Research Title: Study of Physical Factors Affecting the Growth of *Caulerpa lentillifera* J. Agardh in the Ban Yong Star Mangrove Forest, Tha Kham Subdistrict, Palian District, Trang Province.

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This study investigated the physical factors affecting the growth of *Caulerpa lentillifera* J. Agardh. in the mangrove forest of Ban Yong Star, Tha Kham Subdistrict, Palian District, Trang Province. The objective was to examine the effects of these factors on the growth of *Caulerpa lentillifera* J. Agardh. Water and soil quality data were collected and analyzed for their relationship to *Caulerpa lentillifera* J. Agardh growth. The results showed that the average water temperature in areas with *Caulerpa lentillifera* was 30°C, higher than the average of 26°C in areas without *Caulerpa lentillifera*. The pH of the water was the same in both areas, at 5.5, which is considered acidic. Dissolved oxygen (DO) levels averaged 6.75 mg/L in the area with *Caulerpa lentillifera*, significantly higher than the average of 5.75 mg/L in the area without *Caulerpa lentillifera*. The water transparency in the area where *Caulerpa lentillifera* was found averaged 66 centimeters, higher than the area without *Caulerpa lentillifera* (52.5 centimeters). The salinity in the area with *Caulerpa lentillifera* averaged 2.8 ppt, higher than the area without *Caulerpa lentillifera* (2.3 ppt). Regarding soil quality, the soil temperature in the area with *Caulerpa lentillifera averaged* 30°C, higher than the area without *Caulerpa lentillifera* (27°C). The soil pH in both areas was the same at 5.5. This study indicates that temperature, pH, dissolved oxygen, water transparency, and salinity are important factors affecting the growth of *Caulerpa lentillifera* J. Agardh.

Keywords Grape algae *(Caulerpa lentillifera* J. Agardh), physical factors, growth

Introduction

Kom Silpacharn et al. (2019) described the sea grape (*Caulerpa lentillifera* J. Agardh) as a seaweed with high economic and nutritional value. It is popularly consumed because it is rich in vitamins, minerals, and dietary fiber. It is commonly eaten fresh as a garnish in salads or served with dipping sauces for its unique crunchy texture. It is also cultivated for commercial sale. It is often found in shallow coastal waters and mangrove forests, areas with suitable environmental conditions for its growth. The growth of this seaweed depends on physical factors of the water and soil, such as water temperature, pH, dissolved oxygen (DO), water transparency, and salinity. This includes temperature and soil pH. Research from the Department of Fisheries indicates that sea grapes grow best in water with a temperature of 25–30°C, salinity of 25–30 ppt, pH of 7.5–8.5, dissolved oxygen of at least 5 mg/L, and suitable water transparency of 30-60 centimeters. These are crucial factors for photosynthesis and sea grape growth.

Therefore, the research team conceived the idea of studying the physical factors affecting the growth of sea grapes to provide preliminary information for the economic cultivation of sea grapes and to create supplementary income for the community.

Research Objective:

To study the physical factors that affect the growth of *Caulerpa lentillifera* J. Agardh

Research Question:

physical factors affect the growth of *Caulerpa lentillifera* J. Agardh ?

Research Hypothesis:

Physical factors affect the growth of *Caulerpa lentillifera* J. Agardh**.**

Scope of Study

This research studies and compares the factors affecting the growth of *Caulerpa lentillifera* J. Agardh between areas where it is found and where it is not found in the mangrove forest of Ban Yong Star, Tha Kham Subdistrict, Palian District, Trang Province. The study examines physical factors, namely water and soil, that influence the growth of *Caulerpa lentillifera* J. Agardh during the period of October 2025 to January 2026, which is the optimal time for monitoring and observing *Caulerpa lentillifera* J. Agardh growth. Factor analysis was performed. Physical factors such as water temperature, water pH, dissolved oxygen (DO), water transparency,

water salinity, soil temperature, and soil pH are assessed to evaluate the suitability of the environment for the growth of *Caulerpa lentillifera* J. Agardh.

Materials, Equipment, and Research Procedures:

1) Thermometer   2) pH Meter

3) Dissolved Oxygen (DO) Test Kit   4) Water Transparency Tester

5) Salinity Meter   6) Water and Soil Sample Containers

7) Notebook and Pen for Recording Experimental Results

The GLOBE measurement methodology

Hydrosphere: Primary methods for water measurement.

Pedosphere (Soil): Primary methods for soil measurement.

Study Site Designation

The study site is defined as a straight line approximately 2 kilometers along the edge of the mangrove forest at Ban Yong Star, Tha Kham Subdistrict, Palian District, Trang Province, Latitude 7.1730812, Longitude 99.6766430.

