Research Title: Relations between Air Quality and *Ploiarium alternifolium* Characteristics on Lichen Diversity in Thung Khai Garden

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Abstract

The purposes of research were to study air quality, temperature, relative humidity (RH) in *P. alternifolium* garden, to study *P. alternifolium* characteristics, bark texture, stem size, number of aerating root and to study the lichens diversity on *P. alternifolium*. Procedures were proceeded according to the Globe protocols. From the results, Area around small *P. alternifolium* had temperature from 23.2-23.6°C averaged at 23.4 ± 0.2°C and RH from 69-77%RH averaged at 73 ± 3%RH. They had rough stem, stem size from 14-27 cm averaged at 20 ± 6 cm, aerating root from 3-5 roots averaged at 4 ± 1 roots and they were discovered crustose type, 2 family, Graphidaceae Chrysotrichaceae, 2 genus, Ocellularia Chrysothrix, 2 species, *Ocellularia* sp.1 *C. candellaris*. *Ocellularia* sp.1 was discovered the most at 73%RA. Diversity and evenness index of lichens was equal to 1.63 and 2.35, respectively. Area around large *P. alternifolium* had temperature from 23.1-25.3°C averaged at 23.9 ± 0.9°C and RH from 79-99%RH averaged at 87 ± 9%RH. They had rough stem, stem size from 32-39 cm averaged at 36 ± 3 cm, aerating root from 5-12 roots averaged at 8 ± 3 roots and they were discovered crustose type, 4 family, Graphidaceae Arthoniaceae Chrysotrichaceae Physciaceae, 6 genus, Graphis Ocellularia Cryptothecia Chrysothrix Sarcographa Amandinea, 7 species, *Graphis* sp.1 *Ocellularia* sp.1 *Cryptothecia* sp.1 *C. candellaris S. labyrinthica A. extunata Cryptothecia* sp.2. *Ocellularia* sp.1 was discovered the most at 50%RA. Diversity and evenness index of lichens was equal to 16.83 and 8.65, respectively. So, the results show that the relations between air quality and botanical characteristics of *P. alternifolium* effected on lichen diversity. The air quality, it was higher temperate, humid and the botanical characteristics of *P. alternifolium*, they had the larger stem size and more aerating root relate to higher diversity of lichens.

Keywords: Air Quality, Botanical Characteristics**,** *Ploiarium alternifolium*, Lichen Diversity, Lichen

Introduction

Lichens are mutually symbiotic systems consisting of fungal and algal symbionts. While diverse lichen-forming fungal species are known, limited species of algae form lichens. These interactions are frequently described in terms of availability, selectivity and specificity of the mycobionts and photobionts towards one another. This formation of lichens is not a random but it is from the environmental, ecological evolutionary factors (Peksa & Skaloud, 2011) and then it brings to the specificity and selectivity (Fernández-Mendoza *et al.*, 2011; Muggia *et al.*, 2013; Muggia *et al.*, 2014; Vargas Castillo & Beck, 2012). These factors do the lichens have the high diversity and they can live in many ecosystems and environments. The simple structure of lichen, it is called thallus, it has different grow in specific environment. Lichens have three big type, namely, crustose foliose and fruticose (Gilbert, 2004). So it can use just a species for identification the environmental conditions (Nimis *et al.*, 2002). Residence characteristics are a factor for lichen growth such as bark and size of the stem. Lichen can use for producing the medicines, dyes, perfumes and beverages. They can be found on *P. alternifolium*, *G. cowa* and *H. brasiliensis*. However, lichens are biological resources that have not been explored and studied rigorously because they are not well-known in Thailand. *P. alternifolium* is a shrub, found in the southern Thailand, growing in inpeat swamp, melaleuca and rain forest. *P. alternifolium* can also be found in Thung Khai Botanic Garden Trang, Thailand.

The researchers have an idea to study the relations between air quality such as temperature and relative humidity in *P. alternifolium* garden and the botanical characteristics of *P. alternifolium* such as bark texture, size of the plant stem and number of aerating root on lichen diversity in Thung Khai Botanic Garden Trang, Thailand.

