Searching for Nature Stories 2012

Fighters in the Dust:

Aleurites moluccana and Bauhinia blakeana

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Content

Abstract

Hong Kong, a sophisticated city is seriously polluted. Walking along the roads in busy zones, we are not surprised to see cars got stuck giving out exhaust gas containing harmful substances like carbon dioxide (CO_2), nitrogen dioxide (NO_2)…But when we look around, to our surprise, we find many trees like aleurites moluccana, bauhinia blakeana are planted in these busy zones beside these roads. Why are such plants planted? Are they planted on purpose e.g. greening and planted for absorbing the harmful gases? If yes, what specialized structural adaptations benefit them to do the above jobs?

Introduction

We propose to investigate the effects of seriously polluted environment on leaf stomata density in bauhinia blakeana leaves and aleurites moluccana. We hypothesize that stomata density in such condition will be greater because most of the stomata will be blocked by the dust from the environment, affecting the rate of transpiration and photosynthesis, thus stomata are needed in great amount in order to keep the rate of the two important processes constant. Stomata are very unique structure in plants. They are tiny pores, mainly situated in the lower part of the leaves, open and close under the control of guard cells. When they open, they allow water vapour to diffuse out of the leaf, resulting in extra water being pulled up through the stem for the sake of photosynthesis.

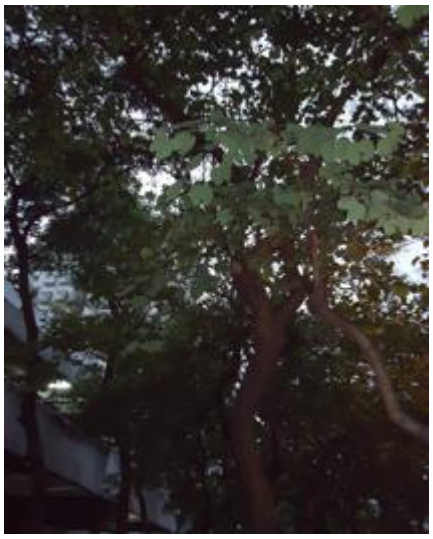
Background information:

(1) Background of aleurites moluccana:

Aleurites moluccana is a flowering tree in the spurge family, Euphorbiaceae, growing quickly and acting as a shelter for trees or brushes surrounding. Similar to other tropical trees, they only grow best in the tropic-like environment.

(2) Background of bauhinia blakeana:

Bauhinia blakeana are evergreen tree with large think leaves and orchid-like flower blooming from early November until the end of March. It is believed that such plants are being widely cultivated as they has got a relatively longer flowering period.



Objective of investigation:

To study the effect of seriously polluted environment on leave by observing their

(A) colour intensity

(B) dust level

(C) stomatal density.

Area of investigation:

We carry out our investigation in Castle Peak Road and Sai Lau Kok Road. This are two major roads in Tsuen Wan where lots of bus stops are situated, suggesting that there is a incessant cars flow. The environment is thus seriously polluted by the smoke given out by cars.

Field Trip

Date and Time	Venue	Aim
16-2-2012 16:30-18:30	Tsuen Wan 	(1) To observe the distribution of different types of trees beside roads (2) To take photos of trees
18-2-2012 12:00-15:00	Tsuen Wan	(1) To collect tree leaves beside roads as samples

		
19-2-2012 12:00-13:00	School Garden 	(1) To collect tree leaves as samples
19-2-2012 16:00-18:30	School laboratory	(1) To observe the density of stomata on each sample of leaves under light microscope.

Figure1. Distribution of Bauhinia blakeana beside the Castle Peak Road (Tsuen Wan)

Figure2. Distribution Aleurites moluccana of beside the Sai Lau Kok Road

Methods of investigation

In the experiment, we would like to investigate the structural difference and appearance processed by Hong Kong Orchid Tree, aleurites moluccana in a higher air pollution roadside and between those found in relatively lower air polluted area.

First, we would compare the color and dust level directly by observation.

Second, we would carry out an experiment to measure the relative stomatal density between the 2 plants in different areas (roadside with relatively higher level of pollution and school garden with relatively lower air pollution).

Biological principles

Stomata are significant features for plant carrying out photosynthesis, gas exchange, transpiration and many vital processes. The distribution, density and opening of the stomata are affected by environmental factors such as the presence of sulphur dioxide and air pollution etc.

