# Types of fertilizers that affect the growth of sea grape

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**Abstract:**

This research aims to study types of fertilizers that affect the growth of sea grape (*Caulerpa lentillifera*) and the sea grape culture water quality. By experimenting with growing sea grapes in a greenhouse, divided into 6 experimental sets, with sets 1–5 using different fertilizers, including fertilizer formula 16-20-0, bat guano, urea, bio-extract, and cytokinin hormone, respectively. Experimental set 6, without fertilizer, was used as a control set. Cultured in a system with controlled light intensity. Collect water quality data every day, measure the growth of sea grapes, and change the used water every 7 days for 4 weeks. The results of the study found that sea grapes grow differently with different types of fertilizers. And the heaviest weight of sea grape was urea fertilizer. The length of sea grape grown in fertilizer formula 16-20-0 was the greatest. The length of sea grapes growing in cytokinin hormone is less than that in the control set. The sea grape length of using urea fertilizer was more than using bio-extract fertilizer, and the length of sea grapes using urea fertilizer was greater than that using bio-extract fertilizer. In addition, the sea grape using bio-extract fertilizer has noticeable external characteristics, which are tight ramulus arranged closely together, plump, beautiful, and large inflorescences with a darker green color than the other experimental sets. Sea grapes using bio-extract fertilizer were of great weight, with short and tight inflorescence, and popular among consumers. As for the water quality, it was showing no significant statistical difference.

**Keywords:** Sea grape, Growth, Urea, Fertilizer formula 16-20-0, Bat Guano, Bio-extract, Cytokinin hormone

**Research Questions:**

1. Which type of fertilizer is most suitable for the growth of sea grapes?
2. Does each type of fertilizer affect the water quality of growing sea grapes?

**Introduction and Review of Literature:**

The rising temperature causes the melting of polar ice, resulting in higher sea levels. This leads to a decrease in seawater salinity, which is not suitable for the survival of grape seaweed. Optimal seaweed growth occurs within a salinity range of 27-33 parts per thousand. If seawater salinity decreases below 25 parts per thousand, it affects growth and may lead to decreased seaweed production and viability. Sea grapes (*Caulerpa lentillifera J. Agardh*) is a green algae commonly known as Sea Grapes due to its spherical shape resembling grapes. This is found distributed in tropical and subtropical regions, including Indonesia, the Philippines, Thailand, Vietnam, and Japan. Currently, there are two main cultivation systems for sea grapes: closed-system cultivation and open-system cultivation. However, open-system cultivation faces challenges related to changes in seawater salinity during the rainy season, affecting them growth.

In closed-system cultivation, various factors are involved in sea grapes cultivation, such as temperature, salinity, light intensity, strength of seedlings, water turbidity, and pH levels. Apart from these factors, fertilizer plays a crucial role in growth. The selection of fertilizer must be appropriate, such as leaf or root fertilizers, free from contaminants and residues. Generally, Sea grapes is cultivated using chemical fertilizers, such as NPK (16-20-0) or urea, which are environmentally toxic. Therefore, it is essential to study high-quality organic fertilizers that reduce residues and provide essential nutrients for grape seaweed, such as organic fertilizers. Organic fertilizers are composed of natural substances derived from living organisms, including plants, animals, and microorganisms, through natural production processes. Organic fertilizers are primarily used to improve soil properties, such as soil porosity, aeration, and drainage, making it easier for plant roots to absorb nutrients. They are categorized into various types, such as animal manure, food scraps, leaf litter, and compost, which contain essential mineral nutrients: phosphorus (P), nitrogen (N), and potassium (K). These nutrients play crucial roles in plant growth

and are found in various organic sources. The adoption of organic fertilizers and soil improvement practices by farmers helps reduce production costs significantly, especially in the face of high chemical fertilizer prices. This approach not only reduces production costs but also contributes to environmental sustainability and the health of farmers and consumers.

Therefore, the researchers are interested in studying the type of organic fertilizer that has the greatest impact on the growth of sea grapes compared to chemical fertilizers. This study aims to provide data for farmers to use in sea grapes cultivation as a new alternative for the future. Besides being a health food, sea grapes have various other benefits in terms of social, economic, and environmental aspects.