Research Objective

1. To study the air quality such as air temperature and relative humidity in *P. alternifolium* garden.

2. To study the botanical characteristics of *P. alternifolium* such as bark texture, size of the plant stem and number of aerating root.

3. To study lichen diversity in *P. alternifolium* garden.

Research Question

Do the air quality and botanical characteristics of *P. alternifolium* effect on lichen diversity in *P. alternifolium* garden?

Research Hypothesis

The air quality and botanical characteristics of *P. alternifolium* could show the different lichen diversity.

Materials and Equipments

1. CU Smart Lens 20x
2. Camera
3. Research record keeping book
4. GPS
5. Digital thermometer
6. Digital hygrometer
7. Measuring tape

Study Site

Study Site	Geographic coordinates	
	Latitude (°N)	Longitude (°E)
Thung Khai Botanic Garden Trang, Thailand	7.46839	99.63834

Research Method

1. The materials and equipments were prepared according to the Globe protocols.

2. The study site was measured the geographic coordinates by GPS.

3. The temperature and relative humidity in *P. alternifolium* garden were measured and recorded.

4. The bark textures of *P. alternifolium* were observed, size of *P. alternifolium* stem was measured, the number of aerating roots of *P. alternifolium* was counted and then recorded.

5. The lichens on *P. alternifolium* were observed by CU Smart Lens 20x, all of the physical characteristics of lichen were recorded such as thallus colour and reproductive organ form, the number of lichen was counted, the lichens were taken a photo and then kept 1 meter distance from the before observed *P. alternifolium* for the next observed *P. alternifolium*.

6. The observed lichens were identified and compared the physical characteristics with the Lichen Identification Guide book.

Data Analysis

1. The data of observed lichens was brought to calculate the Shannon-Wiener's Species Diversity Index (Shannon & Weaver, 1949).

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

Where; H' = the species diversity index, s = the number of species และ p_i = the proportion of individuals of one particular species found divided by the total number of individuals found.

2. The data of observed lichens was brought to calculate the evenness index.

$$E_H = H' / H_{Max} = H' / \ln S$$

Where; E_H = the evenness index, H' = the species diversity index, S = the total number of species.

3. The data of observed lichens was brought to calculate the relative abundance.

$$RA = T_S / T_P \times 100$$

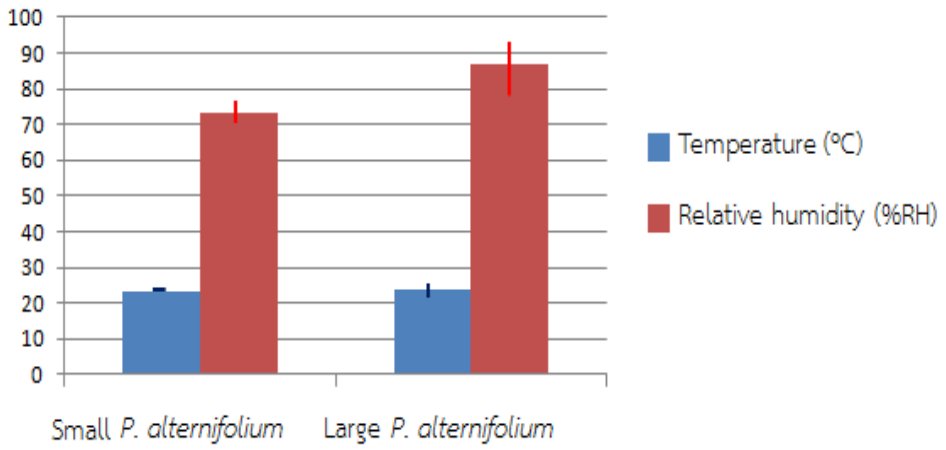
Where; RA = Relative abundance, T_S = the total number of species, T_P = the total number of population.

4. The data of temperature, relative humidity in *P. alternifolium* garden, size of *P. alternifolium* stem and the number of aerating roots of *P. alternifolium* was brought to analyze by mean ± S.D.