In addition, plants may exert control over their gas exchange rates by varying stomatal density in new leaves when they are produced (such as in the spring or summer or in high air pollution regions). The more stomata per unit area (stomatal density) the more CO_2 can be taken up, and the more water can be released. Thus, higher stomatal density can greatly amplify the potential for behavioral control over water loss rate and CO_2 uptake. Plants seem to develop different structural adaptations.

Experiment 1:

Comparing the difference in appearance of leaves in two regions

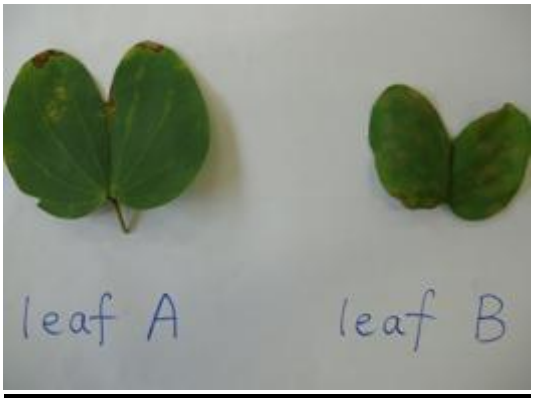
Date: 12-3-2012
Time: 13:20-14:00

Aim:

To compare the difference in appearance between aleurites moluccana leaves in relatively higher air polluted regions (roadside in Tsuen Wan) and those in relatively lower air polluted regions(school garden).

Materials and Apparatus:

-leaves samples from school garden and roadsideX3 respectively
-air tight bags
-light microscope



Procedure:

1. Leaves samples were obtained from school garden and roadside.
2. Leaves were put immediately into the air tight bags after cutting.
3. Leaves samples were observed under a light microscope to see whether any dust was blocked in the stomata
4. Record the results in a trial table.

Result:

Leaves of aleurites moluccana	Roadside	School garden
color	Relatively darker	Relatively lighter Fresh and young green
Dust level	Relatively larger amount of dust on the leaves' surface, some even blocking the stomata	Relatively cleaner

Experiment2:

Measuring the relative stomatal density of the leaves

Date: 12-3-2012
Time: 16:00-17:00

Aim:

To investigate the relative stomatal density of aleurites moluccana in serious air pollution roadside (eg. Tsuen Wan) compared with those in a relatively low air pollution area (school garden).

Materials and Apparatus:

-leaf samples of aleurites moluccana (Tsuen Wan) x3
-leaf samples of aleurites moluccana in school x3
- leaf samples of bauhinia blakeana (Tsuen Wan) x3
- leaf samples of bauhinia blakeana in school x3
-colourless nail polish

-light microscope
-tape

Colourless nail polish

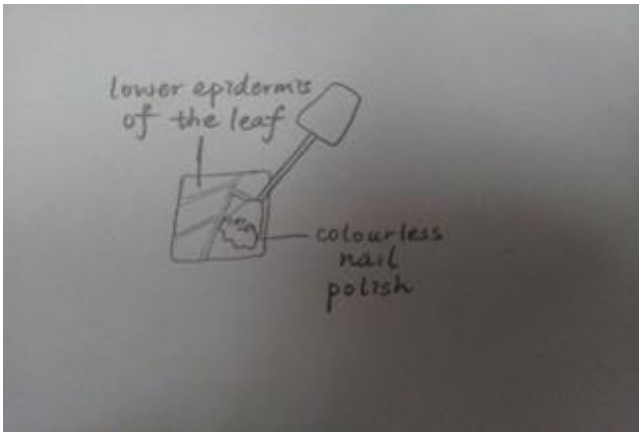
bauhinia blakeana aleurites moluccana

Key:

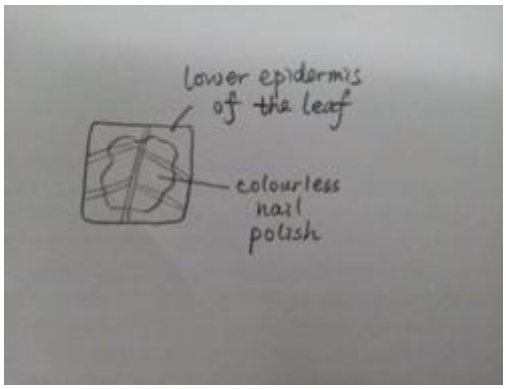
Leaf A: leaf sample from school garden
Leaf B: leaf sample from roadside

Procedure:

