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The Study of Climate and Its Influence on the Flowering Period and the Plant's Age on Harvest Time of Durian Plantation (*Durio Zibethinus* Murr.) on Different Level of Altitude Area

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ABSTRACT

This study is aimed at gathering the information on the correlation of climate variables and the Flowering period and the length of harvest time in durian plantation in the different altitude area. The method of research was survey in the central of local durian producer, which were categorized in 3 altitudes: 1) low altitude (< 300 m above the sea level), 2) Medium altitude (300-600 m above the sea level), and 30 High altitude (>600 m above the sea level). Two samples of local durian producer were taken from each altitude. The observation done was done during a year (from January 2011 until March 2012) over the precipitation and the temperature. The plant variables being observed was the flower from the initial show up until the blooming period and the length of the harvest time in each altitude. The methods of analysis used were correlation, regression by using SPSS for Windows in the Frequencies sub program. The result of the study shows that there is significant correlation between climate variables (the number of dry season months, the average temperature, maximum and minimum temperature) and the plantation variables (the formation of the flower buds, blooming period and harvest time) in different altitude. The precipitation intensity does not affect the flower buds formation and the length of harvest time, except the number of the dry months. The temperature, temperature difference (maximum and minimum) and minimum temperature have negative correlation towards Flowering period and harvest time in different altitude. The increase of altitude will long then the harvest time of local durian. The quantitative correlation between altitude and the flower budding formation period as well as with the harvest time, in cubic, is $R^2 = 0.80$ and $R^2 = 0.79$

Keywords: Climate, Flowering period on durian plantation, Altitude area

INTRODUCTION

Durian (*Durio zibethinus* Murr.) belongs to the 10 national fruits commodity. The Indonesian government is urgent the need the improvement in it productivity to increase the competition and export value which in turn will be expected to improve the state's income. In 2010, the production of durian decreased to 22.2% compared with that in 2009 which reached 900.000 tons [2]. This phenomenon caused the increase the import of durian from Thailand which reached 27,149 tons with the value of more than US$ 38,1 million in the last 2 years [15].

The basic problem so far is the global climate change which causes the unstable production and low productivity both in quantity and quality of the local durian. There have so many efforts done to improve the productivity such as in the technology and policy used in the cultivation implemented by the government such as in the multiplication and provision of high quality durian [14], the Agronomy technique of durian in acid type of soil [7], inflorescence and fertilization technique [8], and the policy of local durian cultivation [9, 1]. However the impact of the global climate towards the instability and low fruit production caused by hydrological cycle, have not been paid attention to especially in the effort of climate disaster mitigation caused by the pattern of weather change and climate in different altitude. That information is very beneficial for farmers to increase their income from durian in a year. It can also be used to support the development of durian in new location with its different climate.

This study is important to be conducted to decrease the effect of weather and climate change towards the stability of local durian production in many different altitudes. Those study were aimed at collecting information on the correlation of climates variables (precipitation and temperature) with the variable of durian fruits production (Flowering period and the length of harvest time) in several altitudes. Therefore, the study on the climate and its influences towards the Flowering period and harvest time of local durian in different altitudes is needed.

MATERIALS AND METHOD

The study was conducted in 6 different central producers in East Java, from January 2011 to March of 2012. The locations of the study are mentioned in the table 1.

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Table 1 The location of the study in different altitudes as the central production of local durian in East Java.

Stratum Altitude (m)		Location	Altitude (m above the sea level)	Eastern Longitude	Southern Latitude
Low land (0 – 300)	1	Village : Patemon District : Tanggul City. : Jember	76	113°27'38,41"	8°08'51,87"
	2	Village : Suburejo District : Tirtoyudo City : Malang	257	112°53'47,63"	8°20'08,03"
Medium Altitude (300 – 600)	1	Village : Balak District : Songgon City : Banyuwangi	327	114°13'17,68"	8°14'46,34"
	2	Village : Kuninglor District : Arjasa City : Bondowoso	503	113°41'46,96"	8°05'15,20"
High Altitude (>600)	1	Village : Ngepung District : Sukapura City : Probolinggo	681	113°03'25,95"	7°51'49,69"
	2	Village : Sumberpitu District : Tutur City : Pasuruan	733	112°47'43,61"	7°52'14,81"

The sampling was gathered for several climate variables was done by doing proportional observation [12], where the characteristics of the same population (age or height of crown). Therefore the devices to measure the atmosphere of physical environment were located in the same group of age or same height of the crown. In the group of durian with relatively the same age and height of crown, the devices were located in the midle of the crown and on the soil surface. The observations were done in the morning (06.30 – 07.00) in the minimum temperature and in the afternoon (17.00 – 17.30) for the maximum temperature and precipitation [11]. The observation on durian was done over: 1. The Flowering, by observing the emergence of the buds at productive branches by using loupe in terms of date and months (days), 2. Blooming phase, by counting the length of time taken for the flowers to bloom until the fruits are formed (days) and the duration (in days) when durians are ready for harvest in each altitude.

