Taiwanese Rain Tree-Exploring the Relationship between temperature, solid temperature, humidity.

Students

1. Liu, Yen-Ying
2. Tsai, Yun-Ying
3. Tsai, Jia-Yu
4. Jhang, Jing

Teacher

1. Lee, Yu-Hsien
2. Siao, Jhong-Chun
3. Yu, Ting-Chun

Team Photo

Observing

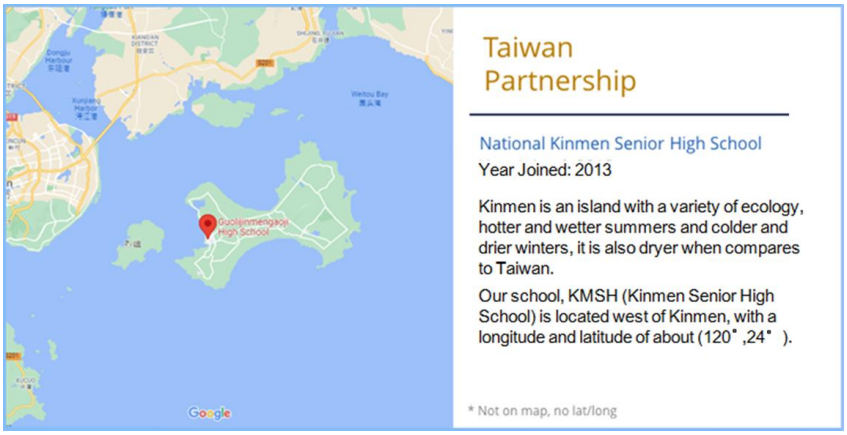
Background Research

Kinmen is located at 118°32'E and 24°44'N. It is located outside the mouth of the Jiulong River in China, opposite Xiamen Bay and surrounded by the sea. Compared with Taiwan, the four seasons here are more distinct and the climate is drier, with less precipitation and concentrated rainfall. From Feb. to April, and from July to September, the passing of typhoons will bring some precipitation, and the annual average rainfall is less than 1100 mm. Our school, Kinmen High School, is located west of Kinmen.

Taiwan Rain Tree, also known as four-color tree, is a plant unique to Taiwan, with strong drought tolerance, mainly distributed on both sides of river valleys and low-altitude sunny broad-leaved forests. September to Oct. is the flowering season, in which bright yellow flowers will bloom with bright red petal bases, while Nov. to Dec. is the fruiting season, in which pink capsule bracts will first bloom, which will gradually become Reddish-brown, finally brown when it gets ripe. Also because of its strong ability to resist pollution and absorb exhaust gas, it is mostly planted as street trees along the highway and all over the island.

School Introduction

Our school, KMSH(Kinmen Senior High School), is located in the west of Kinmen.



Taiwan Rain Tree in KMSH (Our School)

Spring	Winter
	
1. The upper end of the southwest branch turns yellow, and the lower part is still green. 2. The ends of the branches in the northeast are orange-red, and the middle part is light orange.	1. The upper part of the northeast has turned orange and the leaves have fallen. 2. A small part of the leaves in the middle and lower parts of the southwest has gradually turned yellow.

