Searching for Nature Stories 2011

MORE MOSSES

Investigation on the favourable environmental factors for the growth of mosses

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Date:
7th April, 2011

Content

Abstract

Given the multifarious applications of mosses, our group carried out investigations to propose the general favourable environmental conditions of growing mosses. It is hoped that our project can render assistance in growing mosses extensively.

At the beginning, we went for field trips to find suitable samples. Having set five locations as our target, we started to collect data, followed by comparing the environmental factors of the five places, including soil temperature, wind speed, slope direction, light intensity and moisture content. Soil samples were also collected for experimental determination of their water content, pH, organic matter content and particle sizes.

Subsequently, a set of favourable factors for growth of mosses can be deduced: lower soil temperature, lower wind speed, higher light intensity, higher environmental moisture content, larger amount of soil water and organic matter as well as a well mix of different soil particle size.

At last, we tried to promote the growth of mosses in a controlled environment for further investigation.

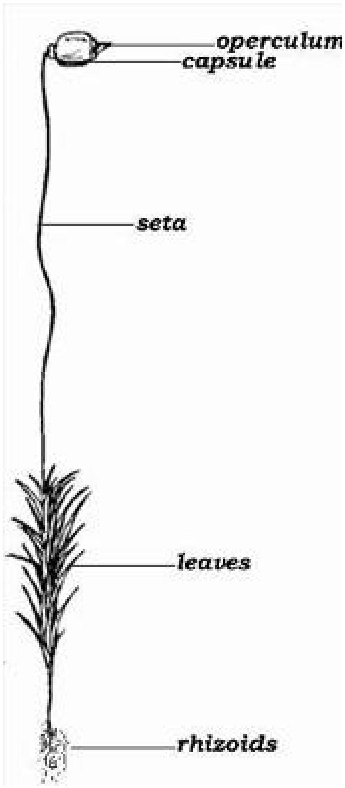
1 Introduction

When you were hiking or walking along the roadside, have you ever noticed that there were always clumps of green tiny plants under your feet? Don't step on them! They are mosses, one of the most common plant species found in Hong Kong. Very often, they looked so insignificant that we would just ignore them. But after knowing from the news articles that some countries actually treat mosses as an important natural resource, we started aware of these little funny plants, and we discovered that they are in fact a great helper in our environment. We can no longer leave them unnoticed. In the following investigation, we are going to introduce them into your daily life!

1.1 Facts about mosses

1.1.1 What are mosses?

Mosses are small, soft plants that are typically 1–10 cm tall. They are grouped as a single division Bryophyta, and divided into eight classes.(List 1.1.1.1)There are about 12,000 species of mosses in the world. They commonly grow close together mats in damp shady locations. Their simple leaf-like structures cover the thin wiry stems. They do not have true roots but rhizoids. They reproduce by forming spores instead of seeds.



Division Bryophyta
Class Takakiopsida
Class Sphagnopsida
Class Andreaeopsida
Class Andreaeobryopsida
Class Oedipodiopsida
Class Polytrichopsida
Class Tetraphidopsida
Class Bryopsida

List 1.1.1.1 Classes in Bryophyta

Fig 1.2.1 Simple structure and classification of moss

1.2 Applications of mosses

1.2.1 As a soil conditioner

Moss can increase the soil capacity to retain water and nutrients especially when dealing with sandy soil or soil that needs more moisture to flourish the plants.

1.2.2 Water filtration

Some mosses are natural alternatives to chlorine in swimming pool sanitation because not only can moss filter the water, but also kill the bacteria. Better-balanced natural buffer in moss pool water helps improved the water quality.

1.2.3 As a source of energy

Peat moss after dried under high pressure can be used as fuel to produce energy by burning without producing great amount of greenhouse gases.

1.3 Reasons and Objectives of our investigation

Albeit mosses are so helpful, especially in protecting the environment, it is known that rules of cultivation are not widely established, mostly due to the difficulties in establishing combinations of optimal growing factors. Regarding this, we wondered if we can find out a set of general favourable conditions for growing mosses by data collections and experiments, subsequently grow mosses in large scales (even at your homes!), so that mosses can be used and utilized effectively. In this report, we are going to investigate the factors affecting the growth of moss, thus come up with most favourable environment for the moss based on the results.

2 Materials and Methods

2.1 Methodology

2.1.1 Confirmation of spots and samples being investigated

We had chosen 5 spots for investigation. By collecting plants samples from each spot, followed by analysis under microscope, we could confirm the moss-present spots and moss-absent spots.