1. Leaves were washed and dried.
2. A thick swath of nail polish was paint on the lower epidermis of the leaves.

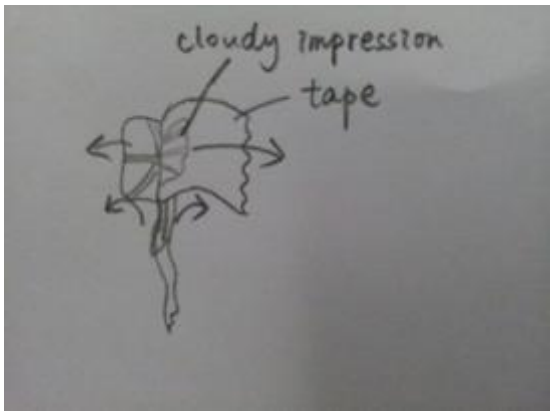


3. The nail polish was allowed to dry for several minutes.

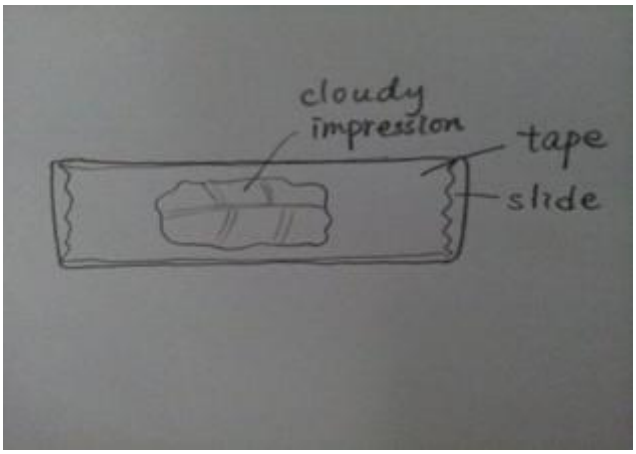


4. A piece of clear tape was stuck to the area containing dried nail polish swath.

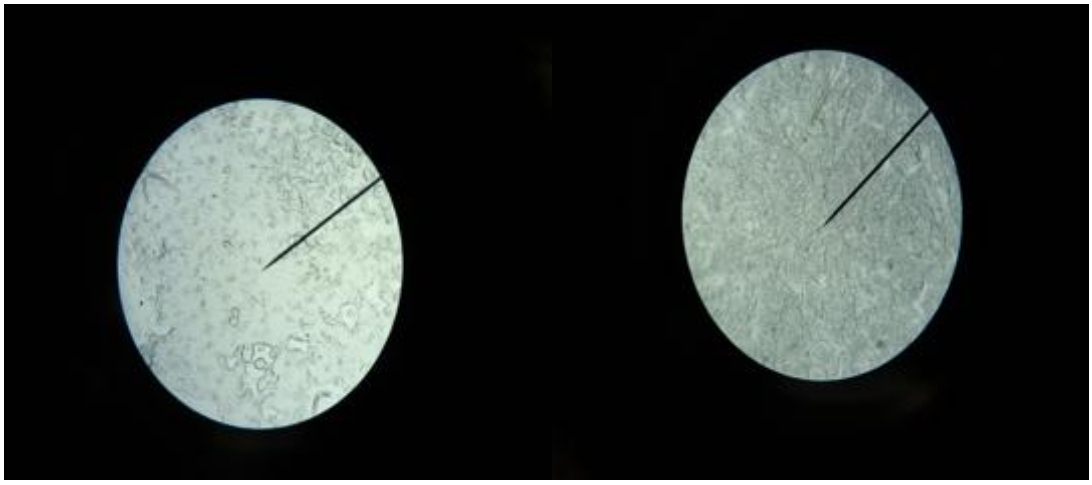
3. The nail polish swath was peeled from the leaf completely and a cloudy impression of leaf was attached to the tape.



