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Effect of the abiotic factor on *Schleichera oleosa* chlorophyll level

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Abstract

Chlorophyll in Schleichera oleosa is important to observe because S.oleosa is a tree plant that is often found on the road as a green plant. This role requires sufficient chlorophyll to maximize plant function for photosynthesis. Photosynthesis is supported by environmental factors. There are several environmental factors needed to maximize photosynthesis, namely altitude, humidity, ambient temperature, and light intensity. This study wanted to determine the effect of altitude, air humidity, ambient temperature, light intensity with chlorophyll content in S. oleose in several places. Altitude is measured using GPS. Measurement of air temperature and wind speed were measured using the Altimeter sights ler application version 2.0. Light intensity is measured using a lux meter. Soil moisture and soil pH were measured using a soil tester. Chlorophyll levels were measured using a spectrophotometer with a wavelength of 665 and 649, chlorophyll was calculated using the Wintermans and De Mots formula (1965). The results showed that chlorophyll content increased with increasing altitude. At the highest altitude of 833.6 m asl, the chlorophyll content is 53,770 with an ambient temperature of 27°C which decreases at an altitude of 833.6 m asl

1. INTRODUCTION

Trees have an important role in greening the environment. Trees that are often planted in cities are deliberately chosen to be plants that have the ability to absorb higher carbon dioxide, so they are effective if they are used as reforestation trees (Chaturvedi et al., 2012). One of the tree plants that has good potential for reforestation is S. oleosa (Lee, 2016).

S. oleosa is a member of the Sapindaceae family which has a tree shape, grows and spreads in Asia (Anuragi & Mishra, 2017). S. oleosa is a green plant in urban environments that contains secondary metabolites of chlorophyll derivatives such as flavonoids, tannins, polyphenols (Bhatia et al., 2013), so that the importance of these secondary metabolites to support primary metabolic processes such as glycolysis can be increased.

The potential of S. oleose to become a green plant is supported by a high rate of photosynthesis. The role of S. *oleosa* as a tree plant planted in urban areas has an important function, not only as shade and greening but also as a producer of oxygen in the air. The biggest oxygen producer comes from plants, the more vegetation, the greater the oxygen produced. Oxygen is produced from the photosynthetic process which is mostly carried out by plants (Ikkonen et al., 2018). Most of the photosynthesis process is carried out to produce carbohydrates, while oxygen is a byproduct of the process (Flood et al., 2011).

Chlorophyll becomes an important pigment in the process of photosynthesis. Chlorophyll is a pigment that is owned by plants which is used for photosynthesis. Chlorophyll is used to receive light spectrum emitted by the sun (Ni et al., 2019) (suharja & sutarno, 2009), to produce electrons that can be used to perform the photosystem. Chlorophyll pigments are synthesized through three stages of the pathway, at the beginning the formation of chlorophyll which is formed from glumathic acid is an amino acid formed from nitrogen (Tanaka & Tanaka, 2006). This chlorophyll pigment has a unique structure, this structure consists of 4 N atoms which can be produced from nitrogen synthesis (suharja & sutarno, 2009). Nitrogen in the cycle is not obtained directly from the soil, but through a long process of nitrogen assimilation.

The synthesis of chlorophyll in greening plants is influenced by light intensity (Jilani et al., 1996). Light intensity is related to the energy transmitted to plants, so that energy can move electrons to change the excited H molecules in the photosystem I process. Increased chlorophyll becomes important to support the photosynthesis process. Environmental temperature has a role in determining the formation of ATP in the respiration process (Pérez-Patricio et al., 2018).

2. MATERIALS AND METHODS

S. oleosa samples were obtained from Mojokerto Jawak timur with the location points as shown in Figure 1. Location of Sample S. oleosa. The sampling distance based on the presence of S. oleose is not a predetermined point. S.oleosa was taken based on a survey in the Mojokerto area, then the altitude measurements were made at each point.

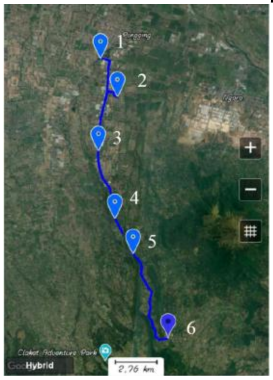


Figure 1. Location of Sample S. *oleosa*

Altitude measurement

Measurement of station height using the Altimeter Sights Ler version 2.0 application. Measurement begins by turning on the GPS on the cellphone when it is at the sampling location, then opening the application and the application will automatically read the location and altitude of the area metric (masl) or imperial (ft).