2.1.2 Investigation on the factors affecting the growth of moss

We measured the environmental conditions of the 5 chosen spots, 2 of them manage to cultivate moss while the remaining 3 do not, through:

- Field study on the physical climatic factors, including temperature, moisture, wind speed and light intensity;
- Laboratory experiments on the soil condition factors, including water content, organic matter content, pH value and particle size.

By comparing the data collected from moss-present spots with those from moss-absent spots, the favourable conditions for growing moss could be established.

2.1.3 Cultivation of moss under a controlled environment in laboratory

We suggested a controlled environment in laboratory to grow moss, with favourable temperature, moisture, wind speed, light intensity and soil conditions based on the results of investigation. The success of our investigation would be proven by the healthiness of the moss.

2.2 Information of field trips

We carried out 4 field trips at 5 spots: A, B, C are located at Tsz Ching Estate of Tsz Wan Shan, while D and E are located at Laguna Park of Cha Kwo Ling.

2.2.1 Reason for choosing the spots

We found that moss or some similar plants such as primitive ferns grow there, the differences in their environmental conditions help us investigate why moss grow in some of the chosen spots but not the others.

2.2.2 Field trip to Cha Kwo Ling

	Field trip 1	Field trip 2
Date	20/3/2011	24/3/2011
Time	9:00-12:00	9:00-12:00
Venue	Laguna Park, Cha Kwo Ling	
Temperature (℃)	16-24	16-21
Relative humidity (%)	90	73
Weather condition	Cloudy	Cloudy
Objective	To measure temperature, moisture, wind speed, light intensity of the sites, and to collect plant and soil samples.	To re-measure temperature, wind speed, and light intensity.

Table2.2.2.1 Record of field trip 1 and 2

Fig.2.2.2.1 Map of Cha Kwo Ling

Fig.2.2.2.2 Spot D

Fig.2.2.2.3 Spot E

Location of Cha Kwo Ling slope reg. no. of slope D and E are 11NE-D/CR368 and 11NE-D/C212 respectively.

2.2.3 Field trip to Tsz Wan Shan

	Field trip 3	Field trip 4
Date	26/3/2011	4/4/2011
Time	9:00-12:00	9:00-12:00
Venue	Tsz Ching Estate, Tsz Wan Shan	
Temperature (℃)	16-21	18-22
Relative humidity (%)	77	74
Weather condition	Sunny	Cloudy, rainy, with sunny intervals
Objective:	To measure temperature, moisture, wind speed, light intensity of the sites, and to collect plant and soil samples.	To re-measure temperature, wind speed and light intensity.

Table 2.2.3.1 Record of field trip 3 and 4

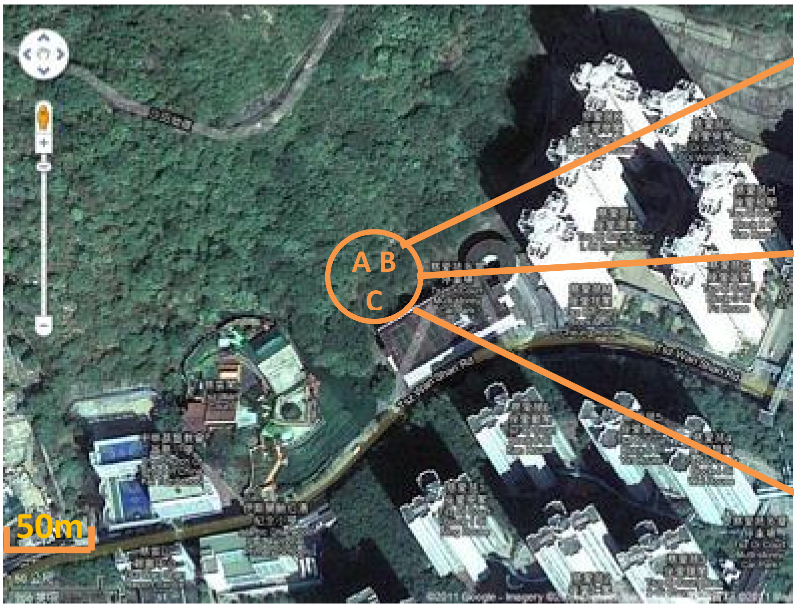


Fig 2.2.3.1 Map of Tsz Ching Estate


Fig 2.2.3.2 Spot A


Fig 2.2.3.3 Spot B


Fig 2.2.3.4 Spot C

Location of Tsz Ching Estate slope reg. no. 11NE-A/CR6

2.3 Identification of moss

We had collected samples A, B, C, D, and E from spots A, B, C, D, and E respectively. They were observed under microscope to confirm the identities.