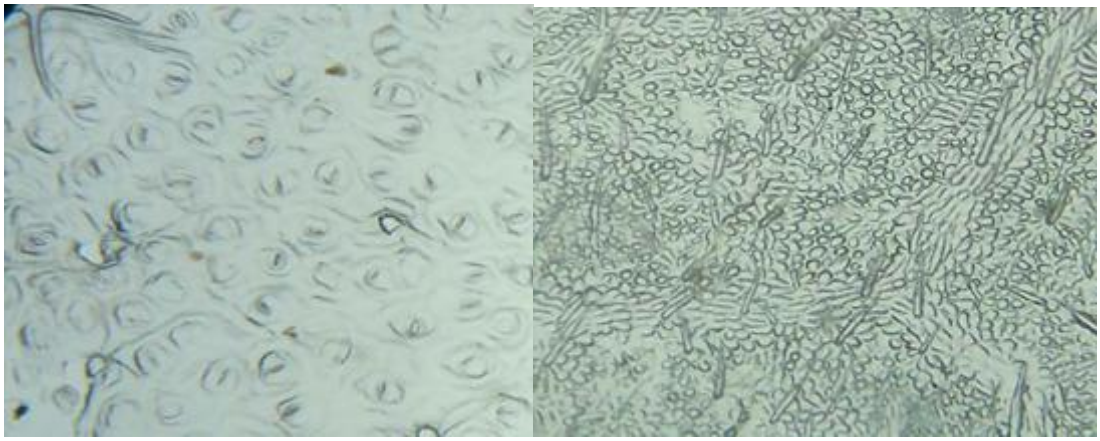
6. The tape was stuck onto the slide and put under the light microscope.



7. The leaf impression was focused under at least 400X power.



aleurites moluccana bauhinia blakeana



aleurites moluccana bauhinia blakeana

8. The number of stomata was count in an area with highest stomatal density.
9. The stomatal density of leaf was calculated.
10. Leaf samples obtained in school were used to repeat procedures 1 to 9.

Precaution:

All the leaves should be put in to an air tight bag immediately after cutting.

Result:

Density of the stomata= Number of stomata/ area of circle

Data was presented in a trial table and a bar chart showing the relative stomata density of the leaf samples.

	Relative stomatal density no./mm2	
Leaves of aleurites moluccana	Roadside	School garden
1st trial	6.96	4.32
2nd trial	7.89	5.23
3rd trial	6.89	3.23
Average	7.25	12.78

	Relative stomatal density no./mm2	
Leaves of bauhinia blakeana	Roadside	School garden
1st trial	5.32	3.28
2nd trial	4.67	4.13
3rd trial	4.23	2.98
Average	4.74	3.46

Interpretation

(1) Relative stomatal density of aleurites moluccana and leaf samples collected in school

From the results obtained in experiment 1, the leaves of aleurites moluccana had a relatively higher stomatal density than the leaves found in school garden.
This is because the air pollution in roadside was more serious than that in the school, more dust and tiny particles of cement and coal would stick on to the stomata of aleurites moluccana, or forming a thin film on plant leaves which lowers light intensity, thus affecting the gas exchange, transpiration and photosynthesis of the plants. So aleurites moluccana in high air pollution place tends to develop more stomata in order to carry out normal life processes like the plants in relatively low air pollution regions

Limitation and Improvement

(1) The high flexibilities in stomatal density and guard cell size would change in response to water status.
*Improvement: The experiment should be repeated for several times and the average result can be taken.

(2) The nail polish might not be eventually painted so that the parts being observed did not contain the excess number of stomata.
*Improvement: The colourless nail polish should be painted evenly.

(3) The presence of dust which hadn't been thoroughly washed away might stick on the tape and affecting the observation.
*Improvement: The leaves should be washed thoroughly with distilled water.

(4) The number of stomata might not be precise as human eyes were employed.
*Improvement: The same person is employed or an electron microscope can be used.

(5) The identification of stomata might not be accurate as the field of view from the light microscope was not clear enough.
*Improvement: The electron microscope can be used or higher power objectives can be used.

(6) The dust level might vary as the leaves from the roadside were not put into the air tight bag at once, some dust might be blown away by wind.

Conclusion

(1) The higher the air pollution level, the larger the size of the leaves, the darker the color of the leaves and the higher the level of dust stuck on it.

(2) The higher the air pollution level, the higher the stomata density of Aleurites moluccana.

Implication

Hong Kong is one of the busiest cities in the world and it is well-known for its rapid growth in urbanization. Such growth gives a boost to our city's economic development, and as citizens' income increases, they tend to consume luxurious goods like private cars. Nevertheless, when materialistic needs are over-aware, environmental development seems to have left behind. According to the latest findings from the government, Hong Kong's roads are the most crowded in the world, with almost 280 vehicles for every kilometer of road. Cars produce abundant harmful substances e.g. carbon dioxide. Our city's air quality is indeed lowering with more private car owners.

To improve such condition, we suggest the government to plant more trees like bauhinia blakeana and aleurites moluccana to absorb harmful substances in the atmosphere. During this investigation, we figure out that leaves of these two trees are full of dust, reflecting that they can somehow 'trap' the dust, and hence lowering the concentration of dust in the atmosphere. In other words, our city's air quality can be improved.

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