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Research Article
Growth Study of Pandemics Durian (*Durio zibethinus* L.) Based on Nutritional Analysis

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Abstract

Background and Objective: Durian pandemic can be planted in lowland to highland because it has high adaptive character. However, further studies on durian cultivation techniques are needed because durian is an annual plant and did not have continuous growth but cyclical. The purpose of this study was to know the relationship of nutrient content with growth of durian. **Materials and Methods:** The research was conducted in Ngembal village, Tutur Nongkojajar district, Pasuruan city. The research was conducted from May, 2016 until October, 2016. This research was informative without any treatment but samples were collected 4 leaves on the upper, middle and lower stratum. Then quantitative analysis was conducted on carbon and nitrogen total content. Each sample taken from plants durian (Montong, Matahari and Kani) has been fruitful. The results were analyzed with SPSS 17.0 software processed by correlation analysis. **Results:** The results showed on the generative phase (flowering) in durian Kani and Montong is characterized by the absence of growth in stem diameter but in durian Matahari, there is still increase in the number of stem diameters. The decrease of shoot quantity is also characteristic of the inclusion of generative phase at Kani, Montong and Matahari. **Conclusion:** The flowering phase indicated a decrease in the number of shoots, total nitrogen content and an increase in the organic carbon content in the leaves.

Key words: Carbon/nitrogen ratio, *Durio zibethinus* L., flowering, nutritional analysis, periodic growth

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Durian is a fruit that could grow in the tropical zone and including to seasonal fruit and known as the king of fruit in Indonesia. There are many varieties of durian that have not been cultivated commercially, only a few species are already known as commercial crops. *Durio zibethinus* and *Durio kutejensis* as well as the offspring of both varieties have been widely grown as a commercial crop. Basically commercial durian are endemic and pandemic. Durian with endemic types have specific environmental conditions, that is, the environment changes could produce different quality and quantity of fruit. The interaction between the air temperature and plant growth durian at various altitudes, causing changes in the quality and quantity of fruit species of *Durio zibethinus*[1]. Durian pandemic has a high adaptability to the new environment, especially to the type of soil (with neutral pH to slightly acid) and altitude (up to 800 m.a.s.l). In the relative diverse environments, durian pandemic is still capable to producing fruit with the quality and quantity relatively equal. According to Kurniawati[2], the durian found many obstacles in the plant growth because of the periodic growth characteristic, so it is difficult to predict the timing of flowering. In various studies, it is noted that the flowering happened in certain range of C/N area, which is an indicator of nutrient availability of organic C and N in plant tissue. Younger plant tissue has lower the C/N and it varies between one plant to another[3].

Durian plant growth patterns happen periodically. Environmental conditions is a favorable factor for vegetative growth (formation of shoots and branches, trunks and branches as well as the enlargement of root growth) and was not followed by the emergence of flowers bud and fruit[4]. In particular, fruit quality problems is thought to be caused by element deficiency nutrients in the soil. Analysis of plant nutrition content could determine the vegetative and generative growth of plants and the analysis of C/N levels on the leaves can be used to determine flower initiation period, without ignoring the other factors that affect flowering in durian[2]. The importance of predictive knowledge of growth patterns of durian plants in the flowering phase is the first step in the process of reproduction. The accuracy of the regulation of chemical growth patterns can be done by analyzing the nutritional content present in the plant. Analysis of nutrient content in plants will be very helpful in determining the effect of nutrients on each varieties with the flowering period, the level of C/N content in the plant will be very helpful in determining the period of flower initiation, without other factors affecting flowering on the durian crop. Based on the description, this research aimed to study the relationship of nutrition content with growth of durian.

MATERIALS AND METHODS

The research was conducted in the Ngembal village, Subdistrict Tutur, Pasuruan, at an altitude of 686 m.a.s.l, with Andisol soil type, which is soil of volcanic material and widely used for the cultivation of horticultural crops[5]. The study was conducted from May, 2016 until October, 2016. The materials used for this research were gaff, cutter, plastic bags, aluminum foil, tape measure, paper labels, ice box and some of leaves samples such as durian Montong, Matahari and Kani.