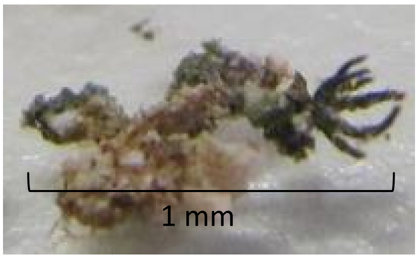
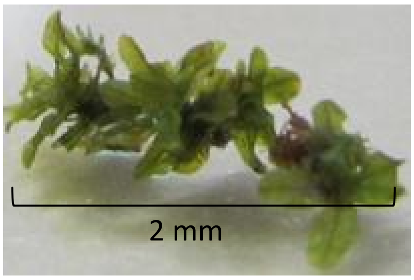
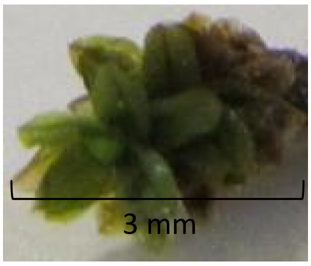
	Sample	Photo under stereomicroscope	Type of species
A			*Claopodium aciculum* (Narrow-leaved Feather Moss)
B			Primitive ferns
C			Primitive ferns
D			*Herpetineuron toccoae* (Ram's Horn Moss)
E			Primitive ferns

Table 2.3 Analysis on identity of samples

Utilizing library books and websites as reference, we gradually get acquainted with the characteristics of moss. Samples A and D are moss while samples B, C, E are not, distinguish features are their presence of discrete upright central strands.

2.4 Field study

Several physical factors at the spots were investigated during the field trips.

2.4.1 Temperature

Objective: To investigate the effect of temperature on the growth of mosses.

Apparatus:

Alcohol-in-glass thermometer Stop watch

Procedures:

1) The thermometer was put in air for 3 minutes, the temperature was measured.
2) The bulb of thermometer was inserted into 1 cm of soil for 3 minutes, temperature was measured. (Fig 2.4.1.1)

Fig 2.4.1.1 Method of measuring soil temperature

Results:

	A	B	C	D	E
Environmental temperature (Trip 1) (℃)	16.0	16.5	17.0	24.0	24.0
Environmental temperature (Trip 2) (℃)	19.4	19.3	19.4	17.5	17.5
Average environmental temperature(℃)	17.7	17.9	18.2	20.8	20.8

Table 2.4.1.1 Environmental temperature at different spots

	A	B	C	D	E
Soil temperature (Trip 1) (℃)	15.0	16.5	18.0	19.0	21.0
Soil temperature (Trip 2) (℃)	19.6	19.7	20.0	16.0	18.2
Average soil temperature(℃)	17.3	18.1	19.0	17.5	19.6

Table 2.4.1.2 Soil temperature at different spot

2.4.2 Wind speed

Objective: To investigate the effect of wind speed on the growth of mosses.

Apparatus:

Wind speed meter Stop watch

Procedure:

1. The wind speed meter was placed perpendicular to the soil surface. (Fig 2.4.3.1)
2. The "average wind speed" mode of the wind speed meter was turned on.
3. The reading was taken for 2 minutes.

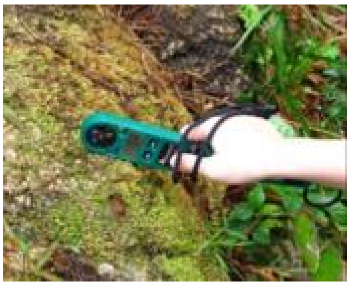


Fig 2.4.3.1 Method of measuring wind speed

Results:

	A	B	C	D	E
Wind speed (Trip 1) (KT)	4.0	5.3	4.2	0.9	2.6
Wind speed (Trip 2) (KT)	3.7	4.3	4.0	3.0	3.4
Average wind speed (KT)	3.85	4.8	4.1	1.95	3.0

Table 2.4.3.1 Wind speed at different spots

2.4.3 Moisture

Objective: To investigate the effect of moisture on the growth of mosses.

