought is one of the factors that inhibits the growth and development process of plants, plants that only get a small volume of water will affect the vegetative phase and can cause death due to water deficiency. This is related to disturbances in the plant's metabolism, such as smaller cell volume, decreased leaf area, slow rate of photosynthesis, changes in carbon and nitrogen metabolism. Water plays a very important role in plant physiology, a supporting factor for photosynthesis. Formation of compounds – complex compounds such as carbohydrates, proteins, fats through respiration and transpiration. Water also acts as a plant temperature stabilizer, as well as maintaining cell turgidity such as cell enlargement, open and closed stomata, and protoplasm constituent (Trimayora and Fuadiyah, 2021). This study aims to determine the interval of watering on the growth response of mung bean plants (*Phaseolus radiatus*).

Material and Methods

Material

The planting medium used is soil and sand, with a ratio of 1 : 1. All the materials for the planting medium are mixed evenly, filled into polybags, planted with Phaseolus radiatus seedlings. This study used an experimental design using a Group Random Design (RAK) consisting of 4 treatments with 3 replicas of each treatment. Where each treatment is as follows:

F0U1, F0U2, F0U3 : Control Treatment (No Watering)
F1U1, F1U2, F1U3 : Watering frequency 1 (one) time a day
F2U1, F2U2, F2U3 : Watering frequency 2 (two) times a day
F3U1, F3U2, F3U3 : Watering frequency 3 (three) times a day

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Observation parameters in this study include:

1. Plant length (Calculated plant length, starting from root tip to leaf tip on the last day of observation)
2. Number of Leaves (Calculated the number of leaves present on the plant once a week. Observation was carried out for 6 weeks)
3. Plant Height (Calculated plant height once a week, starting from the base of the stem to the tip of the stem. Observation was carried out for 6 weeks)

Data Analysis

The data obtained was analyzed using the 2022 version of SPSS using the Analysis Of Variance (ANOVA) method. If the treatment has a noticeably different effect, it is followed by the Duncan New Multiple Range Test (DNMRT) at the level of 5% ($P < 0.05$) on the treatment factor.

Results and Discussion

Plant Height of Green Beans (*Phaseolus radiatus*)

Plant height is one of the parameters that indicate plant growth. The tallest mung bean plant (Phaseolus radiatus) is taken once a week for six weeks. The high data of mung bean plants (Phaseolus radiatus) with watering interval treatment can be seen in table 1 and figure 1 below:

Table 1. Effect of Watering Interval on Plant Height.

	Tinggi Tanaman					
Perlakuan	**Minggu 1**	**Minggu 2**	**Minggu 3**	**Minggu 4**	**Minggu 5**	**Minggu 6**
F0	3.67^{a}	9.72^{a}	16.44^{a}	23.44^{a}	30.44^{a}	36.05^{a}
F3	5.44^{b}	10.55^{a}	18.78^{a}	24.78^{a}	30.78^{a}	36.22^{a}
F2	6.44^{bc}	14.11^{b}	23.33^{b}	32^{b}	38.44^{b}	44.94^{b}
F1	7.44^{c}	16.56^{c}	27^{c}	34.44^{b}	44^{c}	51.16^{c}

Keterangan: Angka yang diikuti huruf berbeda, bernilai signifikan ($p<0,05$)

