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Correlation Analysis Between Watering Interval, Stem Height, Stem Diameter, And Number Of Leaves In Jackfruit Seedlings (*Artocarpus Heterophyllus* Lamk)

Umar Husein Abdullah[1*)], Nurfaizah[1)], Dewi Yana[1)], Halim Akbar[2)], Ruhalena Wilis[3)], Elvrida Rosa[4)]

[1]*Department of Plantation Management, Politeknik Indonesia Venezuela, Aceh Besar, 23372, Aceh Besar, Indonesia.*
[2]*Department of Agroteknology, Agriculture Faculty, Universitas Malikussaleh, Kampus Utama Cot Tengku Nie Reuleut, Muara Batu, Aceh Utara, Aceh Indonesia.*
[3]*Department of Agroteknology, Agriculture Faculty, Universitas Iskandar Muda, Jalan Kampus UNIDA No. 15 Surien, Kecamatan Meuraxa Banda Aceh, Aceh Indonesia.*
[4]*Department of Agroteknology, Agriculture Faculty, Universitas Abulyatama, Jl. Blangbintang Lama KM 8, RW.5, Lampoh Keude, Kec. Kuta Baro, Kabupaten Aceh Besar, Aceh Indonesia.*

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Corresponding Author:
Umar Husein Abdullah, Department of Plantation Management, Politeknik Indonesia Venezuela, Aceh Besar, 23372, Indonesia.
Email : umarah_1977@yahoo.co.id

Abstract

The study aims to determine the correlation analysis between watering interval, stem height, stem diameter and number of leaves in Jackfruit Seedlings (*Artocarpus Heterophyllus* Lamk). The research was conducted in the closed room experimental garden of the Plantation Management Study Program, Politeknik Indonesia Venezuela located in Cot Suruy Village, Ingin Jaya District, Aceh Besar Regency, from May 2024 to July 2024. The temperature in the experimental garden is set at 25°C – 28°C. To see the correlation analysis between the watering interval, stem height, stem diameter, and number of leaves in Jackfruit Seedlings (Artocarpus Heterophyllus Lamk) bivariate correlation analysis was used. The results showed that there was a relationship between plant height, stem diameter, and number of leaves. There is no relationship between the length of the watering interval and the variables of plant height, stem diameter, and number of leaves. At a watering interval of once every nine days showed that there are no variables that are strongly related and have a significant effect on the watering interval, plant height, stem diameter, and number of leaves. The decreasing amount of water causes plants to be unable to grow normally.

Keywords: field capacity, pearson correlations, significant, variable, water availability

1. Introduction

Climate change caused by global warming can affect the results of the economy and food sustainability due to changes in rainfall patterns, increased temperatures, and changes in ecosystems that affect agricultural productivity such as decreased agrarian yields, increased failures, and resulting in food prices (Malihah, 2022). The negative impacts of climate change are making temperatures hotter, and causing drought.

Water has a vital role starting from biological interactions, and metabolic and chemical functions in cells. Water has a very good solvent, to transfer nutrients and digestive waste into tissue cells. In the plant world, plants produce oxygen, the oxygen released by plants comes from water, not carbon dioxide. Scientifically, the air we breathe which is more critical to life than water, basically comes from water too. Likewise, with the capillary process of water, water rises from the roots of plants to the stems and leaves without the help of a pump (Suskha et al., 2020). If a plant lacks water, the plant will get a small oxygen supply and if the plant has excess water, the plant will rot in the roots of the plant (Reddy et al., 2022).

Jackfruit (Artocarpus heterophyllus Lamk) is one of the fruits originating from India and spread to tropical regions including Indonesia, in Indonesia this plant is very popular almost throughout Indonesia this fruit can be found and has a fairly high economic level. Jackfruit belongs to the Moraceae family, namely large fruit with a sharp fragrant aroma and sweet taste. As one of the horticultural plants that is a priority for development is not without strong reasons. This type of plant has bright prospects as a supporter of government programs, especially in the State Foreign Exchange Increase and Food Diversification Program. Because its processed products are of high value, jackfruit is known as a multipurpose plant because all parts of the plant can be used for various purposes ranging from food needs, housing, greening, livestock, industry, and even health such as cancer treatment which has been proven to be efficacious (Anggriana et al., 2017).