Apparatus:

Dry cobalt(II) chloride paper — Stop watch

Camera — Sticker tape

Procedures:

1) A piece of dry cobalt (II) chloride paper was placed on soil surface.
2) The surface of cobalt chloride paper was covered with sticker tape. (Fig 2.4.2.1)
3) The stop watch was started.
4) After 45 seconds, a photo of the cobalt chloride paper was taken immediately.

Fig 2.4.2.1 Method of measuring the moisture

Results:

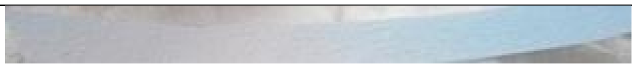
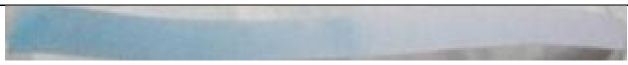
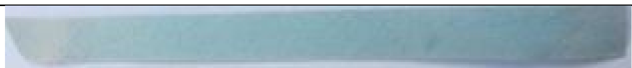
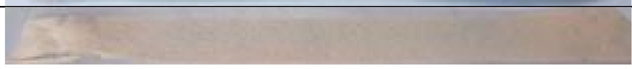
Spot	Appearance of cobalt chloride paper	Level of moisture*
A		+++
B		++
C		+
D		+++++
E		++++

Table 2.4.2.1 Level of moisture at different spots

* Number of "+" represents the degree of moisture

2.4.4 Light intensity

Objective: To investigate the effect of light intensity on the growth of mosses.

Apparatus:

Light intensity meter (Environmental comparator) and light probe

Procedure:

1) The sensitivity of the light intensity meter was set as A.
2) The probe connected the light intensity meter was pointed out perpendicularly of the ground surface. (Fig 2.4.4.1)
3) The readings were recorded.

Fig 2.4.4.1 Method of measuring light intensity

Results:

	A	B	C	D	E
Light intensity (Trip 1) (a.u.)	72	67	68	70	66
Light intensity (Trip 2) (a.u.)	69	70	66	68	44
Average light intensity (a.u.)	70.5	68.5	67	69	55

Table 2.4.4.1 Light intensity at different spots

2.5 Laboratory experiments

Several condition factors of the soil samples are investigated in the laboratory.

2.5.1 Soil water

Objective:

To determine the percentage of water in different samples of soil in order to investigate the relationship between soil water with the growth of mosses.

Apparatus:

Watch glasses	Forceps
Electronic balance	Oven

Principle:

The amount of water in soil will affect the water absorption and transpiration of the moss thus affecting the growth of moss. Water can evaporate into gas and escape from the soil samples in high temperature (>100℃).

Assumption:

The difference of weight between the dry mass and the fresh mass of the soil directly represents the amount of water in the soil samples.

Procedures:

1) The mass of the watch glass was measured.
2) 100g of soil sample A was added on the watch glass.(Fig 2.5.1.1)
3) Steps 1-2 were repeated with other soil samples B, C, D, and E.
4) All soil samples with the watch glasses were put into oven at 110℃ for at least 24 hours.(Fig 2.5.1.2)
5) The final total mass of the watch glass and the soil was measured.
6) The difference of mass between the dry and fresh soil was calculated so the proportion of the amount of water in the soil sample could be found.

Fig 2.5.1.1 Soil samples on watch glasses

Fig 2.5.1.2 Putting samples into the oven

Results:

	A	B	C	D	E
Mass of watch glass (g)	33.2	32.6	30.9	39.5	32.8
Final total mass of soil and watch glass (g)	90.1	93.1	93.0	53.7	65.2
Difference in mass between fresh and dry soil samples (g)	43.1	39.5	37.9	85.8	67.6
Proportion of water in the soil samples(%)	43.1	39.5	37.9	85.8	67.6

Table 2.5.1.1 Results of the proportion of water in the soil samples

2.5.2 Soil organic matter

Objective:

To determine the percentage of organic matter in different samples of soil in order to investigate the relationship between soil organic matter with the growth of mosses.

Apparatus:

Crucible with cover	Bunsen burner
Tripod	Heatproof mat
Pipe clay triangle	Tongs
Forceps	Stop watch
Electronic balance	Matches

Principle:

Different soil samples have different amount of organic matter. Organic matter can provide a lot of nutrients for the growth of plants. Organic matter can be decomposed into air under high temperature heating.

Assumption: All organic matters can be decomposed into the atmosphere under heating so the difference of weight between the final and the initial mass of the soil after heating directly represents the amount of organic matter in the soil samples.