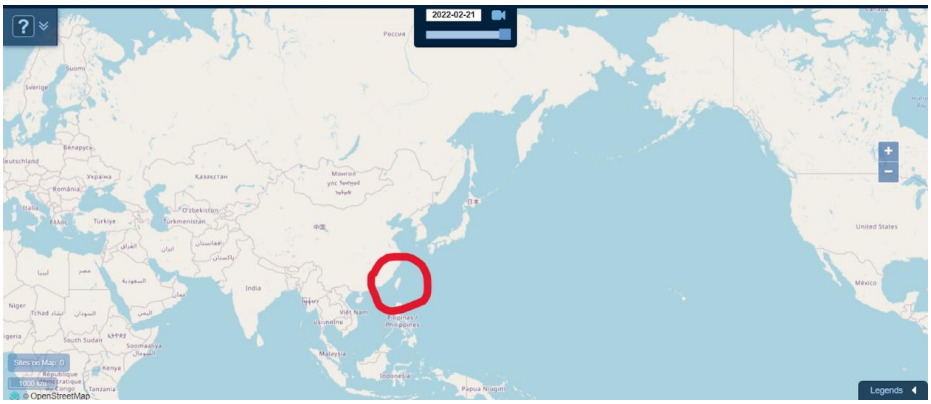
Abstract

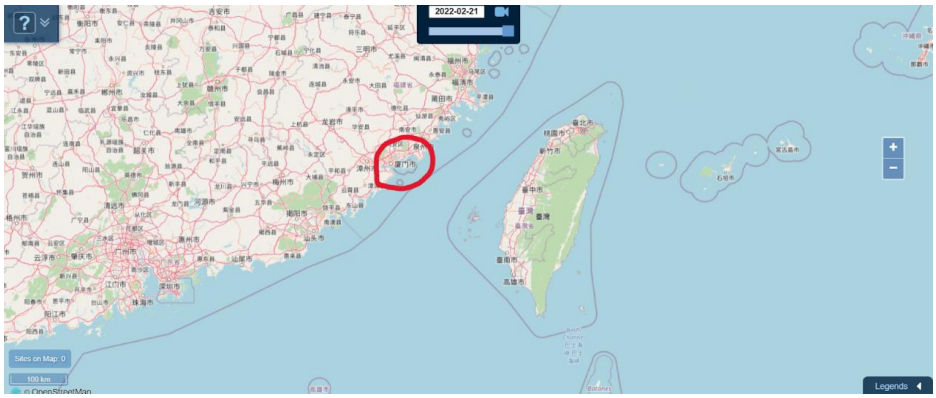
The Taiwan Rain Tree is peculiar to Taiwan. In our campus, there are such special plants, coupled with the special geographical environment of Kinmen: dry and cold, with little rain, so we began to study the relationship between the color change of Taiwan Rain Tree leaves, temperature, and humidity, and then find out the factors that affect the change of leaf color.

By regularly observing the Taiwan Rain Trees in different locations of the school, understanding their color changes and falling leaves, etc., and comparing with meteorological data, we infer the impact of the environment on leaf drop and bract color changes. The main reason for the color change of its bracts is the anthocyanins in the bracts. Finally, we concluded that anthocyanins are affected by sunlight, temperature, and humidity. At low temperatures, the environment is conducive to the synthesis of anthocyanins. Under the same conditions, if the humidity is high, the temperature will be lower due to the small specific heat. Treatment in the shade can also increase the amount of anthocyanin synthesis.

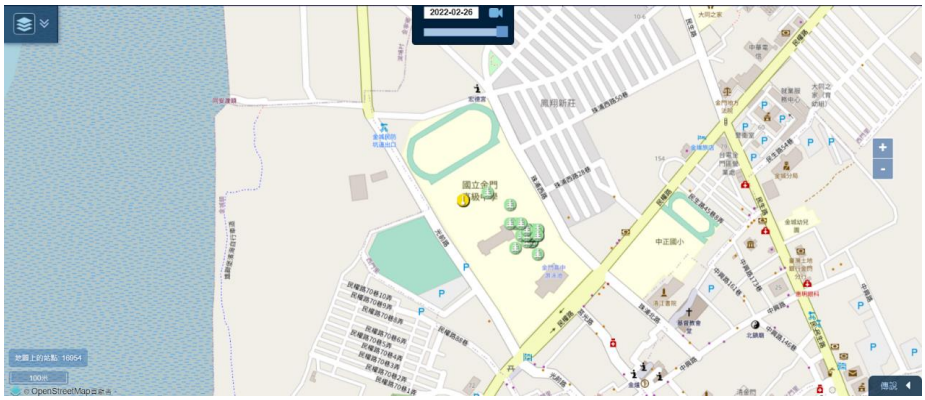
Observe location

The Position of Kinmen





The Position of KMSH (Our School)



Motivation

Taiwanese Rain tree(Koelreuteria elegans) is an endemic species to Taiwan. There are such specific plants on our campus, coupled with the special geographical environment of Kinmen: dry and cold, soil acidity, and less rainfall, we want to study the relationship between the color change of Taiwan Rain Tree leaves' temperature, humidity, and then find out the factors that affect the change of leaf color.