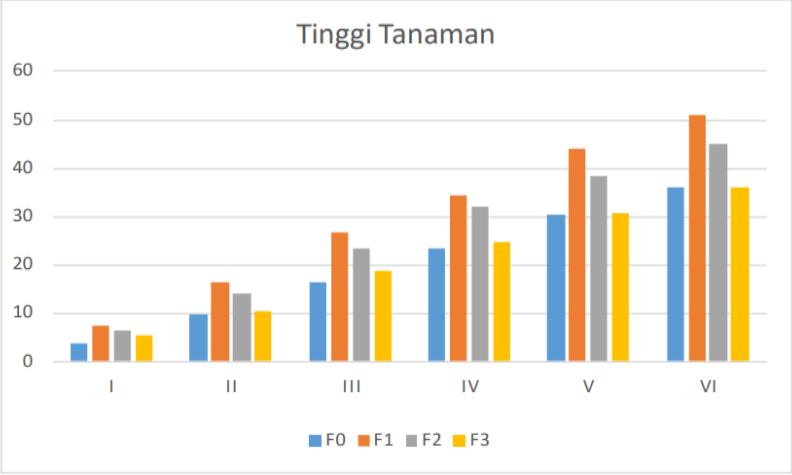

Figure 1. Watering interval to plant height

Based on table 1 and figure 1, it can be seen that the highest plant height is found in the F1 treatment, which is 51.16 cm with a watering interval treatment once a day. Meanwhile, the shortest plant height was found in the F0 treatment, which was 36.05 cm as a control treatment or without watering. According to Sari et al. (2016), Phaseolus radiatus in the treatment of watering frequency once every day has a higher plant height and is significantly different from the treatment of watering frequency 2 times a day, 3 times a day and not watered at all. This is because

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evaporation at the frequency of watering once a day is very high which causes the soil to lose a lot of water so that the water intake for plants will increase. By watering 3 times a day, plant root rot in the soil can occur because the roots absorb more water, causing the plant to grow dwarf and wilt. Excess and lack of water will be detrimental to a plant. If the plant lacks water, it will get a small supply of oxygen and excess water will cause rot in the root area of the plant. This is in accordance with the opinion of Arifin (2002) in Sari et al. (2016), stating that plants that lack water will trigger the formation of abscisic acid inhibitor hormones and growth hormone inhibitors. According to Nur et al. (2018), the growth of mung beans is determined by the characteristics of each variety, environment and genetics. The sum total of the factors involved in plant growth, both environmental and genetic, results in the appearance of the plant called phenology. If the plant lacks water, it will get a small supply of oxygen and excess water will cause rot in the root area of the plant. Plants that lack water will trigger the formation of abscisic acid-inhibiting hormones and growth-stimulating hormone inhibitors.

Length of Green Bean Plant (*Phaseolus radiatus*)

Plant length is one of the parameters that indicate plant growth. The length data of mung bean plants (Phaseolus radiatus) was taken once, namely in the last week of observation, can be seen in table 2 below.

Table 2. Effect of Watering Interval on Plant Length

Panjang Tanaman	
Perlakuan	**Panjang Tanaman**
F0	41.05[a]
F3	41.22[a]
F2	49.94[b]
F1	56.16[b]

Keterangan: Angka yang diikuti huruf berbeda, bernilai signifikan (p<0,05)

Based on table 2, it can be seen that the longest plant is found in the F1 treatment, which is 56.16 cm with a watering interval treatment once a day. Meanwhile, the shortest plant length was found in the F0 treatment, which was 41.05 cm as a control treatment or no watering. According to Sari et al. (2016), the frequency of watering has a relationship on the absorption of roots and leaves. If the frequency of watering is less frequent, there will be high evaporation and more plant roots, longer stems and larger plant stem diameter. Growing media stores enough nutrients and water for growth is one of the good growing media. The planting medium must be able to create crumb structures, supported by the right mix of materials, because each type of planting medium has its own effectiveness on plants (Mariana, 2017). Varieties have a role for plant development, because superior varieties determine the potential yield so that in their use they can increase productivity. The potential results in the field are influenced by the interaction between the growing environment conditions and genetic factors (Sinaga, 2017). According to Hendrata and Sutardi (2010), the frequency of watering has an effect on root length and does not show any influence on seedling height, number of leaves, stem diamater and root length. It is likely that the influence of plant growth media has a function, namely causing good growth and aeration for plants so that they are able to retain water and store nutrients.

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Number of Leaves of Green Bean Plant (*Phaseolus radiatus*)

The number of leaves of the mung bean plant (Phaseolus radiatus) is taken once a week for six weeks. Data on the number of leaves of mung bean plants (Phaseolus radiatus) with watering interval treatment can be seen in table 3 and figure 2.