Durian Montong, Matahari and Kani; used as sample were spotted fruitful. The number of plant samples used in this study were 60 plants, each variety using 20 plant samples. Durian tree was divided into two strata; the upper and lower stratum. Each stratum samples taken mature leaves randomly every three weeks and continued with laboratory tests from the beginning to final observations.

Parameters of observations: Variables observations including the number of flush formation, stem diameter (cm) and flowering periods will be characterized by the emergence of flower buds. The results of laboratory analysis were data in the form of C-organic with Walkley and Black method, total nitrogen content with Kjeldahl method and C/N ratio of leaves. The C/N measurements were performed by calculating the ratio of total C-organic and total nitrogen values obtained from the analysis data[6]:

$$C / N = \frac{C - organic}{Total\ N\ content}$$

Statistical analysis: The data of durian observations were analyzed with software SPSS 17 and continued by correlation analysis. Correlation test aimed to examine the relationship between the vegetative and generative growth characteristics to the plant nutritional content linked with the observation periods.

RESULTS

Relationship between vegetative growth and plant nutrient of durian Kani: The results of durian Kani correlation in Table 1, show a positive correlation that occurred between

Table 1: Variables of observation on Durian Kani

Variable	Shoot (%)	⊙Trunk (cm)	CO (%)	NT (%)	C/N	Rainfall (mm)
Shoot (%)	1.00	0.51	0.10	0.86**	-0.52	0.63
⊙Trunk (cm)		1.00	-0.01	0.47	-0.27	0.25
CO (%)			1.00	0.25	0.69*	0.39
NT (%)				1.00	-0.51	0.68*
C/N					1.00	-0.14
Rainfall (mm)						1.00

Numbers followed by asterisk (**) is a significant correlation on the level of 1%, an asterisk (*) is a significant correlation on the level of 5% and the numbers that are not followed by an asterisk there is no significant correlation, ⊙Trunk: Trunk diameter, CO: Carbon organic, NT: Total nitrogen, C/N ratio

Table 2: Variables of observation on Durian Montong

Variable	Shoots (%)	⊙Trunk (cm)	CO (%)	NT (%)	C/N	Rainfall (mm)
Shoots (%)	1.00	0.12	0.75*	0.91**	-0.87**	0.64
⊙Trunk (cm)		1.00	-0.27	-0.19	0.08	0.45
CO (%)			1.00	0.83**	-0.52	0.27
NT (%)				1.00	-0.89**	0.36
C/N					1.00	-0.35
Rainfall (mm)						1.00

Numbers followed by asterisk (**) is significant correlation on the level of 1%, an asterisk (*) is a significant correlation on the level of 5% and the numbers are not followed by an asterisk there is no significant correlation, ⊙Trunk: Trunk diameter, CO: Carbon organic, NT: Total nitrogen, C/N ratio

Table 3: Variables of observation on Durian Matahari

Variable	Shoots (%)	⊙Trunk (cm)	CO (%)	NT (%)	C/N	Rainfall (mm)
Shoots (%)	1.00	-0.70	0.24	0.84**	-0.37	0.87**
⊙Trunk (cm)		1.00	0.14	-0.67	0.62	-0.73
CO (%)			1.00	0.22	0.63	0.25
NT (%)				1.00	-0.59	0.60
C/N					1.00	-0.17
Rainfall (mm)						1.00

Numbers followed by asterisk (**) is a significant correlation on the level of 1%, an asterisk (*) is a significant correlation on the level of 5% and the numbers that are not followed by an asterisk there is no significant correlation, ⊙Trunk: Trunk diameter, CO: Carbon organic, NT: Total nitrogen, C/N ratio

the shoot and total nitrogen with the correlation of r = 0.86, which indicated when the increased nitrogen content was directly proportional to number of shoots. The positive correlation was found between organic carbon with a C/N and total nitrogen in precipitation with level of 5%. Table 1 shows the correlation between organic carbon in the C/N was equal to r = 0.69, which indicated that when there was an increase in organic carbon, then the value of C/N will extend. The total nitrogen content in durian Kani and rainfall precipitation had a significant positive correlation of r = 0.68. it showed the nitrogen content during observation.