Research Purpose and Method

1. Research Purpose:

By observing the Taiwanese Rain tree in different locations of the school, we tried to find out the substances that cause the leaf color change of the Taiwan Rain Tree. By comparing the meteorological data and the observation results of two trees, we also infer the influence of the environment on the leaf drop and the change of leaf color.

2. Research Method:

(1) Check the relevant reference article to understand the basic knowledge of Taiwan Rain Tree.
(2) Observe the Taiwan Rain Tree by taking pictures at fixed points every week.
(3) Search the school meteorological data on the Globe website and draw the data into a graph.
(4) Observe the photo of the tree, record the obvious leaf drop time and the date of leaf color change, and compare the meteorological data map to find out the problem and discuss, analyze it.

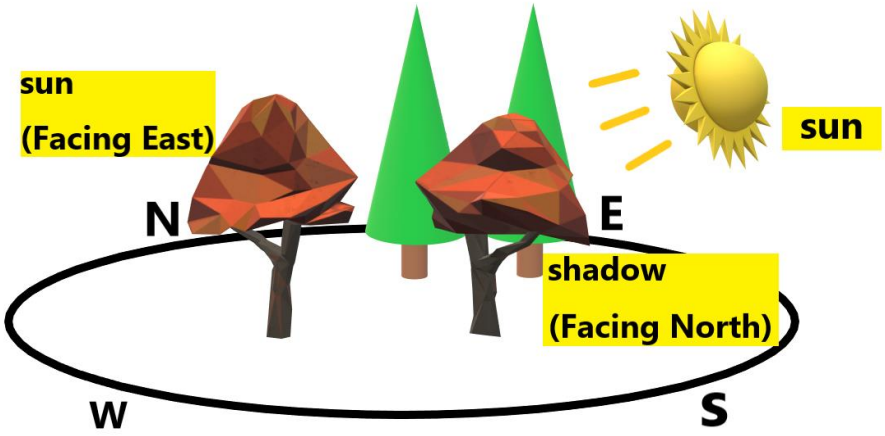
Methods and Materials