Procedures:

1) The mass of the crucible was measured.
2) 20g of dry soil sample A was added on the crucible.
3) Steps 1-2were repeated with other soil samples B, C, D, and E.
4) The soil samples were heat by the Bunsen burner.(Fig 2.5.2.1)
5) The heating was stopped after 5 minutes.
   The crucible was covered to prevent soil from escaping. (Fig 2.5.2.2)
6) The total mass of the crucible and the soil was measured when the soil temperature was as same as the atmospheric temperature.
7) Steps 4-6 were repeated until the total mass of the crucible and the soil was constant for three times.
8) The final total mass of the crucible and the soil was measured
9) The difference between the final and the initial mass of the soil was calculated so the percentage of the amount of organic matter in the soil samples could be found

Fig 2.5.2.1 The heating process

Fig 2.5.2.2
The sample covered when cooling down

Results:

	A	B	C	D	E
Mass of crucible (g)	23.0	23.0	26.0	24.3	25.4
Final total mass of soil and crucible (g)	41.8	42.2	45.0	30.6	39.6
Final mass of soil (g)	18.8	19.2	19.0	6.3	14.2
Proportion of organic matter in the soil samples(%)	6.0	4.0	4.5	68.5	29.0

Table 2.5.2.1 Results of the proportion of organic matter in the soil samples

2.5.3 Soil pH

Objective:

To determine the soil pH of different samples of soil in order to investigate the relationship between soil pH with the growth of mosses.

Apparatus:

Dry pH paper
Electronic balance
Test tube with stopper
Forceps
Distilled water
White tile

Principle:

Different plants will have different favourable soil pH as the chemical reaction of plant involves enzymes with different optimal pH value. Therefore, these soil samples containing different amount of moss are doubted to have different pH value.

Assumption:

The colour change of pH paper has shown the pH value of the soil. The comparison of different colour change in pH paper for different samples was accurate.

Procedures:

1) 5 samples of soil were weighed for 10g and put in a test tube for each sample.
2) 5ml of distilled water was pipetted and added to each test tube.
3) The test tubes were stoppered and shaken to mix the soil with water well.
4) For each test tube, the mixed solution was dipped by a pH paper.
5) The colour change of each pH paper was observed and compared with the pH scale (Fig 2.5.3.1) after 10s.

Results:

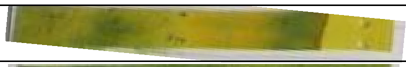
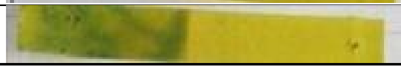
Soil samples	Appearance of the pH paper	Soil pH value
A		7.5
B		8
C		8
D		8
E		8

Table 2.5.3.1 Results of pH value of soil samples

Fig 2.5.3.1 pH scale

2.5.4 Size of soil particles

Objective:

To determine the size of soil particle of different samples of soil in order to investigate the relationship between soil pH with the growth of mosses.

Apparatus:

Electronic balance

Multi-layer sieve (Fig 2.5.4.1)

Principle: The six samples of soil were taken from different places. Each soil sample has different portion of soil particle size. While the variation of different soil particle size will affect the water filtration of the soil thus affect the growth of moss.

Procedure:

1) 20g of soil from each sample was weighed.
2) A sieve with different layer with different known pore sizes was prepared, with the layer with largest pore size in the top and so on.
3) 20g of the soil was put into the sieve and the sieve was shaken gently for 5 minutes. (Fig 2.5.4.2)
4) The soil particles on the layer with different pore size were weighed respectively.
5) Step 1-4 was repeated for different samples.
6) The portion of different soil particle size was calculated into percentage

Fig 2.5.4.1 The multi-layer sieve

Fig 2.5.4.2 Shaking process

Results:

	Percentage of soil particles in different size (%)				
Soil samples / soil particle size (mm)	A	B	C	D	E
>1.28	49.8	72.7	73.0	14.9	13.0
0.83-1.28	8.1	15.9	9.7	18.8	14.0
0.56-0.82	4.9	4.9	4.8	20.8	15.0
<0.56	37.2	6.5	12.5	45.5	58.0

Table 2.5.4.1 Results of proportion of different soil particle size in soil samples