Table 3. Effect of watering interval on the number of leaves

	Jumlah Daun					
Perlakuan	**Minggu 1**	**Minggu 2**	**Minggu 3**	**Minggu 4**	**Minggu 5**	**Minggu 6**
F0	0	1.78^{a}	2.89^{a}	4.33^{a}	5.78^{a}	7.33^{a}
F3	0	1.78^{a}	3.33^{a}	5.78^{ab}	8^{b}	11.44^{b}
F2	0	2^{a}	3.78^{a}	6.44^{b}	9.78^{bc}	12.44^{b}
F1	0	2^{a}	5.33^{b}	8.67^{c}	11.44^{c}	13.11^{b}

Keterangan: Angka yang diikuti huruf berbeda, bernilai signifikan (p<0,05)

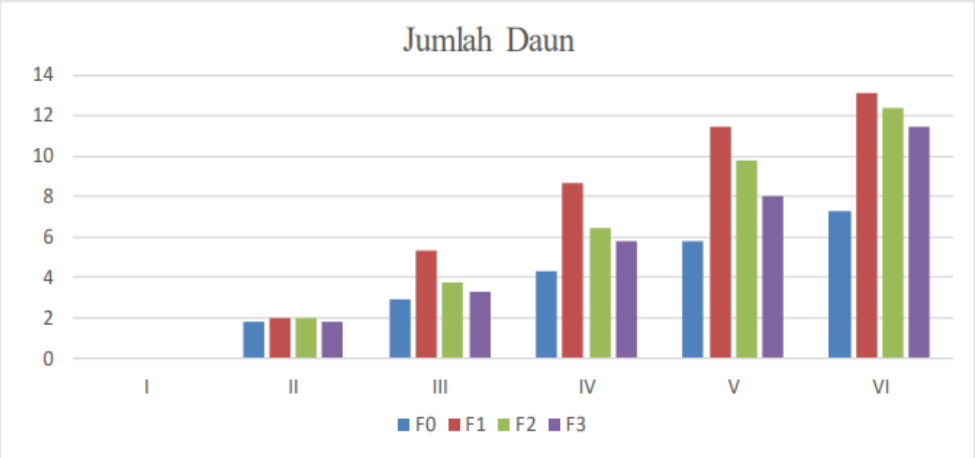

Figure 2. Number Of Leaves

Based on table 3 and figure 2, it can be seen that the average number of plant leaves that are the most abundant in the F1 treatment is 13.11 leaves with a watering interval treatment once a day. Meanwhile, the average number of leaves was found the least in the F0 treatment, which was 7.03 leaves as a control treatment or without watering. According to Manurung et al. (2019), the frequency of watering with a certain capacity can reduce the pressure of the turgor of the cell, so that it can affect the ability of the cell to enlarge and lengthen. This is what causes the growth and development of plants such as leaves, stems, and roots to be inhibited. Lack of water in plants can reduce the growth rate in those plants. The number of leaves in the plant is directly proportional to the increase in plant height, because the taller the plant stem, the more stem segments are formed, therefore the taller the plant, the more stem nodes will be produced, this is what causes the leaf blades to grow more. The role of water in plants affects all metabolic processes, so the less water given to a plant, the lower the growth yield obtained.

According to Nurhidayat et al. (2020), to accelerate growth and increase plant yields, watering is needed according to water needs. This plant will be able to grow well if its water needs can be met in the right amount and time, as well as sufficient nutrients, CO2, temperature and

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sunlight. By providing watering frequencies that are appropriate to the needs of plants, groundwater will affect the overall growth of plants. With appropriate watering, the formation of plant leaves will be optimal. In addition to being influenced by the number and moisture content, the number of leaves is affected by water stress and environmental conditions that cause plants to adjust their physiological functions.

Conclusions

The best watering interval for plant length is watering once every 1 (one) day, where the highest plant length is 56.16 cm in the F1 treatment. The best watering interval for the number of leaves of the plant is watering (once) a day, where the average number of leaves is 13.11 leaves in the F1 treatment. The best watering interval for plant height is watering once every 1 (one) day, where the average height of the highest plant is 51.16 cm in the F1 treatment.

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