Interval is a term that is often associated with distance. In its use, interval is one of the words often mentioned in physics, mathematics, and even music. Interval is a statistical level of measurement. One example of an interval is time. A clock breaks down time into intervals of seconds, minutes, and hours. Interval is also called calculation in everyday life. Synonyms of separation, distance, or interval, so it can be concluded that the watering interval is the distance between one watering time and another. This is what underlies the author's research to test the resistance of jackfruit seedlings at several watering intervals. Jackfruit plants can grow and produce well in hot and tropical climates. This fruit tree bears fruit once a year and the fruit tree grows up to 90 cm and is 50 cm in size. In Indonesia, the area suitable for jackfruit plants is the lowlands with an altitude of 700 meters above sea level. These plants require a minimum temperature between 16ºC-21ºC and a maximum of 31ºC-32ºC, rainfall of 1,500 mm - 2,400 mm per year, and air humidity between 50% -80%. To obtain optimal growth and production, jackfruit plants require sandy loam soil, loose fertile, rich in organic matter, has good aeration and drainage, soil pH of 5-7, and water depth between 1 m - 200 m from the ground surface (Siregar, 2022). Factors that influence growth consist of internal factors and external factors. Internal factors are factors found in the seeds or plants themselves. External factors are factors found outside the seeds or plants, one of which influences growth in terms of external factors is water (Darmawan et al., 2015).

Water is a very important component in the life of living things. Water often limits the growth and development of plants. Water requirements for plants vary, depending on the type of plant and its growth phase. Lack of water can affect cell turgor, which will reduce cell development, protein synthesis, and cell wall synthesis. Water availability will affect the growth and development of a plant. Water loss from plants by transpiration is an inevitable result of the need to open and close stomata for CO2 entry and water loss through transpiration is greater through stomata than through the cuticle. Plants in conditions of continuous water shortages will experience water stress. The effect of water availability on plant growth depends on the level of water availability experienced and the type or cultivar planted. The initial effect of plants experiencing water shortages is the occurrence of obstacles to the opening of leaf stomata which then has a major effect on physiological and metabolic processes in plants (Felania, 2017).

The success of plants to produce optimally cannot be separated from the management provided, such as cultivation techniques in determining the amount of water needed. Water availability determines the success of plant production, both vegetatively and generatively because water is a basic need for plants. Water requirements increase with increasing groundwater content, but the highest water use efficiency is at groundwater levels between 55–70% of field capacity (Supriadi et al., 2018). This study is a follow-up to the study conducted by Faozi & Matana (2017) conducted a study entitled The Effect of Watering Intervals on Coconut Seedling Growth showing that there was no interaction effect between watering intervals and coconut varieties used on root length, root volume, number of roots and increase in seedling height. Watering intervals twice a week and once a week provided good vegetative growth, namely an increase in seedling height and Nias Yellow Genjah (NYG) had the largest number of roots. Meanwhile, this study aims to determine the correlation analysis between watering interval, stem height, stem diameter, and number of leaves in Jackfruit Seedlings (Artocarpus Heterophyllus Lamk).

2. Materials and Methods

The research was conducted in the closed room experimental garden of the Plantation Management Study Program of the Politeknik Indonesia Venezuela located in Cot Suruy Village, Ingin Jaya District, Aceh Besar Regency, from May 2024 to July 2024. The temperature in the experimental garden is set from 25°C – 28°C. The tools used in this study are stationery, a cutter knife, a camera, a ruler, a notebook, and a pen. The materials used in this study are 1-month-old jackfruit seedlings, planting media, and water.

The media used are soil and compost, each polybag contains soil and compost that do not differ in terms of nutrient content that will affect the growth of *Artocarpus Heterophyllus* Lamk in the end. The prepared jackfruit seedlings are planted in polybags measuring 15 x18 cm which have been filled with soil and compost. Then planted in polybags that already contain soil and fertilizer.

