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Absorption of Carbon dioxide by Angsana (*Pterocarpus indicus*) Saplings

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ABSTRACT

Humans need plants that produce oxygen. On the other hand plants need carbon dioxide. Each type of plant has a different ability to produce oxygen in balance with its ability to absorb carbon dioxide. Angsana (*Pterocarpus indicus*) has never been investigated for its ability to absorb carbon dioxide. This study aims to (a) measure the CO2 absorption capacity of Angsana plant saplings and (b) measure the fluctuation in CO2 uptake of Angsana plants in the measurement period at 06.00-06.30, 12.00-12.30 and 15.00-15.30 WIT. Angsana saplings used in this study were ± 3-5 months old. Measurement of CO2 absorption using a 50 cm x 50 cm x 30 cm containment method and CO2 gas analysis using Gas Cromatography. The time period for measuring CO2 absorption is at 06.00-06.30 West Indonesia Time, 12.00-12.30 West Indonesia Time and 15.00-15.30 West Indonesia Time with the time interval for taking 5, 10, 15, 20, 25 and 30 minutes for 4 (four) weeks. The results showed the rate of CO2 uptake of Angsana plant tillers fluctuated in the morning, afternoon and evening. The results showed the average CO2 absorption rate of Angsana saplings was 0.354 mg / m2 / minute. The CO2 uptake rate of Angsana plant species fluctuated, where the highest CO2 uptake occurred in the time period of 15.00-15.30 WIT at 0.439 mg / m2 / minute followed by 12.00-12.30 WIT at 0.435 mg / m2 / minute and CO2 absorption the lowest occurred at 06.00-06.30 WIT at 0.187 mg / m2 / minute.
KEYWORDS: Angsana, uptake, carbon dioxide, saplings

INTRODUCTION

Many researchers predicted an increase in the average temperature in the earth's atmosphere around 0.5oC compared to 100 years ago. Greenhouse gases (GHGs) in the atmosphere which are increasing compared to other GHGs are carbon dioxide (CO2) gases. The impact caused, among others, is the higher air temperature on the surface of the earth which is not good for living creatures above it. In 2005, GHG emissions around ± 15% of Indonesia's total GHG emissions were generated from the province of Central Kalimantan. Green open space (RTH) is one of the land uses that is considered as a guardian of environmental equilibrium in urban areas. One of the environmental conditions that is strongly influenced by green space is the direct and indirect atmosphere of the atmosphere. Although all trees or plants that have leaf green substances naturally absorb CO2 from the atmosphere in producing food and oxygen through the process of photosynthesis, but it is not the same in terms of its ability to absorb CO2 so a study of the ability of each type of plant to absorb CO2 is needed.

Researchers [1-4] have done a lot of research on carbon dioxide uptake by several plants in Central Kalimantan. Also research on the use of plants as aesthetics of the city. Angsana is a type of plant that is planted in the Green Open Space area in the City of Palangka Raya. Angsana (Pterocarpus indicus Willd.) Name of the region: Angsana (Indonesia); Asan, Athan, Hasona, Sena, Lansano, Sana (Sumatra); Angsana, Asana, Sana, Sana Kapur, Sono Kembang (Central Java, West Java, Nusa Tenggara); Sana Kembang (Madura); Sana, Ai Kenawa, Angsanan, Angsane, Kayu Merah, Matani, Aina (Nusa Tenggara); Naakir, Acha, Patena, Candana (Sulawesi); Nara, Lala, Lalau, Ligna, Lingguo (Maluku). Angsana is distributed in almost all regions of Indonesia, including eastern Indonesia such as Papua and Sulawesi. All types of Pterocarpus produce high-value wood. The wood is rather hard, used for fine furniture, floors, cabinets and musical instruments. Propagation of Angsana plants can be done vegetatively, namely grafting and stem cuttings. Propagation can also be done with seeds that are old (generative).

The research aims (a) to measure the ability of CO2 absorption of Angsana plants and (b) to measure fluctuations in CO2 uptake of plant saplings during the measurement period at 06.00-06.30 WIT, 12.00-12.30 WIT and 15.00-15.30 WIT.

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METHODS

Place and time of research

The study was conducted in Palangka Raya City, Central Kalimantan Province, Laboratory of the Indonesian Agricultural Research Institute for Jakenan Pati, Central Java for the calculation of CO2 absorption. Palangka Raya University Forest Product Technology Laboratory for calculation of biomass and organic carbon. Implementation of research July - August 2019.