Research Methodology

2.1 Research Preparation

1) Identifying the research topic: The chosen research topic is "Physical Factors Affecting the Growth of *Caulerpa lentillifera* J. Agardh. The focus is on the physical factors of water and soil that affect the health of the algae."

2) Research and Collection of Knowledge and Theories related to the research: Basic data was collected on physical factors of water and soil, such as water temperature, water pH, dissolved oxygen (DO), water transparency, water salinity, soil temperature, and soil pH suitable for the growth of *Caulerpa lentillifera* J. Agardh. The measurement procedures were conducted according to GLOBE Protocols.

3) Defining the Study Objectives: To study the physical factors affecting the growth of *Caulerpa lentillifera* J. Agardh

4) Determine sampling points within the study area, selecting the Ban Yong Star mangrove forest area,at Ban Suan Na Nin, latitude 7.1730812, longitude 99.6766430. Divide the

sampling into at least two points in the same area: an area where no *Caulerpa lentillifera* J. Agardh. was found and an area where grape seaweed was found.

2.2 Procedures and Data Collection

1. Water Temperature Measurement: Use a thermometer, insert the probe into the soil at a depth of approximately 5–10 centimeters. Wait until the temperature stabilizes, then read and record the result in degrees Celsius (°C).

2. Water pH Measurement (using a pH Meter): pH is an indicator of the acidity-basicity of water. Measure it using a pH meter, then immerse the probe in the water sample. Wait until the value stabilizes, then record the pH value displayed on the screen.

3. Dissolved Oxygen (DO) Measurement (using a DO Test Kit): Use a dissolved oxygen test kit. Collect a water sample and place it in the test bottle. Add the chemicals according to the instructions in the test kit. Shake well, then compare the color of the solution to the standard color chart to read the amount of dissolved oxygen in the water and record the result.

4. Water Transparency Measurement: Use a transparency tube, which is a clear tube with a height scale. Pour the water sample into the tube until the symbol at the bottom of the tube is no longer visible. Then read the water level in centimeters and record the result.

5. Water Salinity Measurement 5. Measure the salinity of the water using a salinity meter by immersing the probe in the water sample. Read the salinity value in ppt and record the result.

6. Measure the pH of the soil. Collect soil samples from the study area. Mix the soil with clean water in the appropriate ratio. Then use a pH meter to measure the pH of the soil and record the result.

7. Measure the soil temperature. Insert a thermometer probe into the soil at a depth of approximately 5–10 centimeters. Wait until the value stabilizes, then record the value in degrees Celsius (°C).

Analysis and Summary of Research Results:

1) Analyze and compare the physical factors affecting the growth of grape algae, such as water temperature, water pH, dissolved oxygen (DO), water transparency, water salinity, soil temperature, and soil pH

2) Create a graph showing the average data values comparing areas where grape algae were found and areas where they were not.

3) Summarize the experimental results.

Research Results

Table 1: Geographic Coordinates

Nature trail	Geographic coordinates	
	Latitude (N)	Longitude (E)
Yong Star Mangrove Forest at Baan Suan Na Nin	7.1730812	99.6766430

Table 1, the geographical coordinates were used to study the mangrove forest area of Ban Yong Star, Tha Kham Subdistrict, Palian District, Trang Province.

Table 2 shows the water temperature in the studied area.

Area where found	1st time	2nd time	Third time	average
Areas where Caulerpa lentillifera J. Agardh. are not found.	25	27	26	26
Areas where *Caulerpa lentillifera* J. Agardh. are found.	30	31	30	30

Table 2 *Caulerpa lentillifera* J. Agardh**.**are typically found in areas with an average water temperature of approximately 26°C, which is the optimal temperature range for their growth. Conversely, *Caulerpa lentillifera* J. Agardh**.** were not found in areas with an average water temperature of approximately 30°C, which is too high and can hinder or even stop their growth.

Table 3 shows the pH values of the studied area.

Area where found	1st time	2nd time	Third time	average
Areas where *Caulerpa lentillifera* J. Agardh. are not found.	5.5	5.5	5.5	5.5
Areas where *Caulerpa lentillifera* J. Agardh. are found.	5.5	5.5	5.5	5.5

Table 3, the pH values of the water in the studied area, the area without grape algae and the area with grape algae, had an average pH of 5.5, which is acidic.

Table 4 shows the transparency values of the water in the studied area.