The data analysis was done by correlating the climate variables with the plants growth. Boer [3] states that the approach used in defining the agroclimatological zone appropriate for the plant is the correlation of the climate variables and the plants growth (including the infloresences phase and the fruit production).

The data collected was presented in the form of a tables and later was described in the form of number and presentage. The data then was analyzed by using SPSS program for Windows at Frequencies sub program.

RESULTS AND DISCUSSION

1. Precipitation and temperature in different altitudes

The precipitation intensity was happened in each altitude as shown in figure 1, while wet and dry months in figure 2. As the central of durian production in East Java, the lowest precipitation was found in district of Arjasa, and the highest was in district of Songgon. The high potency of precipitation in Songgon and Tutur was not balanced with the number of wet months in a year so that high level rain fell in a relatively short time (figure 2). In the districts of Tanggul and Tirtoyudo, the precipitation levels were lower than that of Songgon. In the same stratum category in Songgon and Arjasa, the precipitation level and the number of the wet months were not equal in number. In Songgon, the altitude was classified as Wind Word Side, while in Rajasa it was Lee Word Side effect. That condition caused the low level of precipitation and the number of wet months to happen in Rajasa than in Songgon[4, 13]. In the same level on high land in Sukapura and Tutur, the pattern of precipitation increased along with the increase in altitude, yet it worked the opposite for the average monthly temperature (Figure 3).

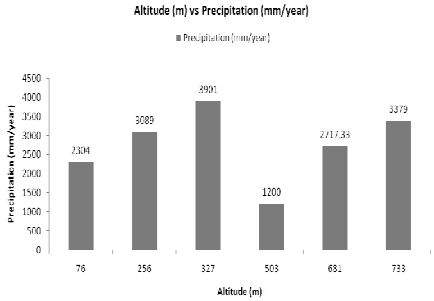


Figure 1.
Precipitation average annually in each altitude

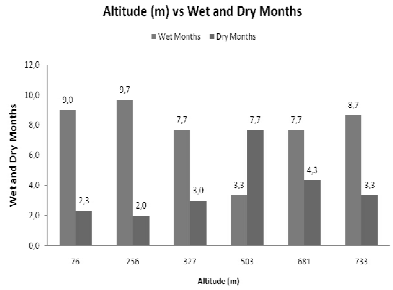


Figure 2.
Wet and dry months average in different altitude

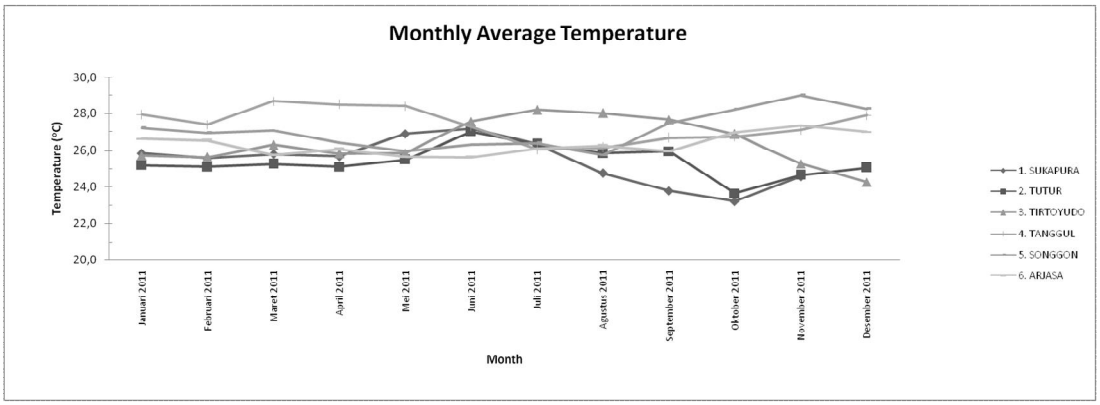


Figure 3.The average monthly temperature from January 2011 to December 2011 in different altitude.