Relationship between vegetative growth with plant nutrient of durian montong: The correlation test was performed to determine if there was a relationship between the characters of vegetative growth and analysis of nutritional content of durian Montong. The test results on a correlation variable (Table 2), showed a significant correlation between shoot growth with total nitrogen and total organic carbon with nitrogen at level of 1%. While the relationship between shoots with organic carbon were significantly different at level of 5%. The positive correlation was also found on the relationship of shoots with total nitrogen and shoots with organic carbon. The correlation between total organic carbon with nitrogen had a value of r = 0.83. The high organic carbon could make an increasing number of shoots on the durian due to increased the nitrogen content, which contribute in the vegetative growth of the plants. The relationship of shoots and total nitrogen, reveals the increase in the total of nitrogen, followed by the increasing of shoots percentage in durian Montong.

Based on the results of the correlation between variables observed in plants durian Montong negative correlation between shoots and C/N with a value of r = -0.87 and total nitrogen C/N of r = -0.89. the relationship between shoots with C/N showed a decrease in C/N ratio will be followed by the increasing number of shoots on Montong durian. The low content of C/N during the flush (shoot growth) due to the high content of nitrogen, so the plants more encouraged in vegetative growth. The high shoots percentage was because the value of total nitrogen on the plant was high. Thus, the results of the correlation between total nitrogen and C/N obtained a negative correlation, which means that the high value of total nitrogen caused the low value of the C/N or vice versa.

Relationship between vegetative growth with plant nutrient of durian matahari: Based on Table 3, shows shoots

in Durian Matahari meliki positive correlation with rainfall that is 0.87. Durian Matahari shoot and total nitrogen had positive correlation with r = 0.84, which indicated the shoots growth followed by increasing nitrogen content. On, illustrates shoots relationship with total nitrogen and showed an increase in nitrogen content, followed by the increasing number of shoots.

DISCUSSION

The development of stem diameter and formation of the flush were occur alternately on the durian species Kani, Monthong and Matahari. Flush formation was not correlated with rainfall, except on durian Matahari. The formation of flower will be followed by a decrease in the number of shoots. The decline in total nitrogen content and increasing the organic carbon content in the leaves followed by a decrease in C/N ratio could intensify the emergence of flower in the plant.

The value of organic carbon caused by the C/N because the C/N value is obtained from the mass ratio of carbon to nitrogen mass in a substance. C/N is an indicator of nutrient availability of organic C and N in plant tissue. The high frequent of rainfall in June because Indonesia has a monsoon rain patterns, that are characterized by unimodal the type of precipitation (the peak of the rainy season). Nitrogen content were increased due to the rainfall affects most of some chemical elements in the soil. Increased levels of nitrogen in the leaves of durian is directly related to the high frequency of rainfall during the observation[7].

Haq *et al.*[8], stated that nitrogen is an essential element for vegetative growth of plants and play a specific role in the growth and development of plant tissue, stimulate branching and stimulates the production of leaf crops. Gardner *et al.*[9], stated that nitrogen plays a role in the formation of proteins, then nitrogen is absorbed by roots will be converted into amino acids and then it changed into proteins. Thus, there was a decrease in the nitrogen content of the plant leaves, when the plants began to enter the generative phase due to the nitrogen contained in the plants was used for the formation of protein in seeds formation[10].