Materials and Research Tools

Material consists of plant saplings ± 3-5 months old Angsana (*Pterocarpus indicus* Willd.), Printer ink, A4 80 g HVS paper, markers, label paper, paper folders, plastic folders, large envelopes, old newspaper and large ice boxes. Tools include a chamber (size) 50 cm x 50 cm x 30 cm, Gas Cromatography, syringe, rubber band, camera, cork box and writing stationery. Angsana plant saplings are kept in beds for ± 2 weeks to adjust to the conditions of the surrounding environment so as not to stress.

Gas Sampling in a Cap

Sampling of plant saplings of CO2 gas is Angsana by the chamber method. Tiller plants are placed on a cement floor and then covered with a lid that is equipped with a thermometer, dry batteries and a small fan, as well as control hoods (without plant saplings). Cover each side of the lid with sand to prevent air from entering the lid. A small fan is turned on in the lid and the rubber cover / septum above the lid is opened for 2-3 minutes and closed again. Sampling of gas in the hood through the septum using a syringe and recording temperature data on the thermometer in the hood and the temperature around the study site on the thermometer outside the hood in each period of gas sampling. Gas samples were taken at 06.00-06.30 WIT, 12.00-12.30 WIT and 15.00-15.30 WIT with time interval of gas sampling every 5, 10, 15, 20, 25 and 30 minutes so that the number of gas samples taken 144 samples.

Measuring CO2 Uptake of Plant Saplings

The gas sample in the syringe was sent to the Jakenan Pati Agricultural Environment Research Laboratory laboratory in Central Java to analyze CO2 gas using Gas Cromatography. The results of the analysis of CO2 gas are then calculated the rate of absorption of CO2 gas in the hood by using the formula Khalil [5]:

$$F = \frac{dc}{dt} \times \frac{Vch}{Ach} \times \frac{mW}{mV} \times \frac{273,2}{273,2 + T}$$

where:
F = CO2 absorption rate in the lid (mg / m2 / minute)
dc / s = Difference in CO2 concentration per unit time (ppm / minute)
Vch = Box volume (m3)
Ach = Box area (m2)
mW = CO2 molecular weight (gr)
mV = CO2 molecular volume (22.41 L)
T = average temperature during gas sampling (o C)

CO2 uptake by plant tillers (Fb) is the difference between the rate of uptake of CO2 in a hood containing plant tillers with the rate of uptake of CO2 in a hood without plants / control (K), with the following formula:

$$Fb = F - K$$

Where:
Fb = CO2 absorption by plant saplings (mg / m2 / minute)
F = CO2 uptake rate in the hood (mg / m2 / min)
K = CO2 Absorption Rate in the control hood / without plants (mg / m2 / minute)

RESULTS AND DISCUSSION

Carbon dioxide uptake for Angsana plants

Research data show that the average absorption rate of carbon dioxide (CO2) seedlings of Angsana plants is 0.354 mg / m2 / minute or 21.240 mg / m2 / hour. Each type of plant has a different ability to absorb CO2 and this is influenced by several factors, namely temperature, intensity of sunlight, availability of water, overall leaf area, leaf

age and growth phase [6,7]. There were differences in the ability of plants to absorb CO2 are influenced by leaf area, relative thickness of leaves, number of stomata, plant age and environmental factors (Table 1).

Table 1. Carbon dioxide sequestration for several plants

No	Sapplings	Average CO2 Absorption (mg / m2 / minute)	References
1	Papaya (*Carica papaya* L.)	0,640	[2]
2	Jackfruit (*Artocarpus heterophyllus* Lam.)	0,150	[2]
3	Jelutong (*Dyera lowii Hook. F.)*	0,349	[3]
4	Mangosteen (*Garcinia mangostana* L)	0,119	[4]
5	Hairy fruit (*Artocarpus heterophyllus* Lam.)	0,165	[1]

Data Table 1 when compared with the average CO2 absorption of Angsana (*Pterocarpus indicus*) plant species is higher than the average CO2 absorption of Jackfruit (*Artocarpus heterophyllus* Lam.) Saplings, Mangosteen (*Garcinia mangostana* L) and Hairy fruit (*Artocarpus heterophyllus* Lam) .). The average CO2 absorption of Angsana saplings is almost the same as Jelutong (*Dyera lowii* Hook. F.), but it is smaller when compared to Papaya seedlings (*Carica papaya* L.).

Carbon dioxide uptake fluctuation

The graph of fluctuation in CO2 uptake of Angsana plants based on measurement of time periods as in Figure 1 below.