**Research Methods and Materials:**

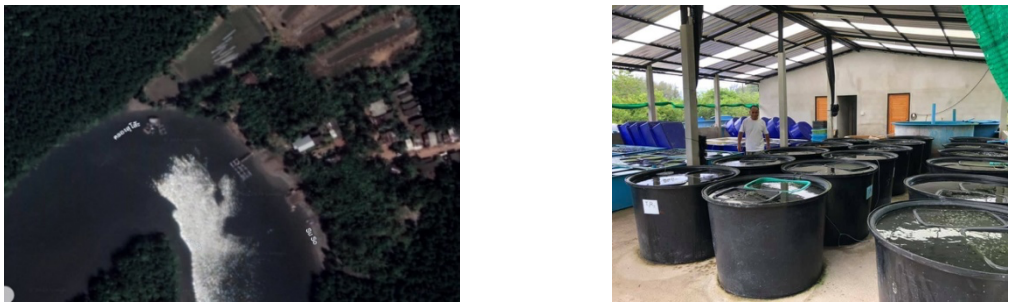
**Materials**

1. Basin diameter: 60 cm
2. O2 fish tank
3. Plastic basket size: 4x6x2 inches
4. pH meter
5. Salinity meter
6. DO meter
7. Vernier caliper
8. Thermometer
9. Globe Observer Application

**Methods**

1. **Study sites**

This research studied two study sites were defined: Na Nin Garden (A) (Latitude 7°10'23"N, Longitude 99°40'36"E ) and Rajamangala University of Technology Srivijaya Trang campus or Rajamangala Beach (B) (Latitude 7°31'27"N, Longitude 99°20'09"E )



(A) (B)

**Figure 1:** Show the study sites

## 2. Data collection of water quality

Measured water quality according to the GLOBE method by measuring salinity, water surface temperature, water temperature, pH, transparency, and dissolved oxygen as follows:

1. Determine the sampling point.
2. Do the GLOBE Land Cover by using GLOBE Observer Application.
3. Study the quality of water according to various indices, including salinity, by using a salinity meter. Measure the water surface temperature and the water temperature by using a thermometer. Measure pH with a pH meter, measure transparency with a transparency tube, and measure dissolved oxygen in water by using a DO meter.
4. Collect 3 data repeatedly and calculate the water quality average. Then send the data to GLOBE Data Entry.

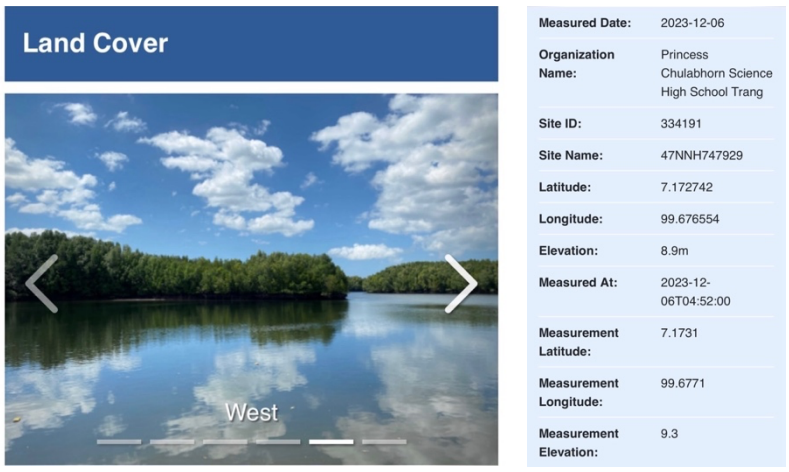



**Figure 2:** Shows the GLOBE Land Cover data

**3. Experimental designs**

Study of types of fertilizers that affect the growth of sea grape *(Caulerpa Lentillifera)* Plan the experiment completely randomly (Completely Randomized Design: CRD). Divide the experiment into 6 experimental sets, each set of 3 replicates as follows:

**Experimental set 1:** fertilizer formula 16-20-0

**Experimental set 2**: bat guano

**Experimental set 3**: urea

**Experimental set 4:** bio-extract

**Experimental set 5:** cytokinin hormone

**Experimental set 6:** Control sets (non-fertilizer)

**4. Preparation of culturing system**

1. Clean and dry 18 basins with diameter 60 cm.

2. Pour filtered seawater with salinity 25 ppt in the basin. Keep the water in the basin at a height of 30 cm. Oxygen was administered through the sand head in every tank throughout the experiment.