2.6 Overall Results

		A	B	C	D	E
Environment temperature (℃)		17.7	17.9	18.2	20.8	20.8
Soil temperate(℃)		17.3	18.1	19.0	17.5	19.6
Average wind speed (KT)		3.85	4.8	4.1	1.95	3.0
Slope direction		S67.5˚E	S45˚E	S22.5˚E	W	N45˚W
Light intensity (a.u.)		70.5	68.5	67	69	55
Moisture*		+++	++	+	+++++	++++
Soil water (%)		43.1	39.5	37.9	85.8	67.6
Soil pH		7-8	8	8	8	8
Soil organic matter (%)		6.0	4.0	4.5	68.4	29.0
Soil particle size (%)	>1.28mm	49.8	72.7	73.0	14.9	13.0
	0. 83-1.28mm	8.1	15.9	9.7	18.8	14.0
	0.56mm-0. 82mm	4.9	4.9	4.8	20.8	15.0
	<0.056mm	37.2	6.5	12.5	45.5	58.0

* Number of "+" represent the level of moisture

Table 2.6.1 Overall Results

3 Discussion

As we wanted to determine the environmental factors favourable to the growth of moss, we had measured a series of environmental conditions of five different places where various types of primitive plants can be found. Besides, we had also collected samples of those plants as well as some soil beneath them during our field trip for investigation.

Subsequent to observing the five samples under stereo microscopes, it was ascertained that only sample A and D were mosses.

3.1 Analysis of Results

3.1.1 Principle of analysis

The factors affecting the growth of moss at different spots were investigated and results were shown in the above table (Table 2.6.1). Having those data compared, some favourable factors for moss growth can be deduced. We had collected the data of A, B, C and D, E in field trips of different weather conditions, such as temperature and relative humidity. The sunny and cloudy weather in the different dates we had our trips might result in great variation of data. In addition, the mosses of A, B, C and D, E were located in different districts (A, B, C were found in Tsz Wan Shan, while D, E were located at Cha Kwo Ling) that the local environmental condition may not be the same. Therefore, with the intention of having fairer comparison and investigation, the data of samples were divided into two groups and compared separately. (i.e. 1st set includes A,B and C; 2nd set includes D and E)

3.1.2 Soil temperature

The slightly lower soil temperature may well be beneficial to moss. As we can see from the data, the soil temperature of locations A was lower than B and C; while that of D was lower than E. It is believed that the lower soil temperature can reduce the evaporation rate of soil water and hence retain more water for photosynthesis and growth of mosses.

3.1.3 Wind speed

According to the column of average wind speed, A had lower value than B and C while that of D was lower than E. It shows that mild and weak wind is another favourable condition. Since the presence of wind would promote the evaporation rate of soil moisture, lower wind speed could assist in conserving soil moisture. This in turns promote mosses' growth.

3.1.4 Light intensity

The light intensity of A was found to be higher at A than B and C and that of D is higher than E. It is believed that greater intensity of light can enhance the photosynthetic rate of mosses due to the greater amount of light energy provided. Therefore, if the mosses are exposed to greater amount of sunlight, their growth rate can be raised.

3.1.5 Moisture

In the part of moisture, it was obvious that the value of A is greater than B and C; while that of D is greater than E. Hence, we could deduce that high moisture on the surrounding (surface) of mosses is good for its growth. In the condition of high moisture content, the evaporation rate of water from the cells of mosses would be lowered. Then more water would be available in the mosses for their growth.

3.1.6 Soil water

As for soil water, sample A has higher percentage of water when compared with B and C, while that of sample D is higher than E. Therefore, soil water also plays a crucial role in promoting the growth of moss. As we all know, water is essential for plants to carry out photosynthesis. Due to the absence of vascular tissues in moss, they were only able to grow to a short height, with the hope of obtaining water from soil. So, the greater amount of soil water enhances the rate of photosynthesis.

3.1.7 Soil pH

The soil pH of the samples was similar to each other in our investigation and did not show contrasting variation. All of them had the pH proximate to neutral (or slightly alkaline) that it could not be determined what range of pH is most suitable for growth of moss by comparison.

3.1.8 Soil organic matter

Amount of soil organic matter also contributes to the growth rate of mosses. A had greater amount of organic matter than B and C; while the proportion of organic matter in soil of D was higher than E. It means that more soil organic matter is beneficial to the growth of mosses. Organic matters were required for the anabolism of cells of mosses.

3.1.9 A well mix of different particle size

Soil particle size of A and D when compared to others, had a well mix of different particle size. Since particle size is associated with soil density and thus associated to water drainage, it was estimated that a well mix of different soil particle size lead to a moderate drainage power. Then the soil would be able to retain some water but not waterlog the mosses at the same time.