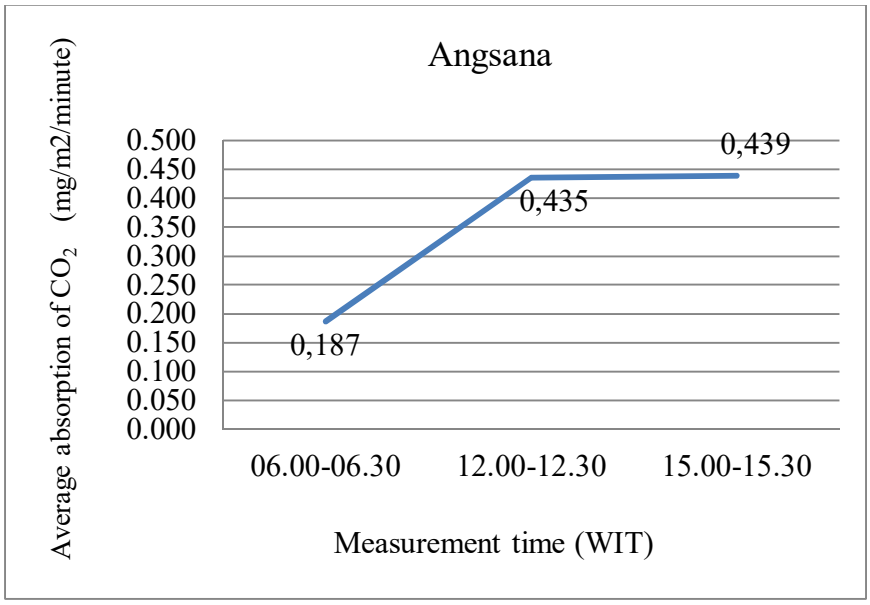

Figure 1. Average Fluctuation of Angsana Carbon Absorption by Time Period

The average fluctuation pattern of CO2 uptake that occurs in Angsana puppies the highest CO2 uptake occurs at 15.00-15.30 then followed at 12.00-12.30 WIT and the lowest at 06.00-06.30 WIT. The optimum temperature for photosynthesis is equivalent to the temperature during the day. In addition these conditions also affect the efficiency of the photosynthesis process. Maulana [8] explains that the high intensity of sunlight is able to carry out the process of photosynthesis to the maximum. Gratimah [9] found that the maximum photosynthetic efficiency will be achieved if the full intensity of sunlight and long days so that the increase in sunlight will gradually increase photosynthesis to the level of light compensation that is the level of light when taking CO2 is equal to CO2 expenditure. The fluctuation in CO2 absorption of Angsana seedlings is influenced by fluctuations in the average temperature inside the hood and the average temperature outside around the study site.

During the experiment fluctuations in the average temperature of the inside and outside of the lid on the graph can be seen Figure 2. The average temperature of the inside of the lid at 06.00-06.30 WIT of 25.50 0C; 12.00-12.30 WIT at 42.10 0C; at 15:00-15.30 WIT at 39.00 0C. The average temperature on the outside of the lid at 06.00-06.30

WIT is 23.20 0C; 12.00-12.30 Eastern Indonesian Time at 32.80 0C; at 15:00-15.30 WIT at 33.80 0C. Sunlight at the research location shines quite blazing which influences the increase in temperature and CO2 absorption. Ludang and Junaedi [2], the amount of temperature in the hood plays an important role in the ability of plant chicks to fix CO2 in photosynthesis, the higher the temperature in the hood causes the amount of CO2 to be fixed will be higher. Maulana [8] explains that the high intensity of sunlight is able to carry out the process of photosynthesis to the maximum. Xu [10] found that is when the temperature increases, plant activity will increase until it reaches the optimal temperature and then decreases.

The average concentration of CO2 in the hood containing Angsana saplings was 633.17 ppm. Ginting [11] found the process of increasing the concentration of CO2 in the air coupled with high sunlight intensity can increase the rate of CO2 absorption in some plant species.

CONCLUSION

The average absorption ability of Angsana tillers is 0.354 mg / m2 / minute or 21.240 mg / m2 / hour. The average fluctuation pattern of CO2 uptake of puppies Angsana uptake of CO2 was highest at 15.00-15.30 at 0.439 mg / m2 / minute then followed at 12.00-12.30 WIT at 0.435 mg / m2 / minute and the lowest at 06.00-06.30 WIT at 0.187 mg / minute m2 / minute. The average temperature of the inside of the lid at 06.00-06.30 WIT is 25.50 0C; 12.00-12.30 WIT at 42.10 0C; at 15:00-15.30 WIT at 39.00 0C. The average temperature on the outside of the lid at 06.00-06.30 WIT is 23.20 0C; 12.00-12.30 Eastern Indonesian Time at 32.80 0C; at 15:00-15.30 WIT at 33.80 0C.

Suggestion

Research on the process of carbon dioxide sequestration needs to be carried out on an ongoing basis considering there are still many types of saplings in Central Kalimantan both in natural forests and plantations that have not been studied completely.

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