Humidity

Air humidity was measured using the Altimeter sights ler application version 2.0. Starting by turning on the data on the cellphone, then opening the application at the location where you want to measure the humidity, and the application will automatically read the ambient humidity. Air humidity measurements were repeated three times at three different times.

Air temperature

Air temperature was measured using the Altimeter Sights Ler version 2.0 application. The measurement starts by turning on the cellular data on the cellphone, then opening the Altimeter application and it will automatically read the data in the form of the location's ambient temperature in ° C. The temperature is said to be moderate in the range of 23.5 ° C to 24.3 ° C. Measurement of air temperature was repeated 3 times at 3 different points.

Light intensity

Light intensity is measured using a lux meter. Starting by opening the cover of the lux meter light panel, with the position of the panel facing up (not exposed to direct light), then the power switch is shifted to on, and it is set to the light intensity range of 0 - 1999 lux (1x) and 2000 - 19999 lux (10x) , the tool will automatically read the amount of ambient light that the lux meter can capture. The light intensity measurement was repeated 3 times (3 days) at 3 different times.

Soil moisture and soil pH

Soil moisture and soil pH were measured using a soil tester. Measurement begins with cleaning the tip of the soil tester, then inserting the soil tester into the soil, and the surrounding soil moisture will automatically read. Soil moisture measurement at 3 different points.

Chlorophyll content measurement

Determination of chlorophyll content of S. oleosa (L.) Oken leaves. conducted using the International Rice Research Institute method which has been modified by Balitbo Bogor (Prastyo, 2015). Leaves of each accession to S. oleosa (L.) Oken. weighed using an analytical balance with a weight of 0.1 g, then washed with distilled water to clean the leaves, then put it in a mortal and crushed with a pestle, added 0.5 ml of boric acid 10 mM, then discarded the supernatant centrifuge and added 96% ethanol. After that it was vortexed and incubated at 4 ° C. Then the supernatant was taken into a centrifuge and put in a cuvet to measure its absorbance value. The supernatant obtained was a chlorophyll extract which would then be analyzed using a spectrophotometer with a wavelength of 649 nm and 665 nm. Chlorophyll content was calculated using the Wintermans and De Mots (1965) formula in (Pratama, 2015):

Chlorophyll a = (13.7 x A665) - (5.76 x A649)
Chlorophyll b = (25.8 x A649) - (7.60 x A665)
Total Chlorophyll Content = Chlorophyll a + Chlorophyll b

3. RESULTS

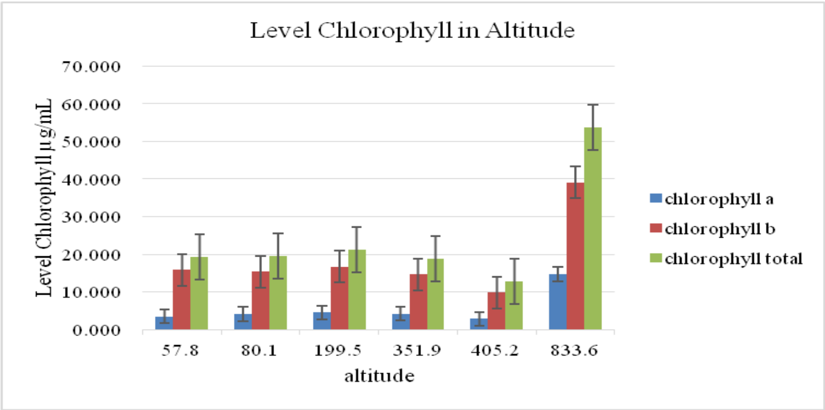
Observations of chlorophyll from S. oleosa from several elevation places are as in Table 1. That the higher the place where S.oleose grows, the environmental temperature decreases, the humidity is medium and the light intensity is medium, but the higher the

chlorophyll The relationship of each environmental factor with chlorophyll indicates that the environment has a greater influence.

Tabel 1. Abiotik Factors dan level Chlorophyll of S. *oleosa*

Sample	Altitude	Temperature	Humidity	Soil pH	Intensity of light	Chlorophyll Total
S1	(57,8 m dpl)	29.2°C	29	4.9	13.560	19.294
S2	(80,1 m dpl)	29.7°C	29	5.9	18.400	19.463
S3	(199,5 m dpl)	28.7°C	29	6	9.900	21.246
S4	(351,9 m dpl)	29.7°C	30	4	9.470	18.833
S5	(405,2 m dpl)	28.8°C	29	5.3	9.750	12.678
S6	(833,6 m dpl)	27.4°C	29	4.9	11.540	53.770

Altitude of 57.8 m asl to 833.6 m asl, the total chlorophyll content can be seen in Graph 1.which shows there is a linear graph and according to the altitude that exists in the environment of each growing place.At an altitude of 57.8 m asl to 833.6 m asl, the total chlorophyll content can be seen in Graph 1. which shows there is a linear graph and according to the altitude that exists in the environment of each growing place.