1. Software: google files, Ms.Paint 3D, Microsoft Office
2. Hardware: computer, mobile phone

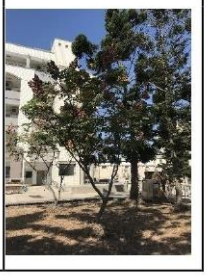
Research Process and Results

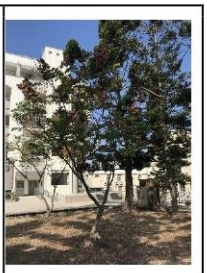
1. Research result

The trees we observed



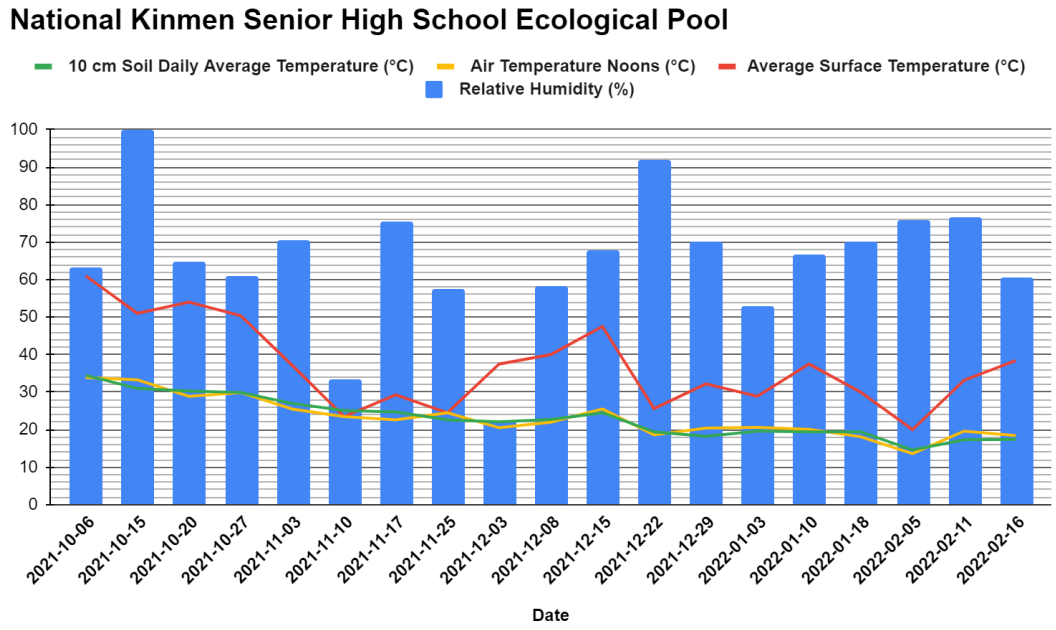
As shown above, we named the left and right trees as “SUN”(facing east) and “SHADOW”(facing north), according to the positions of the two trees to distinguish them. The facing direction is what we face when taking pictures, the directions are east and north. In the SUN (tree on the left), there is less surrounding shade and direct sunlight; in the SHADOW (tree on the right), there are larger trees around it and less area exposed to sunlight.

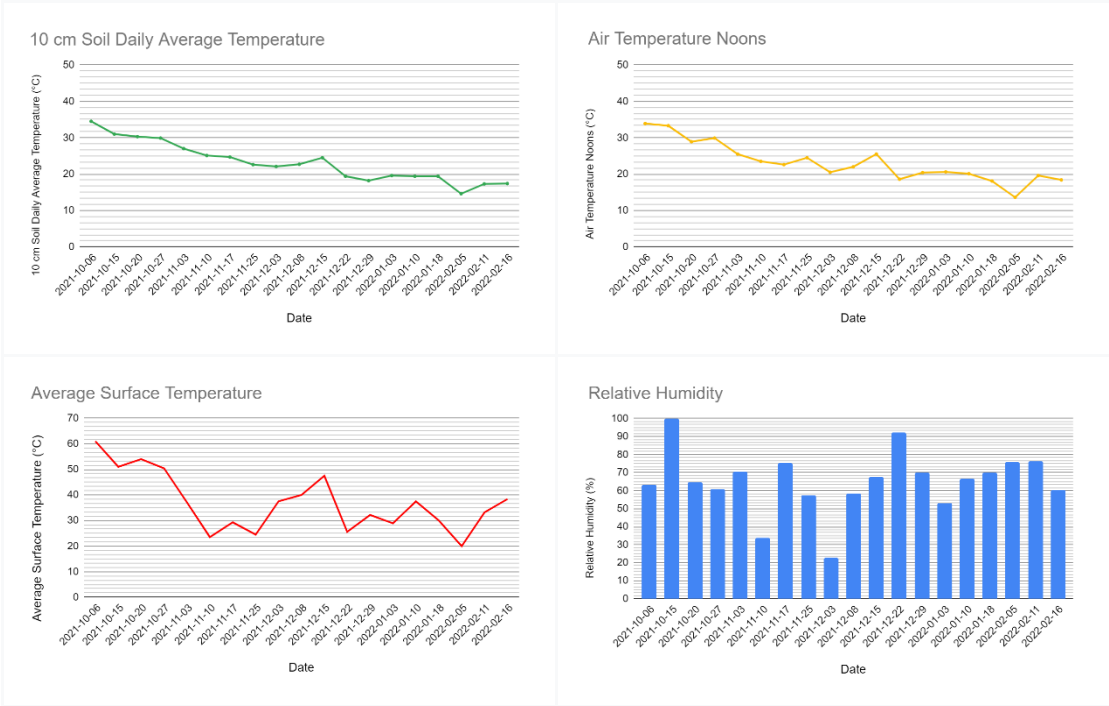
Date	Sun (facing east)	Shadow (facing north)	Date	Sun (facing east)	Shadow (facing north)
10/6			10/15		
10/20			11/03		
11/10			11/17		
11/25			12/03		