Organic carbon is the main ingredient to framing carbohydrate and nitrogen is the main ingredient to create the protein, whereas the protein is composed of amino acids, which is amino acid formulation process will not occur without carbohydrates. The high organic carbon affect the increasing of N content in the crop and gave a significant positive effects to the shoots growth of durian. Nitrogen is needed to form new cells, so the vegetative growth such as the emergence of new shoots will be stimulated[10]. Nitrogen plays an important role for the vegetative growth of plants and development of plant tissue, stimulate branching and the production of new leaves. The low content of nitrogen in plants will result a decreased in protein, inhibits the growth and accelerate the flowering phase[11].

Nitrogen is macro nutrients, that required by plants as protein components. Proteins would be used as constituent vegetative organs such as roots, stems and leaves. Nitrogen is an essential element for vegetative growth and development of plant tissue, stimulate branching and stimulates the production of leaf crops. It is also consistent with research Kurniawati[2], shoots a high growth in the wastebasket and orange durian will be followed by increasing the total value of positive nitrogen. The correlation of shoots and rainfall with a value of r = 0.87. The number of shoots was proportional to the higher rainfall, or vice versa. Increase or decrease in the total number of shoots affected by nitrogen. Despite the weak correlation table showing the correlation between the total nitrogen in precipitation, but rainfall on several observations indicate that an increase or decrease in precipitation and a decrease followed by an increase in total nitrogen. Increased levels of nitrogen in the leaves of durian is directly proportional to the high rainfall during the observation. Rainfall affects most of some chemical elements in the soil particularly the total nitrogen[12].

The entry of the generative phase (flowering) on durian Kani and Montong characterized by the absence of growth of stem diameter, while Matahari still durian increase the amount of stem diameter. The decline in the number of shoots is a characteristic of the early generative phase of durian Kani, Montong and Matahari. The stem diameter was not continue to growth and a decrease in the number of shoots at the time, because the durian crop was entering the generative phase, which requires mostly carbohydrate during the flower initiation and to form the flowers[13]. Thus, vegetative phase initially was using carbohydrates and proteins for stem and leaf growth, will be transferred into the formation of generative organs, so the vegetative growth was not continue for a while, which make decreasing the number of shoots on the durian plant. The research conducted by Liferdi *et al.*[10], showed a decrease nitrogen content in the leaves, when rambutan crop start to enter the generative phase.

The generative phase on the three types of durian could be predicted from the increase in the value of

organic carbon and C/N as well as a reduction in total nitrogen prior to flowering phase. Some research indicated that a high content of C/N on the leaves are compatible to flowering period and an increased slightly of carbohydrates could stimulate flowers bud initiation. This is because carbohydrates are vastly used at the beginning of plant growth, so the sufficient carbohydrate level is needed for the flowering phase. High content of C/N ratio could accelerate the plants to flowering[14].

In addition, the decreasing levels of nitrogen, increasing organic carbon content and high C/N ratio in a durian can be used as a reference in determining the generative phase. Water stress is one factor that can induce flowering in plants durian. Water stress on the durian Kani, Montong and Matahari located on Ngembal village was happen naturally on the dry season to rainy season. The absence of rainfall in the Ngembal village started on August and September. There are several ways that can be done to regulate flowering fruit trees, which is using water stress treatment[15]. Stressful conditions for plants will decline the photosynthesis process[16]. Furthermore, it will affect the availability of minerals in plants. The interaction between the availability of minerals and growth hormones will inhibit the vegetative growth and spur the cell differentiation process, so it could accelerate the generative growth[17].

CONCLUSION

Based on the analysis of plant nutrients that have been done, the inclusion of generative phases in durian plants Kani, Montong and Matahari, characterized by the decrease in total nitrogen content. Increased organic carbon content and C/N are also factors that can characterize durian plants have entered the generative phase. The level of C/N at flowering has different value between durian Kani, Montong and Matahari.

SIGNIFICANCE STATEMENT

This study discovers the prediction of growth patterns of durian plants, especially in the flowering phase, which is the first step in the reproductive process. The accuracy of the regulation of chemical growth patterns can be done by analyzing the nutritional content contained in the plant. Analysis of nutrient content in plants will be very helpful in determining the effect of nutritional content on each varieties with the flowering period.

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