

Project Topic: The study of efficiency in remediating air quality of tree plant in the green areas of Chiang Mai.



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Abstract

Chiangmai is currently one of the cities in Thailand that faces a problem with air pollution every year. Nowadays, many organizations try their best to come up with different ideas to tackle this problem. One of the ideas is to increase the number of green areas in the city to improve the air quality by using a bioremediation process called phytoremediation. For this, we went to different green areas located in Amphur Mueang, Chiangmai and compared the ability in remediating air quality of tree plant. This was done by measuring the air quality data via our self-made device. Moreover, we also performed a microscopic study to investigate the leaf-surface structures to see how they are related to their air quality remediation. The results showed that the Raintree trees are better at filtering tiny dust particles than the Golden shower trees, because it has a large number of tiny hairs and trichomes on their leaf surface. On the other hand, Golden shower trees are more effective at cooling down the surrounding area by improving the humidity and maintaining the amount of CO₂ in the atmosphere. This maybe due to their broad sized stoma which allows an effective exchange between the water vapour inside the air spaces of the leaf and the air outside. This shows that to develop an effective green area to combat the air pollution problems, we should consider using many different types of trees/plants as each of them has different abilities and will work best by all working together.

Keywords: Air quality treatment, Public green area, Leaf anatomy, Plant remediation



Introduction

Today, in economically prosperous cities that have expanded into tourist destinations and industries, air quality is often a problem. As a result, people in the area have to face the impact of such problems. Chiang Mai Province is one of the economic centers of the northern region which is now facing the problem of dust pollution that occurs annually, specifically, particulate matters. From the study of Chiang Mai University , it was found that every 10 micrograms increase in PM2.5 led to a 0.15% increase in mortality and was also associated with an increase in hospitalizations.(Jantara S, 2020).

Although campaigns after campaigns to reduce burning and forest fire, the source of the problem is not just the local burning in Thailand, but also neighboring countries. Therefore, they could not cover the causes of PM2.5 from other areas. From several research, it was found that many plants can treat air quality by decomposing or transforming the pollution to a less polluted or non-toxic form, this process is referred to as Phytoremediation. It depends on many factors, including leaf characteristics, leaf surface area, leaf coating, leaf density, hairs, and transpiration due to photosynthesis (Xiengying Wei et al, 2017). As another group of people who have been affected by this particulate matter issue, the researcher is interested in the use of air quality treatment plants, by comparing the efficiency of air quality treatment of perennial plants in public green areas and expect that the results are used as a basis for the selection of perennial species in development of green area in our city.



Objective

1. To compare the efficiency in remediating air quality of tree plant in the green areas of Chiang Mai
2. To study the relationship between morphology and anatomy of leaf, and the efficacy in remediating air quality of each plant species.

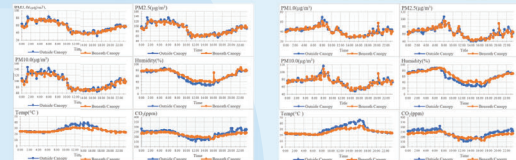
Method

1. Choose the location
2. Survey and record information about the physical characteristics of the trees
3. Make our own automatic-air quality data measurement device using a module from Arduino Uno R3 and different air quality measurement sensors
4. Install the devices to collect data in all our study areas
5. Perform a microscopic study on different leaves from different species of trees in the area
6. Analyse the data collected and draw out a conclusion.



Result and Discussion

Air quality data measured are as follows:

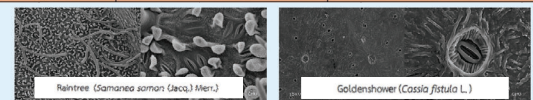


Research site	Overall air quality beneath the canopy compared to outside the canopy.		
	700th Anniversary Public Park	Varee Chiang Mai school	Charoen Prathet Park
PM10 level	lower	lower	lower
PM25 level	lower	lower	lower
PM10.0 level	lower	lower	lower
Relative Humidity	higher	higher	higher
Temperature	lower	lower	lower
CO ₂ level	lower	lower	lower

Conclusion

The results of the air quality measurements at the 3 research sites illustrate that the plants studied were able to treat air quality. Additionally, each plant has a different ability in treating air quality. This can be observed by the comparison between air quality data measure beneath and outside the canopy in 2 research sites with different dominant tree species, Raintree, and Golden shower. It was found that the Raintree was better at filtering particulate matters than Golden shower, while Golden shower was better at reducing the temperature and CO₂ level, along with increasing humidity, as shown in the following table:

Weather information	The difference in air quality under the canopy and outside the canopy (percent)	
	Raintree <i>Samanea saman</i> (Jacq.) Merr.	Goldenshower <i>Cassia fistula</i> L.
PM10	2.7	1.5
PM25	2.1	0.1
PM10.0	2.9	0.4
Temperature	6.4	8.7
Relative humidity	6.1	7.1
CO ₂ content	3.6	7.2



The researcher suspected that this was due to the different leaf surface anatomy of the plants. Raintree leaf has a large number of trichomes and small hairs, thus, having the ability to filter out particulate matters better than the Goldenshower. On the other hand, the leaf surface of Golden shower has wide stomata, thus, more efficient transpiration and gas exchange than Raintree.

Reference

- Geo-Informatics and Space Technology Development Agency (Public Organization). (2019). Summary of forest fires Geo-Informatics and Space Technology Development Agency (Public Organization) and haze situations with satellite images of the year 2019. Bangkok: Geo-Informatics and Space Technology Development Agency (Public Organization).
- Jantara,S. Air quality and haze situation in Chiang Mai Province. Retrieved February 2021, From <https://www.cmu.ac.th/th/article/e2d66ce5-27bb-4e2f-a5fb-b16b7fb5d7a4>.

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