Grafik 1. Level chlorophyll in different altitude

4. DISCUSSION

Chlorophyll levels in S.oleose were observed from various altitudes ranging from 57.8 masl to 833.6 masl. It is known that there is an up and down pattern, this pattern is not only determined by light and altitude factors but also other environmental factors that cause different chlorophyll levels. Several factors that cause changes in chlorophyll levels are related to the determinants of photosynthesis and chlorophyll formation. If it is related to the formation of chlorophylls, the soil pH and intensity of light are related to the formation of proteins in the formation of chlorophylls. The formation of chlorophyll requires amino acids which are assimilated by bacteria and accepted by plants as materials for carrying out amino acid synthesis.

The role of light in amino acid biosynthesis and chlorophyll formation (Fan et al., 2013). The quality of light determines the chlorophyll biosynthesis, the more appropriate the light intensity with enough electrons to replace the Photosystem process in photosynthesis. Several studies related to light intensity which increase the acceleration of biosynthesis have found that light can effectively affect the increase in photosynthesis biosynthesis (Woitsch, 2003).

The wavelength of light in the environment is not always consistent so that plants can receive light with various light waves. Light-receiving pigments in plants make mRNAs increase in number, to increase the number of photoreceptors in the form of phytochromes. Gene expression related to the formation of pigments in plants including chlorophyll can be controlled by phytochromes (Woitsch, 2003). The combination of phytochromic work and nitrogen synthesis will produce maximum chlorophyll according to the plant's ability, in the case of this study, S. oloesa can produce maximum chlorophyll at an altitude of 833.6 masl because the position of S. oleosa gets full light intensity and is accepted by phytocrom and pH 4.9 is slightly acidic, meaning that the soil has many ions that cause the soil to have an acidic pH (Zhou et al., 2011). The presence of nitrogen-degrading bacteria makes soil conditions more neutral in acidity. The more inorganic nitrogen ions, the presence of bacteria, the more it will be neutral (Cho et al., 2016). This pH value of 4.9 shows that more ions cause the soil to become acidic (Rousk et al., 2010), but this pH range is still within safe limits for soil where plants such as S. oleosa can grow.

The environmental temperature observed in S. oleosa showed that a difference of 20C showed a different difference in chlorophyll content. The ambient temperature is 27.40C, the chlorophyll content is 53,770, while the temperature is 28.80C, the chlorophyll content is 12,678, the environmental temperature range is still below 500C where the photosynthetic biosynthetic enzyme is still working well. Too low temperature will also affect chlorophyll biosyntesys (Zhao et al., 2020). In chlorophyll biosynthesis involves many enzymes, catalysis, polymerization processes and involves several Heme genes , all of which require environmental conditions following the work of these enzymes and biosynthesis.

Chlorophyll biosynthesis is divided into three long processes, the first process includes protoporphyrin IX (Proto IX) from glutamate (Vavilin & Vermaas, 2002) catalyzed by glutamyl-tRNA reductase (GluTR), encoded by HEMAgene to produce porphobilinogen (PBG), each four PBG molecules will polymerize and produce urogenous uroporfirin (III) which will carboxy and produce another form of coproporphyrinogen III (coprogen III). In the first synthesis stage, it will produce an aromatic compound in the form of protoporphyrin IX (ProtoIX) (Yuan et al., 2017). The second stage in chlorophyll biosynthesis uses ProtoIX to initiate the branching of the long chain of biosynthesis to become chlorophyll and heme. ProtoIX catalyzed by ferrochelatase produces heme while in other branches ProtoIX becomes chlorophyll a and then becomes chlorophyll b (Yuan et al., 2017).

From this long process, why chlorophyll levels always change and are always influenced by many factors, because it involves many enzymes, so many things are influenced in the formation of chlorophyll. So that in this study of S. oleosa, at an altitude of 833.6 masl, it shows the highest chlorophyll content because at the location where the supporting factors are met, including sufficient light for phytocromes, and S. oleosa with an altitude of 405.2 masl does not show the second height but in fact, it is the lowest chlorophyll content because the supporting factors for the formation of chlorophyll do not support the formation of chlorophylls maximally such as at an altitude of 833.6 masl.

5. CONCLUSION

Abiotic factors in the environment can directly affect the chlorophyll levels in S.oleose. Altitude, soil pH, ambient temperature and light intensity all have their respective roles in chlorophyll biosynthesis. S. oleosa at an altitude of 833.6 masl has the highest chlorophyll content because all factors support the formation of chlorophyll biosynthesis.

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