Area where found	1st time	2nd time	Third time	average
Areas where *Caulerpa lentillifera* J. Agardh. are not found.	52.5	52.5	52.5	52.5
Areas where *Caulerpa lentillifera* J. Agardh. are found.	66	66	66	66

Table 4. Areas without *Caulerpa lentillifera* J. Agardh. had an average transparency of 52.5 centimeters, indicating clearer water with lower turbidity. However, these conditions may not be suitable for *Caulerpa lentillifera* J. Agardh growth. Areas with *Caulerpa lentillifera* J. Agardh had an average transparency of 66 centimeters, indicating slightly higher turbidity than other areas, but still at a level where algae can grow well.

Table 5 shows the dissolved oxygen values in the water of the studied areas.

Area where found	1st time	2nd time	Third time	average
Areas where sea grapes are not found.	5.75	5.75	5.75	5.75
Areas where sea grapes are found	6.75	6.75	6.75	6.75

Table 5. It was found that areas without *Caulerpa lentillifera* J. Agardh had an average dissolved oxygen level of 5.75 mg/L, which may be unsuitable for *Caulerpa lentillifera* J. Agardh growth. This is because *Caulerpa lentillifera* J. Agardh require a clean, transparent environment with sufficient oxygen for photosynthesis. Areas where grape algae were found had an average dissolved oxygen level of 6.75 mg/L, which is suitable for their growth. Sufficient oxygen in the water allows the algae to photosynthesize efficiently, resulting in vibrant green color and good growth.Table

6 shows the salinity values in the water at the study area.

Area where found	1st time	2nd time	Third time	average
Areas where sea grapes are not found.	2.3	2.3	2.3	2.3 ± 2
Areas where sea grapes are found	2.8	2.8	2.8	2.8± 2

Table 6. It was found that the area where *Caulerpa lentillifera* J. Agardh were found had a slightly higher average salinity (2.8 ppt) compared to the area where they were not found (2.3 ppt). This is consistent with the nature of *Caulerpa lentillifera* J. Agardh, which can grow well in brackish to saltwater conditions. Therefore, it can be said that the appropriate salinity level is another factor that affects the growth of *Caulerpa lentillifera* J. Agardh.

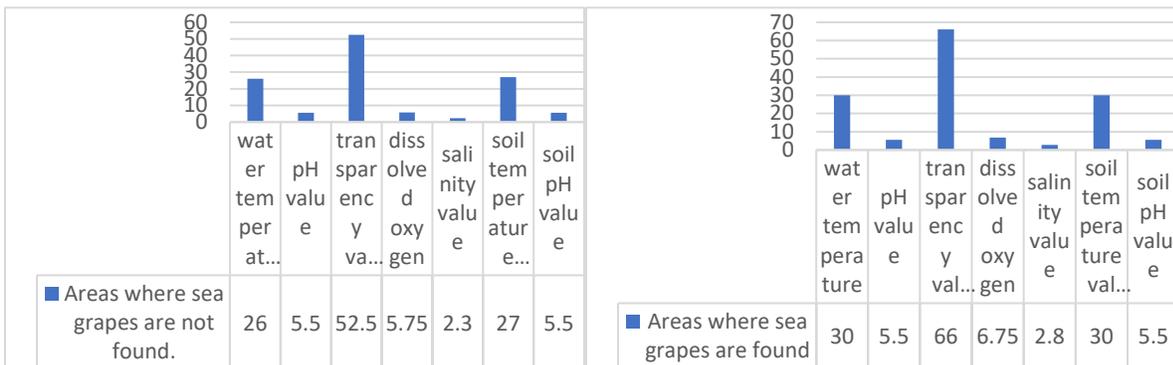**Table 7 shows the soil temperature values in the studied area.**

Area where found	1st time	2nd time	Third time	average
Areas where sea grapes are not found.	27	28	27	27
Areas where sea grapes are found	30	31	30	30

Table 7. It was found that the soil temperature in the area where algae were found had a higher average value (30 degrees Celsius) compared to the area where they were not found (27 degrees Celsius), which reflects the overall warm environment and its effect on the growth of *Caulerpa lentillifera* J. Agardh.

Table 8 shows the soil pH values of the studied area.

Area where found	1st time	2nd time	Third time	average
Areas where sea grapes are not found.	5.5	5.5	5.5	5.5
Areas where sea grapes are found.	5.5	5.5	5.5	5.5

Table 8 shows the soil pH values in the studied areas. It was found that the soil pH in both areas was the same at 5.5 Therefore, it can be concluded that soil acidity-basicity is not   a significant factor causing differences in the presence of *Caulerpa lentillifera* J. Agard

	water temperat...	pH value	transparenc y va...	dissolved oxygen	salinity value	soil temperature...	soil pH value
Areas where sea grapes are not found.	26	5.5	52.5	5.75	2.3	27	5.5

	water temperature	pH value	transparenc y val...	dissolved oxygen	salinity value	soil temperature val...	soil pH value
Areas where sea grapes are found	30	5.5	66	6.75	2.8	30	5.5