All in all, favourable environmental factors for growth of moss are as follow:

1. Lower soil temperature (17℃-18℃)
2. Lower wind speed (0kt - 2kt)
3. Higher light intensity (70 a.u.)
4. Higher moisture level (70%-80%)
5. Greater amount of soil water (50%)
6. Greater amount of soil organic matter (10%-70%)
7. A well mix of soil particles with different size (a random mixture of fine sand)

3.2 Source of Errors and Limitations

Although we had make endeavours to avoid errors, it was impossible to get rid of them entirely. The following are some possible errors as well as limitations we had encountered throughout our investigation.

3.2.1 Variation of weather conditions in different field trips

It is believed that the date and time of measuring the environmental factors contribute to a major discrepancy. It was not feasible for us to collect data of all five locations within the same period of time during each field trip. Therefore, for the field trips to Tsz Wan Shan, only environmental conditions of locations A, B and C could be taken; while data of locations D and E could only be collected in another few field trips to Cha Kwo Ling. Due to variation in weather condition on different dates, such as temperature, relative humidity, etc. , data of A,B and C might not be comparable with that of D and E. Nevertheless, we could still speculate about the favourable conditions for the growth of moss by making appropriate comparisons.

3.2.2 Limitations in measuring wind speed

For the wind speed, it was difficult for us to measure accurately the normal average wind speed of that place. We could only obtain the value within a short period of time (i.e. 5mins each time). Yet, the sudden strong breeze of the day of measurement may result in quite a significant error.

3.2.3 Random errors in measuring light intensity

Light intensity meter and a probe were used for measurement in this part. We tried to adjust the probe in the direction perpendicular to the soil surface as angle of incidence of light ray is the greatest in this orientation, making the most direct impact on moss. However, the orientation of the probe placed on the soil surface may vary in various trials due to random errors.

3.2.4 Limitations in measuring soil thickness

During the measurement of soil thickness, it was no easy task for us to distinguish the soil layer from the layer of rhizoids of mosses. As the rhizoids are embedded into the soil layer, we could only include the height of mosses in our soil thickness. Albeit the mosses were short in height, their height might not be negligible when compared with some shallow and thin soil of samples D and E. Besides, the depth of soil was not uniform within the area moss samples were collected. It was only possible for us to record the data of a few different spots within that area and take the average value.

3.2.5 Limitations in measuring moisture

As for moisture of moss surface, without the aid from electronic instruments, only dry blue cobalt (II) chloride paper can be used. During data taking, we put the paper gently on the moss surface for a fixed period of time (i.e. 45 seconds) and then compared the colour change (the pinker the papers become, the higher the level of moisture). Nevertheless, since the density of moss as well as the texture of rock surface varied from place to place, and we could only observe the colour change with our naked eyes, it was a formidable task for us to compare the moisture precisely.

3.2.6 Possible water loss during storage

When we collect those samples, we stored them in zip lock bags before we measured its weight and put it in the 100℃ the following day. It could not be ensured that if any soil water is lost during that period of time. We assumed that the soil water content remained the same as the time we collected them.

3.2.7 Inaccuracy in determining soil organic matter

The great difference in soil organic matter between A, B, C and D, E might due to the proportion of soil in the sample. For most cases, mosses were of very thin layer and it was difficult for us to completely separate if from the soil sample. Thus, an assumption was made that the amount of mosses in the soil samples was negligible when compared to soil. However, in locations D and E, the soil beneath the plants is comparatively shallow, making the proportion of moss greater in the samples. When the samples were burnt, moss was decomposed as organic matter instead of those in soil, resulting in high organic matter content in soil of D and E.

3.2.8 Possible errors and limitations in measuring particle size

Soil samples were collected beneath the mosses. Nevertheless, some samples had quite a thick soil layer. It was uncertain whether all the soil layers beneath the mosses affect the growth of mosses. It was not sure whether the particles of different size were in a few layers or blended in a single layer. Furthermore, the ranges of pore size of sieves we used are small that could not separate the soil particles of silt, clay and sand. We were unable to classify the particles smaller than 0.56 mm into different types.

4 Further Investigation

After the above investigation, a set of favorable conditions of growing mosses was established. In order to provide a clearer picture of a desirable environment for the moss, in addition to seeing the possibilty of growing mosses in large scale, we have designed the following laboratory setup to grow mosses under the most favorable environment. The growing factors were controlled as below:

<u>Soil temperature</u>

As low soil temperature favors the growth of moss, in the proposed design, the aquarium containing some fresh moss was put in a water bath of about 17℃ and the temperture of the soil was monitared by the thermometer.