The parameters observed are: Plant height is measured using a ruler by measuring from the ground surface to the tip of the highest stem. The stem diameter is measured at a height of one cm above the ground surface using a digital caliper. The number of leaves counted are leaves that have fully opened. The calculation of the number of leaves was carried out two weeks after planting. Measurement of stem diameter was carried out 2 weeks after planting and then measured once a week for seven weeks. The data in this study are primary data obtained from the research site. The study was conducted using a non-factorial Randomized Block Design (RBD) with 6 treatments repeated 4 times. Each experimental unit consists of 1 seedling aged ±1 month, overall having 24 jackfruit seedlings. The data was processed using the Statistical Package for the Social Sciences 25 (SPSS 25) application. To see the correlation analysis between Watering Interval, Stem Height, Stem Diameter, and Number of Leaves in Jackfruit Seedlings (*Artocarpus Heterophyllus* Lamk), bivariate correlation analysis was used (Khriswanti *et al*., 2022; Triadiawarman *et al*., 2022).

Correlation is a number that shows the direction and strength of the relationship between two or more variables. The correlation coefficient has a value between -1 to +1, with plus and minus signs indicating positive and negative correlations. The closeness of the relationship between one variable and another is usually called the Correlation Coefficient which is marked with "r". Multiple correlation test guidelines in SPSS. If the Sig. F change value < 0.05 then there is a significant relationship, and if the Sig. F change value > 0.05 then there is no significant relationship (Ramdani *et al*., 2020). The general formula for finding r is as follows:

$$r = \frac{n\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{(n\Sigma X^2 - (\Sigma X)^2)\,(n\Sigma Y^2 - (\Sigma Y)^2)}}$$

The criteria analysis test correlation can be seen in Table 1 (Abdullah *et al*., 2024).

Table 1 . Criteria Analysis Test Correlation

No.	Correlation value	Information
1	0	There is no correlation between the two variables
2	> 0 – 0.25	The correlation is very weak
3	> 0.25 – 0.5	Correlation enough
4	> 0.50 – 0.75	Strong correlation
5	> 0.75 – 0.99	The correlation is very strong
6	= 1	The perfect correlation is positive
7	= -1	Negative perfect correlation

3. Results and Discussion

Table 1. Results of Correlation Analysis between Watering Interval Twice a Day, Plant Height, Stem Diameter and Number of Leaves

Correlations

		Watering Interval Twice a Day	Plant Height	Stem Diameter	Number of Leaves
Watering Interval Twice a Day	Pearson Correlation	1	0.050	0.302	0.215
	Sig. (2-tailed)		0.836	0.195	0.362
	N	20	20	20	20
Plant Height	Pearson Correlation	0.050	1	0.665**	0.813**
	Sig. (2-tailed)	0.836		0.001	0.000
	N	20	20	20	20
Stem Diameter	Pearson Correlation	0.302	0.665**	1	0.730**
	Sig. (2-tailed)	0.195	0.001		0.000
	N	20	20	20	20
	Pearson Correlation	0.215	0.813**	0.730**	1
	Sig. (2-tailed)	0.362	0.000	0.000	
	N	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2. Results of Correlation Analysis between Watering Interval Once a Day, Plant Height, Stem Diameter and Number of Leaves

Correlations

		Watering Interval Once a Day	Plant Height	Stem Diameter	Number of Leaves
Watering Interval Once a Day	Pearson Correlation	1	0.304	0.221	0.305
	Sig. (2-tailed)		0.193	0.349	0.191
	N	20	20	20	20
Plant Height	Pearson Correlation	0.304	1	0.754**	0.837**
	Sig. (2-tailed)	0.193		0.000	0.000
	N	20	20	20	20
Stem Diameter	Pearson Correlation	0.221	0.754**	1	0.857**
	Sig. (2-tailed)	0.349	0.000		0.000
	N	20	20	20	20
Number of Leaves	Pearson Correlation	0.305	0.837**	0.857**	1
	Sig. (2-tailed)	0.191	0.000	0.000	
	N	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3. Results of Correlation Analysis between Watering Interval Once in Three Days, Plant Height, Stem Diameter and Number of Leaves

Correlations					
		Watering Interval Once in Three Days	Plant Height	Stem Diameter	Number of Leaves
Watering Interval Once in Three Days	Pearson Correlation	1	0.004	0.202	0.017
	Sig. (2-tailed)		0.985	0.392	0.942
	N	20	20	20	20
Plant Height	Pearson Correlation	0.004	1	0.203	0.573**
	Sig. (2-tailed)	0.985		0.391	0,008
	N	20	20	20	20
Stem Diameter	Pearson Correlation	0.202	0.203	1	0.537*
	Sig. (2-tailed)	0.392	0.391		0.015
	N	20	20	20	20
Number of Leaves	Pearson Correlation	0.017	0.573**	0.537*	1
	Sig. (2-tailed)	0.942	0,008	0.015	
	N	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4. Results of Correlation Analysis between Watering Interval Once in Five Days, Plant Height, Stem Diameter, and Number of Leaves