Analysis of the physical factors of water and soil in areas where *Caulerpa lentillifera* J. Agardh **are not found.**

print	1st time	2nd time	Third time	Average ($\bar{x}$) ± standard deviation
temperature (°C)	25	27	26	26 ± 1
pH value	5.5	5.5	5.5	5.5
Transparency value (mg/L)	52.5	52.5	52.5	52.5
Oxygen dissolved in a liquid. (mg/L)	5.75	5.75	5.75	5.75
Saltiness (ppt)	2.3	2.3	2.3	2.3
Soil temperatur (°C)	27	28	27	27.33 ± 0.58
pH value (pH)	5.5	5.5	5.5	5.5

Analysis of the physical factors of water and soil in areas where *Caulerpa lentillifera J. Agardh* **are found.**

print	1st time	2nd time	Third time	Average ($\bar{x}$) ± standard deviation
temperature (°C)	31	29	30	30 ± 1
pH value	5.5	5.5	5.5	5.5
Transparency value (mg/L)	66	66	66	66
Oxygen dissolved in a liquid. (mg/L)	6.75	6.75	6.75	6.75
Saltiness (ppt)	2.8	2.8	2.8	2.8
Soil temperature (°C)	30	31	30	30.33 ± 0.47
pH value (pH)	5.5	5.5	5.5	5.5

Discussion The study demonstrates a significant correlation between the presence of *Caulerpa lentillifera* J. Agardh and enhanced environmental parameters within the ecosystem. Areas populated by the algae exhibited higher average water and soil temperatures of ๓๐°C, which

appears to stimulate metabolic processes and microbial activity, thereby accelerating nutrient cycling. Despite the potential for thermal stress, these areas maintained a superior dissolved oxygen (DO) concentration of ๖.๗๕ mg/L, compared to ๕.๗๕ mg/L in algae-free zones, suggesting that the oxygen produced via photosynthesis outweighs the loss of gas solubility typically caused by warmer temperatures. This photosynthetic efficiency is further supported by increased water transparency, which averaged ๖๖ centimeters in the presence of algae, allowing for deeper light penetration. Regarding chemical composition, a slightly elevated salinity of ๒.๘ ppt was identified as optimal for maintaining cellular balance in this semi-marine habitat. Notably, both water and soil pH remained constant at ๕.๕; while this acidic level would generally inhibit nutrient uptake, the thriving population of *C. lentillifera* indicates a specialized biological adaptation to these conditions. Collectively, these findings suggest that while these algae thrive in environments with higher clarity, oxygen, and temperature, the stability of the ecosystem depends on these parameters remaining within a tolerable range to avoid the detrimental effects of excessive acidity or heat.

Conclusion

 The study of water quality factors in the area where *Caulerpa lentillifera* J. Agardh were found showed an average temperature of 30°C, a pH of 5.5, an average dissolved oxygen (DO) of 6.75 mg/L, an average water transparency of 66 centimeters, and an average salinity of 2.8 ppt. Regarding soil quality, the average soil temperature was 30°C and the soil pH was 5.5 In conclusion, areas with *Caulerpa lentillifera* J. Agardh tend to have higher water and soil temperatures, dissolved oxygen, water transparency, and salinity compared to areas without *Caulerpa lentillifera* J. Agardh. This may be an important factor contributing to the growth and survival of organisms in the study area.

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GLOBE Selection Badges

1. I am a Data Scientist

Research Alignment: This study systematically collected quantitative data following GLOBE Protocols, measuring various physical factors such as water temperature, pH, dissolved oxygen (DO), transparency, and salinity. The researchers functioned as data scientists by calculating averages

and standard deviations (S.D.) for the collected values. Furthermore, the data was presented in tables and summarized to clearly analyze environmental differences between areas where sea grapes were found and where they were not.

2. I Make an Impact

Research Alignment: The findings of this study extend beyond the classroom, aligning with local governance development strategies. Discovered data regarding optimal conditions—such as a dissolved oxygen level of 6.75 mg/L and a water transparency of 66 cm—serves as preliminary information for commercial cultivation. This supports the Ban Yong Star community in creating supplementary income and assists local farmers in site selection and greenhouse design to prevent crop loss.

3. I am a Collaborator

Research Alignment: This research project was a collaborative effort by a team of three students with guidance from advisors. It demonstrates cooperation between educational institutions and external organizations by implementing GLOBE measurement methodologies and referencing technical data from the Department of Fisheries to compare with field results. This teamwork and knowledge exchange were crucial in achieving the research objectives and understanding the complex factors of the mangrove ecosystem