The average temperature also acted as the consideration for climate type decision making. The variation of temperature in each altitude was not the same every month (figure 3), excepting April to September in 2011; it also happened in the case of temperature defense of maximum and minimum (figure 5), but it worked the opposite at its minimum temperature (figure 4).

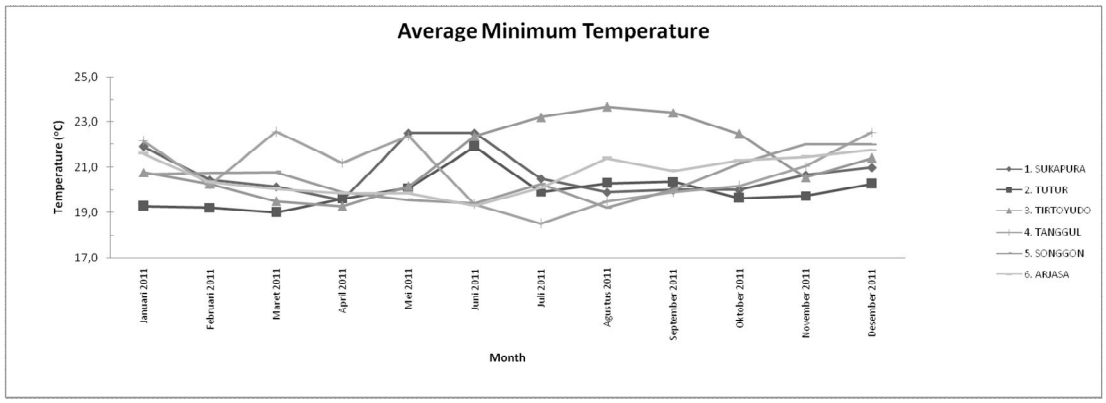


Figure 4 The average of minimum temperature from January 2011 to December 2011 in different altitude.

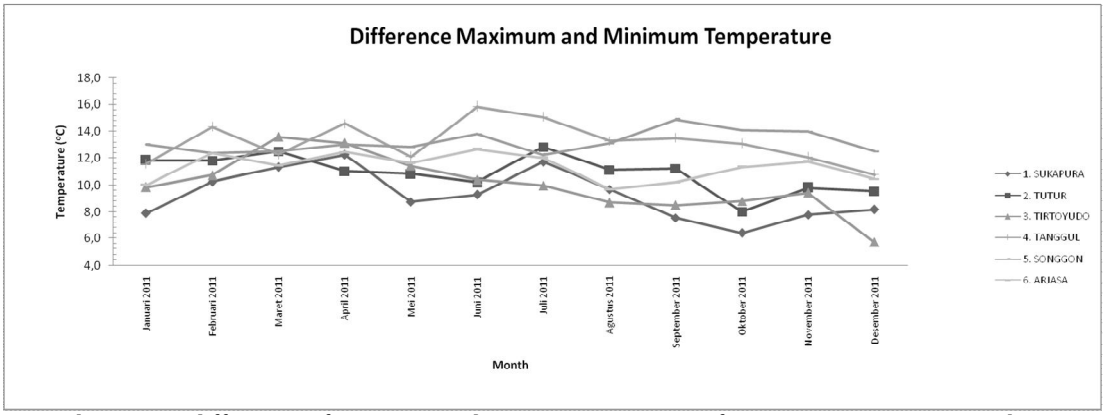


Figure 5 The average differences of maximum and minimum temperature from January 2011 to December 2011 in different altitude.

During January 2011 to December 2011, the difference of maximum and minimum was not the same in each altitude. In those 6 districts, from April to July, the temperature difference was relatively high compared with the other months, except that in Sukapura and Tirtoyudo during January 2011 and December 2011. In the lowland of Tanggul and Tirtoyudo, the monthly temperature was averagely lower compared with that in the average and high land. However, in Tanggul, the difference of maximum and minimum temperature reached its highest in the year especially in April, June, July and August 2011.that condition reflected the different temperature (maximum and minimum) in those months inTanggul as the low land zone behind the Argopuro Mountain.

2. The Interaction between the climate types and flowering period as well as with the harvest length of durian in different altitude.

The altitude change affects the temperature and average precipitation annually, which characterize the specific climate type based on the classification of climate type by Schmidt- Ferguson. It also affected the Flowering stage and the harvest time length in different altitude (table 2).