Results

Part 1 Air quality

Graph 1 shows the temperature and relative humidity around the small and large *P. alternifolium*



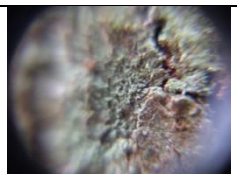
Part 2 Botanical characteristics of *P. alternifolium*

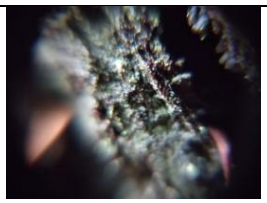
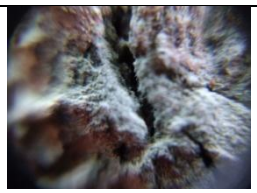
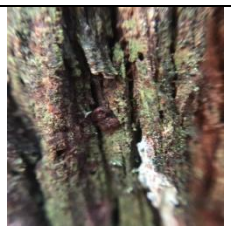
Table 1 shows the bark texture, size of the stem and aerating roots of the small and large *P. alternifolium*

n	Bark texture		Size of stem(cm)		Aerating roots	
Size of stem	**Small**	**Large**	**Small**	**Large**	**Small**	**Large**
1	Rough	Rough	14	39	3	8
2	Rough	Rough	26	38	4	5
3	Rough	Rough	17	36	3	8
4	Rough	Rough	16	32	4	12
5	Rough	Rough	27	35	5	5
Mean ± S.D.	Rough	Rough	20 ± 6	36 ± 3	4 ± 1	8 ± 3

Part 3 Species of the lichen on *P. alternifolium*

Table 2 shows the lichen's species and their photo on the small and large *P. alternifolium*

n	Species		Photo	
Size of stem	**Small**	**Large**	**Small**	**Large**
1	Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1	Crustose Family: Graphidaceae Genus: Graphis Species: *Graphis* sp.1		
		Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1		
2	Crustose Family: Chrysotrichaceae Genus: Chrysothrix Species: *C. candellaris*	Crustose Family: Arthoniaceae Genus: Cryptothecia Species: *Cryptothecia* sp.1		

	Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1	Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1		
		Crustose Family: Chrysotrichaceae Genus: Chrysothrix Species: *C. candellaris*		
3	Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1	Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1		
		Crustose Family: Graphidaceae Genus: Sarcographa Species: *S. labyrinthica*		
4	Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1	Crustose Family: Arthoniaceae Genus: Cryptothecia Species: *Cryptothecia* sp.1		
	Crustose Family: Chrysotrichaceae Genus: Chrysothrix Species: *C. candellaris*	Crustose Family: Chrysotrichaceae Genus: Chrysothrix Species: *C. candellaris*		
		Crustose Family: Physciaceae Genus: Amandinea Species: *A. extunata*		
		Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1		

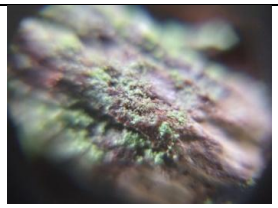
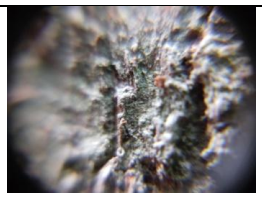
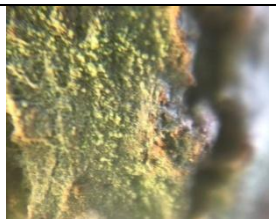
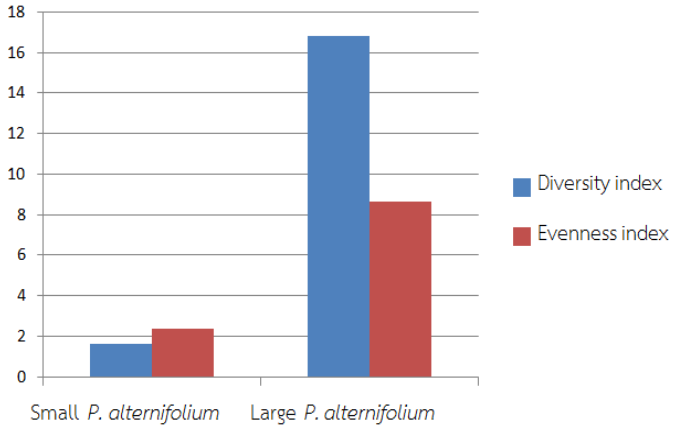
5	Crustose Family: Chrysotrichaceae Genus: Chrysothrix Species: *C. candellaris*	Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1		
	Crustose Family: Graphidaceae Genus: Ocellularia Species: *Ocellularia* sp.1	Crustose Family: Arthoniaceae Genus: Cryptothecia Species: *Cryptothecia* sp.1		
		Crustose Family: Arthoniaceae Genus: Cryptothecia Species: *Cryptothecia* sp.2		
		Crustose Family: Chrysotrichaceae Genus: Chrysothrix Species: *C. candellaris*		