Correlations					
		Watering Interval Once in Five Days	Plant Height	Stem Diameter	Number of Leaves
Watering Interval Once in Five Days	Pearson Correlation	1	0.343	0.142	0.283
	Sig. (2-tailed)		0.139	0.552	0.226
	N	20	20	20	20
Plant Height	Pearson Correlation	0.343	1	0.357	0.574**
	Sig. (2-tailed)	0.139		0.123	0.008
	N	20	20	20	20
Stem Diameter	Pearson Correlation	0.142	0.357	1	0.343
	Sig. (2-tailed)	0.552	0.123		0.138
	N	20	20	20	20
Number of Leaves	Pearson Correlation	0.283	0.574**	0.343	1
	Sig. (2-tailed)	0.226	0.008	0.138	
	N	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5. Results of Correlation Analysis between Watering Interval Once in Seven Days, Plant Height, Stem Diameter and Number of Leaves

Correlations					
		Watering Interval Once in Seven Days	Plant Height	Stem Diameter	Number of Leaves
Watering Interval Once in Seven Days	Pearson Correlation	1	0.122	0.012	0.269
	Sig. (2-tailed)		0.608	0.960	0.252
	N	20	20	20	20
Plant Height	Pearson Correlation	0.122	1	0.872**	0.890**
	Sig. (2-tailed)	0.608		0.000	0,000
	N	20	20	20	20
Stem Diameter	Pearson Correlation	0.012	0.872**	1	0.743**
	Sig. (2-tailed)	0.960	0.000		0.000
	N	20	20	20	20
Number of Leaves	Pearson Correlation	0,269	0.890**	0.743**	1
	Sig. (2-tailed)	0.252	0.000	0.000	
	N	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6. Results of Correlation Analysis between Watering Interval Once in Nine Days, Plant Height, Stem Diameter and Number of Leaves

Correlations					
		Water Interval Once in Nine Days	Plant Height	Stem Diameter	Number of Leaves
Water Interval Once in Nine Days	Pearson Correlation	1	0.548*	0.428	0.339
	Sig. (2-tailed)		0.012	0.060	0.144
	N	20	20	20	20
Plant Height	Pearson Correlation	0.548*	1	0.225	0,338
	Sig. (2-tailed)	0.012		0.339	0.145
	N	20	20	20	20
Stem Diameter	Pearson Correlation	0.428	0,225	1	0.438
	Sig. (2-tailed)	0.060	0.339		0.054
	N	20	20	20	20
Number of Leaves	Pearson Correlation	0.339	0.338	0.438	1
	Sig. (2-tailed)	0.144	0.145	0.054	
	N	20	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

In Table 1, it can be seen that the variable of plant height is very strongly related to the variable of stem diameter and number of leaves (can be seen with the ** sign). The variable of stem diameter is very strongly related to the variable of several leaves. Plant height has a significant effect on stem diameter and number of leaves. Stem diameter has a significant effect on plant height and number of leaves (Sig. F change value <0.05, then there is a significant relationship) (Wahyono, 2014; Dharta *et al*., 2024).

In Table 2, it can be seen that the plant height variable is very strongly related to the stem diameter and number of leaves variables (can be seen with the ** sign). The stem diameter variable is very strongly related to the number of leaves variable. The number of leaves variable is very strongly related to the plant height variable and the stem diameter variable. Plant height has a significant effect on stem diameter and number of leaves. Stem diameter has a significant effect on plant height and number of leaves. The number of leaves has a significant effect on plant height and stem diameter (Sig. F change value <0.05, so there is a significant relationship).

In Table 3, it can be seen that the plant height variable is very strongly related to the number of leaves variable (can be seen with the ** sign). The

stem diameter variable is strongly related (can be seen with the * sign) to the number of leaves variable. The number of leaves variable is very strongly related to the plant height variable and is strongly related to the stem diameter variable. Plant height has a significant effect on the number of leaves. Stem diameter has a significant effect on the number of leaves (Sig. F change value <0.05, so there is a significant relationship).