Durian production central in East Java were in different climate types based on the climate classification by Schmidt-Ferguson, ranging from climate type B, C, and D so that in effect there are different timing for Flowering and fruit production season. it was caused by the differences in several climate variables, such as the average of precipitation in a year, dry months, average temperature, and the differences of minimum and maximum temperature towards the Flower buds period and the harvest time length of local durian. Climate type B (with 2 to 3 of dry months) in low altitude accelerates the flower buds period and the length of harvest time; while type C and D climate at average and high altitude speeds up the flower buds period and lengthen the harvest time. It was predicted to be the effect of the number of wet and dry months and the temperature as the climate variable (figure 6, 7, 8, 9, 10 and 11). The bigger number of wet months and the high temperature in type B climate in Tanggul and Tirtoyudo, accelerated the budding period and shortened the harvest time length in those two areas. And it was the opposite at average and high altitude. Yet, in the average altitude of Arjasa, the D type of climate which happened in 5 months, shortened the flower buds period and harvest time due to the shortage of water.

Table 2.The flower budding formation, blooming and harvest in different altitude.

Location (altitude, m)	Climate type*	Flowering Season (day)		Harvest time (after the blooming periods)
		Flower bud	Blooming	
Tanggul (76)	B	15.7 ± 5.6	19.5 ± 4.1	126.8 ± 12.5
Tirtoyudo (256)	B	14.3 ± 4.7	25.3 ± 2.3	133.7 ± 27.2
Songgon (327)	C	25.6 ± 2.1	31.7 ± 2.6	171.3 ± 21.4
Arjasa (503)	D	26.1 ± 2.6	34.2 ± 2.1	175.2 ± 26.6
Sukapura (681)	C	28.3 ± 1.8	33.5 ± 2.6	165.5 ± 14.4
Tutur (733)	C	28.8 ± 1.5	35.5 ± 2.7	168.2 ± 17.7

Note: * Climate type based on the classification of Schmidt-Ferguson

2.1. The Influence of precipitation level and the temperature towards the Flowering period and the harvest time

The annual precipitation intensity does not significantly correlated with the flower buds period and harvest time length in different altitude, in the order of the sequence, the correlation coefficient value is 0,36 and 0,24 (figures 6 and 7). David and Unam [6] state that to grow well and produce high quality of fruits, durian needs precipitation of 1500 to 2500 mm per year with even distribution monthly. Therefore, the number of dry month has a

significant correlation towards the flower buds period (r = 0.64), blooming phase (r = 0.58) and the harvest time length (r = 0.66) in different altitude (figure 8). Temperature affects the flower induction in durian [5, 10]. Figure 9, 10, and 11 show the influence of average and minimum temperature in different altitude. The negative correlation between temperatures / minimum temperature and the flower buds period with the harvest time length is : r = -0.64; and r = -0.72.

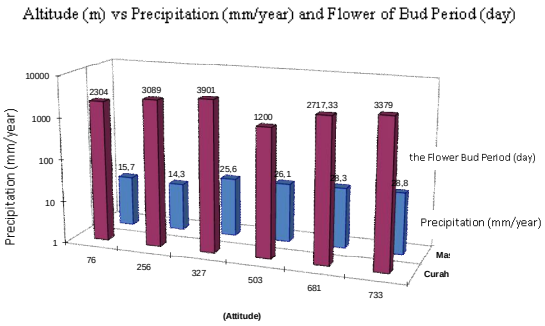


Figure 6.
The correlation of precipitation (mm) and the flower buds period (day) in different altitude

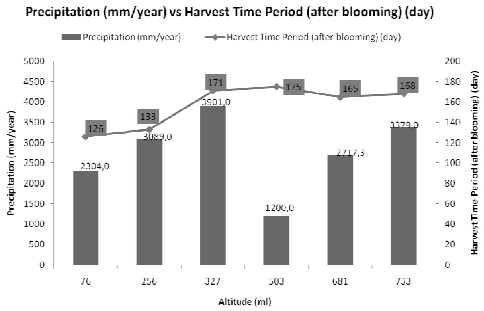


Figure 7.
The correlation of precipitation (mm) and the harvest time period (day) in different altitude

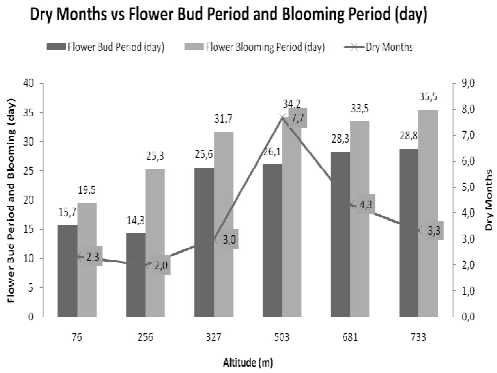


Figure 8.
The correlation of dry and wet months in the flowering period of durian in different altitude