<u>Moisture level</u>

A humidity meter was placed in the aquarium to keep the humidity constant at 70%. Whenever the humidity drops, as shown by a decrease in the water level in the beaker, water would be added in order to maintain the moisture level.

<u>Light intensity</u>

A higher light intensity favours the growth of the moss, so a series of light bulbs were put above the aquarium, and with the aid of the light intensity meter , the light intensity inside was kept at about 70 a.u.. When the light intensity was found to be lower than expected, more light bulbs would be opened, vice versa.

<u>Soil particle size and organic content</u>

The soil under the moss was prepared by a well mix of fine sand in different sizes, and a weighted amount of organic fertilizers were added to ensure a high organic content (about 20%) in the soil.

<u>Soil water</u>

It was found that high soil water content favors the growth of mosses, so water was sprayed into the soil at regular time intervals with a view to maintaining soil water content at 50% by mass.

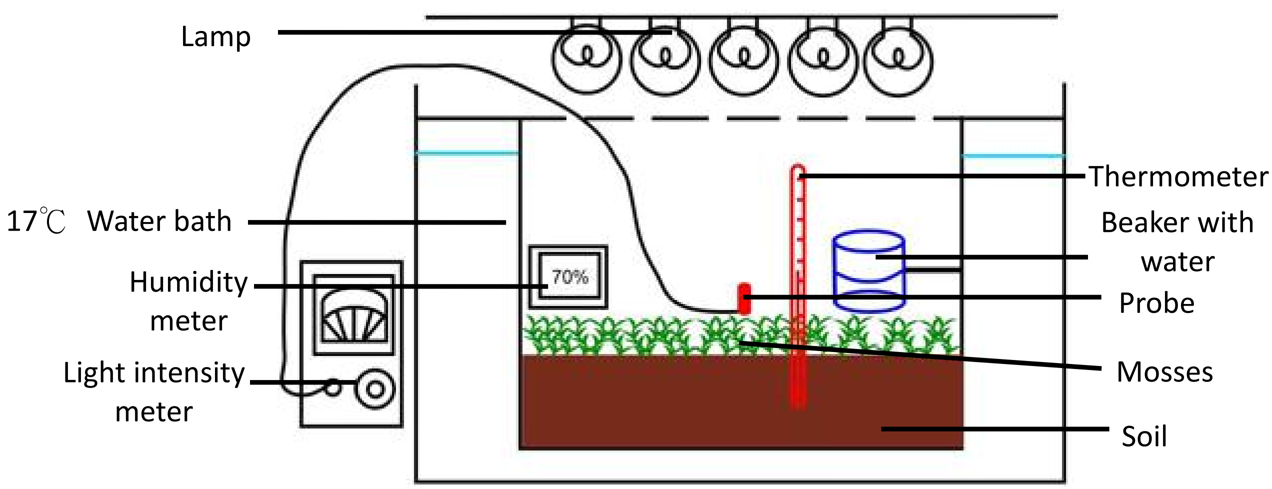


Fig 4.1 Diagram of suggested laboratory setup for growing moss

5 Summary

After a series of data collections, along with field trips and laboratory experiments, we managed to put forward a combination of favourable factors for the growth of mosses. In addition, we have attempted to promote the growth of mosses under a controlled environment in laboratory by using the results found.

Nevertheless, it takes time for mosses to grow in laboratory before we can examine their conditions accurately. Due to time constraints, the results of the further investigation are not discussed here. It is hoped that the investigation will show continual progress in the next few weeks, and the results would be presented in our presentation.

Applications of mosses are wide and environmentally friendly but sadly, they are still not widely used in many countries, mostly because of their tiny sizes. By cultivating mosses in large scale, we truly hope that mosses could be widely applied as natural alternatives to some toxic chemicals, which will cause harm to the environment (e.g. peat moss as renewable, clean energy source.) If planting mosses in large scale is proved to be feasible, the next step would be raising people’s awareness towards the applications of mosses so that more people around the globe can make a difference together to the world by planting the mosses.

Albeit the benefits of mosses, we should avoid over-grazing and exploit them. Cultivation in an extremely large scale will cause imbalance in ecosystem and on the food chain. It is of utmost importance for people to apply mosses in a certain and suitable extent.

Lastly, to avoid causing too much disturbance to the nature, we would return the mosses collected during the field trips back to their original locations.

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The End