In Table 4, it can be seen that the variable of plant height is very strongly related to the number of leaves (can be seen with the ** sign). The variable of stem diameter is very strongly related to the variable of several leaves. Plant height has a significant effect on the number of leaves. Stem diameter has a significant effect on plant height and number of leaves (Sig. F change value <0.05, so there is a significant relationship).

In Table 5, it can be seen that the plant height variable is very strongly related to the stem diameter and number of leaves (can be seen with the ** sign). The stem diameter variable is very strongly related to the plant height and number of leaves. Plant height has a significant effect on stem diameter and number of leaves. The number of leaves is very strongly related to the plant height and stem diameter variables. Stem diameter has a significant effect on plant height and number of leaves. The number of leaves has a significant effect on plant height and stem diameter (Sig. F change value <0.05, so there is a significant relationship). Taz *et al*., (2014) stated that in plant physiology there is a relationship between various plant growth variables, such as stem diameter, number of leaves, and plant height. In Tables 1 to 5, there is no relationship and influence of the watering interval variable with the plant height, stem diameter, and number of leaves. This means that the role of the watering interval in jackfruit seedlings does not play an important role.

Table 6 shows that there are no variables that are strongly related and have a significant effect on the watering interval, plant height, stem diameter, and number of leaves. The decreasing amount of water causes plants to be unable to carry out normal plant growth activities. Impact of Water Deficiency on Plant Growth: Inhibited Growth. Plants that lack water experience inhibited growth because important physiological processes are disrupted. Plant cells cannot develop properly, resulting in decreased vegetative growth and biomass production. In crops, water shortages can cause decreased yields. This is because not only vegetative growth is inhibited, but also the formation of flowers and fruits is disrupted. Stress and Damage. Lack of water causes stress in plants, which can trigger the production of stress hormones such as abscisic acid (ABA). This stress can cause damage to plant tissue and reduce resistance to disease and pests (El Habti, 2019).

The results showed that low water availability (50-12.5% field capacity) harmed plant growth and negatively affected leaf, stem, and root dry weight. The reduction in growth was highly significant in plants with water availability of 12.5% of field capacity. In low water availability, the plant that experience drought stress produced greater sinensetin content (0.0133%). Increased sinensetin in drought stress condition is a biochemical and physiological response of plants to unfavourable conditions (Hadiyanti *et al*., 2023). Drought-tolerant rubber plants (*Hevea brasiliensis* Müll. Arg.) adapt to drought stress conditions physiologically through several mechanisms, including increased production of the hormone ABA, stomata closure, osmoregulation, and antioxidant production (Cahyo *et al*., 2020).

To cope with water scarcity, plants have developed a variety of complex and species-specific adaptation mechanisms. These mechanisms involve physiological and biochemical responses that help plants survive drought conditions. Some of the adaptation strategies include: regulation of growth patterns, modification of root-shoot ratio, transpiration efficiency and osmotic regulation, and delayed senescence. Approaches to address drought stress include: breeding strategies, omics technologies, drought induction and stress. In addition, emerging technologies such as microbes, hydrogels, nanoparticles, and metabolic engineering that regulate the activity of antioxidant enzymes also have the potential to improve plant tolerance to drought stress. These approaches aim to ameliorate the adverse effects of water stress and improve agricultural yields (Seleiman *et al*., 2021).

The research results from tables 1 to 6 show that there is no strong correlation between the effect of watering intervals on plant height, stem diameter, and number of leaves. This is in accordance with the results of the study by Desiana & Heddy (2018), which showed that the watering interval did not affect the number of leaves, leaf area and flowering duration, while the longer the plant was not given water in the generative phase, the number of flowers, the number of fruits and the percentage of fruit formation would increase. The longest watering interval in the treatment was once every 4 days and once every 4 days twice, compared to the flowering interval of once every 2 days which would reduce the number of flowers, the number of fruits and the percentage of fruit formation.

4. Conclusions

There is a relationship between plant height, stem diameter, and number of leaves. There is no relationship between the length of the watering interval with the variables of plant height, stem diameter, and number of leaves. At a watering interval of once every nine days showed that there are no variables that are strongly related and have a significant effect on the watering interval, plant height, stem diameter, and number of leaves. The decreasing amount of water causes plants to be unable to carry out normal plant growth activities.

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