Table 3 shows the lichen's species, number and relative abundance

Species	**Number**		**Relative abundance**	
Size of stem	**Small**	**Large**	**Small**	**Large**
Graphis sp.1		4		6
Ocellularia sp.1	19	33	73	50
Cryptothecia sp.1		5		8
Cryptothecia sp.2		3		5
C. candellaris	7	15	27	23
S. labyrinthica		3		4
A. extunata		3		4

Graph 2 shows the diversity and evenness index of lichen on the small and large *P. alternifolium*



Discussion

Part 1 Air quality

The area around the small size of *P. alternifolium* stem had the temperature range from 23.2-23.6°C averaged at 23.4 ± 0.2°C and relative humidity range from 69-77%RH averaged at 73 ± 3%RH.

The area around the large size of *P. alternifolium* stem had the temperature range from 23.1-25.3°C averaged at 23.9 ± 0.9°C and relative humidity range from 79-99%RH averaged at 87 ± 9%RH.

Part 2 Botanical characteristics of *P. alternifolium*

The area around the small size of *P. alternifolium* stem had rough stem, size of stem range from 14-27 cm averaged at 20 ± 6 cm and aerating root range from 3-5 roots averaged at 4 ± 1 roots.

The area around the large size of *P. alternifolium* stem had rough stem, size of stem range from 32-39 cm averaged at 36 ± 3 cm and aerating root range from 5-12 roots averaged at 8 ± 3 roots.

Part 3 Species of the lichen on *P. alternifolium*

On the small size of *P. alternifolium* stems were discovered the crustose type, 2 family, namely, Graphidaceae Chrysotrichaceae, 2 genus, namely, Ocellularia Chrysothrix, 2 species, namely, *Ocellularia* sp.1 *C. candellaris*. *Ocellularia* sp.1 was discovered the most at 73%RA. The diversity index of lichens was equal to 1.63. The evenness index was equal to 2.35.

On the large size of *P. alternifolium* stems were discovered the crustose type, 4 family, namely, Graphidaceae Arthoniaceae Chrysotrichaceae Physciaceae, 6 genus, namely, Graphis Ocellularia Cryptothecia Chrysothrix Sarcographa Amandinea, 7 species, namely, *Graphis* sp.1 *Ocellularia* sp.1 *Cryptothecia* sp.1 *C. candellaris S. labyrinthica A. extunata Cryptothecia* sp.2. *Ocellularia* sp.1 was discovered the most at 50%RA. The diversity index of lichens was equal to 16.83. The evenness index was equal to 8.65.

Conclusion

From the results, the relations between air quality and botanical characteristics of *P. alternifolium* effected on lichen diversity. The air quality, it was higher temperate and humid and the botanical characteristics of *P. alternifolium*, they had the larger size of the stem and more aerating root relate to higher diversity of lichens.

Recommendation

1. Study more about the percentage of gases in the air for the relating on lichen diversity.

2. Study more about chemical property of bark that relate with lichen diversity.

3. Study more plant that relate with lichen diversity.

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