12/08			12/15		
12/22			12/29		
01/05			01/20		
02/11			02/16		

Taiwan Rain Tree 's leaves turned from green to yellow and finally withered and dropped, while the color of the capsular bracts changed from pink to reddish-brown, and ultimately to brown.

2. School Air Temperature, Surface Temperature, Soil Temperature, and Relative Humidity Records.





According to the above meteorological data, we will move on to discuss four kinds of data.

1. The noon air temperature (yellow):
According to the trend of the chart, we found that the noon temperature from Oct.6th to Feb.16th showed a gradual decrease as a whole.

2. 10cm soil daily average temperature (green):
According to the trend of the chart, the average soil temperature is similar to the noon temperature, which is no obvious difference, and the noon temperature is usually the higher temperature of the day. At this point, the soil temperature is mainly affected by the temperature of the day. And at a depth of 10cm, it is difficult to dissipate heat, so the average soil temperature can be kept the same as the noon temperature of the day.

3. Average surface temperature (red):
Compared with the noon air temperature and the average soil temperature, the surface temperature is relatively high, and the difference is obvious, which may be related to the direct sunlight at noon.

4. Relative humidity (blue):
The humidity changes from Oct.6th to Jan. 3rd fluctuated greatly, among which Nov.10th and Dec.3rd were the lowest; Oct.15th and Dec.22nd were the highest. From Jan.10th to Feb.16th, the humidity trend is relatively stable, maintained at 60% -75%.

5. According to the four items of data in the chart, we found that the average soil temperature may be related to the noon temperature, because the trends of the two kinds of data are close when the humidity shows an opposite trend to the surface temperature. The humidity on Oct.15th, Dec.22nd, Feb.5th is relatively high, while the surface temperature on the graph is relatively low, so the humidity may interact with the surface temperature.

Discussion

The discoloration of plant leaves is dominated by the pigments in the plant. The content of plant pigments is mainly affected by temperature and the length of sunlight exposure. In spring and summer, the insolation duration is long, photosynthesis is active, and there is more chlorophyll in the leaves, but it is opposite in autumn and winter. The content of other pigments such as carotene and anthocyanin is more stable than that of chlorophyll, so they still exist in the leaves, even the chlorophyll has disappeared, and the color of the leaves turns yellow or red.

The main reason for the color change of the bracts is the anthocyanins. Anthocyanins are susceptible to environmental factors. The reason for its formation is that in the fall, the ability of plants to transport nutrients is weakened, and glucose is left in the leaves, so some plants will synthesize the glucose and lutein in the leaves into better nutrients under the action of sunlight. The anthocyanins that absorb ultraviolet rays from sunlight and provide heat to plants.

Observing the two trees of sunshine and shade, we can find that the biggest difference between the two trees is whether they are shaded. In the sunshine tree, we can find that it is not shaded so it can be irradiated by the sun, which causes its surface temperature to be higher than that of shaded trees. And the insolation duration is also longer, so we can also infer that in such an environment, its anthocyanin should be easier to synthesize, and in the photo, we also observed that the bracts of the Capsule of the Sunshine Tree began to turn red earlier, A large area of discoloration began before Oct.6th, while the shadow area began to discolor in a large area after Oct.20th, which is also in line with our inference.

However, in our observations, we found that the maximum time for the color change of the bracts of the fruit is Oct.15th to Oct.22th.In the meteorological data map, we can find that the

temperature on Oct.15th to Oct.22th is not the lowest in the whole month, but it is the week with the largest change in the color of the capsular bracts, so we infer that this is because it is affected by humidity. In the weather data map, we can find that in the week of Oct. 15th, the humidity is the highest in the whole chart. Therefore, we infer that the specific heat is small because of the high humidity, resulting in a large temperature difference between day and night, which makes the chlorophyll decompose, and the synthesis of anthocyanin due to the sunshine in the previous weeks. The proportion of the medium increases, resulting in a large area change in color.