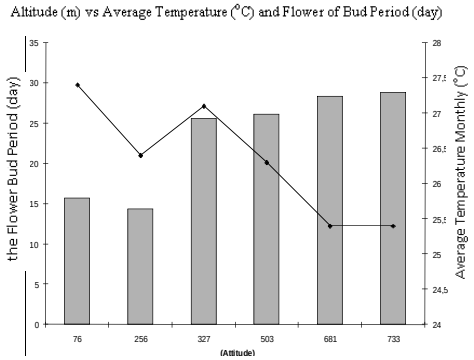


Figure 9
The correlation of average temperature and flower buds period in different altitude

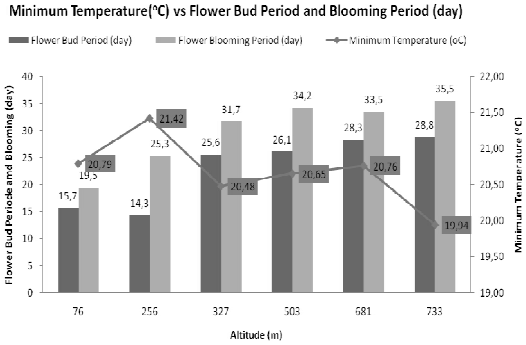


Figure 10.
The correlation of minimum temperature and the flower buds period in different altitude

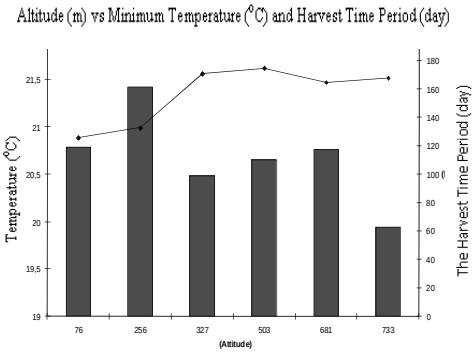
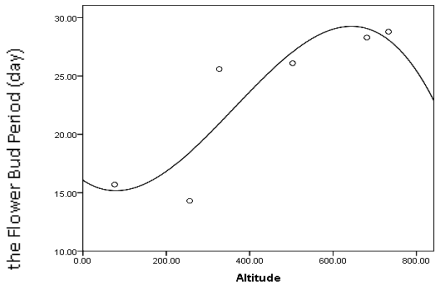


Figure 11.
The correlation of minimum temperature and the harvest time length in different altitude

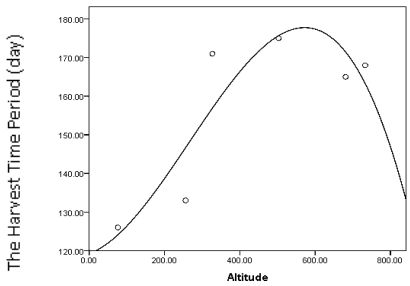
2.2. The influence of altitude towards the flowering period and harvest time length on durian

The regression analysis describes the close relationship of the altitude change and budding formation or harvest time length, shown in figure 12 and 13, with the regression coefficient (R^2) of 0,80 and 0,79 each. In figure 12, with altitude as (X) and flower buds formation period as (Y), the pattern is $Y = 16{,}07 – 0{,}94\ X + 5{,}78\ X^2 – 4{,}07\ X^3$, while Y as the harvest time length, then the pattern is $Y = 119{,}24 + 0{,}43\ X + 4{,}29\ X^2 – 4{,}10\ X^3$, as shown in figure 13.



$Y = 16{,}07 – 0{,}94\ X + 5{,}78\ X^2 – 4{,}07\ X^3$

Figure 12.
The close relationship of altitude with the budding formation period



$Y = 119{,}24 + 0{,}43\ X + 4{,}29\ X^2 – 4{,}10\ X^3$

Figure 13.
The close relationship between altitude and the harvest time period

CONCLUSION

The precipitation intensity in a year does not significantly correlated with the flower buds formation period and harvest time of local durian. Yet the number of dry months in each altitude does.

The average temperature, temperature difference (maximum and minimum) and the minimum temperature are negatively correlated towards the flower buds formation and harvest time length periods of durian in different altitude.

The close relationship (regression) between altitude (X) and flower buds formation period (Y) or harvest time length (Y) form polynomial equation in cubic (the increase of altitude will lengthen the flower buds formation period and harvest time length).

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