From the picture, we also observed the fact that the bracts in the shadow are deeper than those in the sun, and the reason for this result is that the surface temperature in the sun is higher than that in the shadow due to direct sunlight. In addition to being unfavorable for the synthesis of anthocyanin, the high level also reduces the decomposition of chlorophyll, so the accumulation of anthocyanin in the bracts in the shadow is higher than that in the sun, resulting in a darker color.

Conclusion

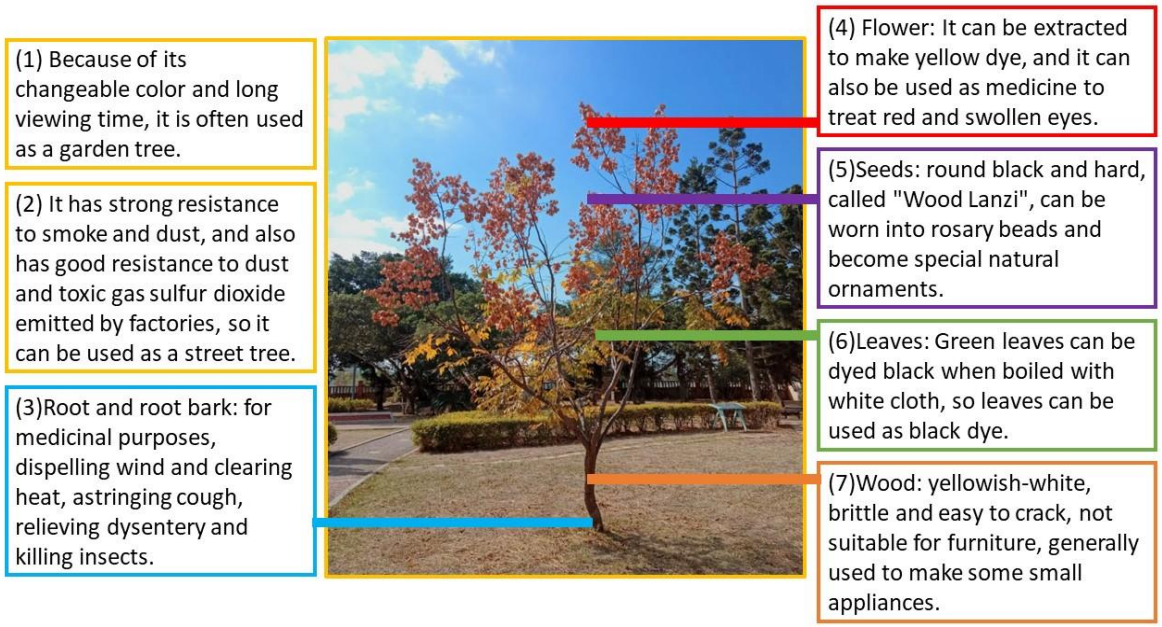
We speculate that the difference between the two trees is mainly due to the influence of the sun. The stronger the sunshine and the more ultraviolet rays, the more anthocyanins should be synthesized. However, because the surface temperature of the sun irradiated places is higher, high temperature is not conducive to anthocyanins. Therefore, we can find that the bracts in the sunlight begin to change color in large areas earlier, but the bracts in the shadows are in darker color.

And from the above inferences and online data, we can also draw the fact that although anthocyanins are affected by sunlight, temperature, and humidity, the temperature is more affected than humidity, and we can also learn from the data that under high temperature and high humidity conditions,

anthocyanins are easily hydrolyzed so that their content in plants decreases, but in the case of low temperature and high humidity, the opposite is true. Because the specific heat of water is small, it can reduce the temperature of plants, increasing the synthesis of anthocyanins.

Outlook

The use of Taiwan Rain Tree



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