3. Control light and provide light through LED bulbs (Philips LED tube T8, LED neon tube, 18 watt long tube, LED Ecofit model) by controlling the light intensity in the range of 1000-3000 lux continuously for 24 hours.

**5. Preparation of sea grape**

Sea grapes used in this study was obtained from Rajamangala University of Technology Srivijaya, Trang Campus. Sea grape was prepared before experimentation for 6 sets of experiments and weighed before use. In the experiment of selecting the sea grapes, the characteristics were perfect. Clean sea grape by removing foreign objects and sticky substances such as barnacles, small mollusks, and other types of seaweed. put it in a small basket, width 4 inches length 6 inches height 2 inches. Weight of sea grape 25 grams per basket. Total 54 baskets.

**6. Cultivate and collect data**

1. Change the water once a week and maintain the salinity of the water not more than 35 ppt.

2. Use fertilizer in culturing sea grape. Use fertilizer with a concentration of 5 ppm per week in every experimental set. Put it on after every water change. Cultured for a period of 4 weeks.

3. Weigh the sea grape and measure the length of the sea grape from the beginning of the experiment. Before weighing and measuring the length, there must be a minimum amount of remaining water. Measure once a week.

**7. Data analysis**

1. Compare the weight of sea grape since the beginning to end of the experiment.
2. Compare the lengths of sea grape since the beginning to end of the experiment.
3. Analyze the water quality of sea grape cultivation in each experimental set.
4. Use one-way ANOVA to compare average weight and average length of sea grape.

**Results:**

**The weight of sea grapes**

A study on the average weight of sea grapes over a period of 4 weeks revealed an increase in weight throughout the 4-week period. The experimental set which used urea had the highest average weight, followed by bio-extract, bat guano, 16-20-0 fertilizer, cytokinin hormone, and no fertilizer, with weights of 60.82±3.73, 59.55±4.93, 55.43±4.60, 54.58±4.76, 52.43±5.30, and 52.33±4.97 grams, respectively.

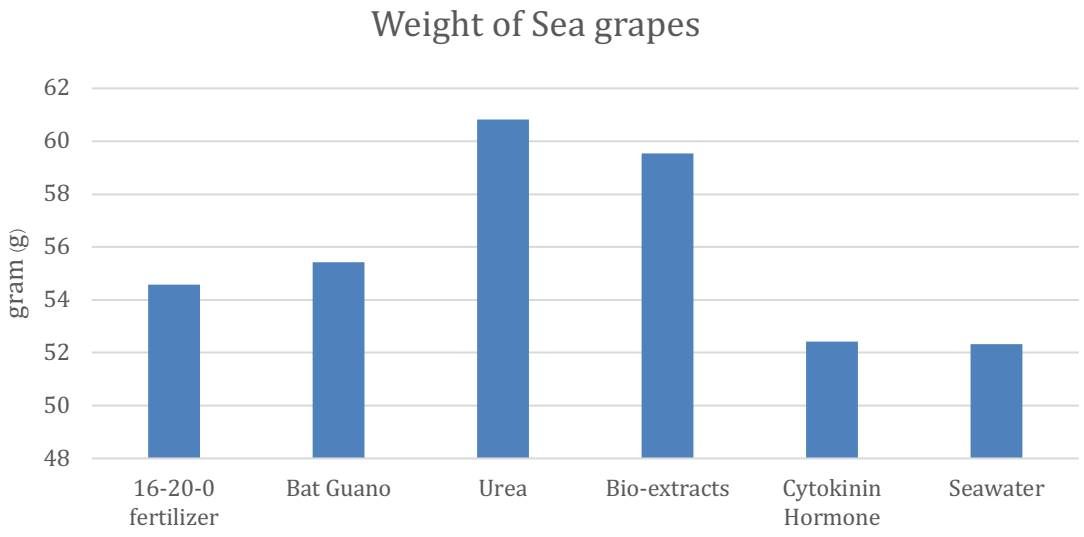



**Figure 3. the average weight of sea grapes (grams) over a period of 4 weeks**

**The length of sea grapes**

A study on the average length of sea grapes over a period of 4 weeks shown that the experimental set which used 16-20-0 fertilizer had the highest average length, followed by urea, bio-extract, bat guano, no fertilizer, and cytokinin hormone, with average lengths of 62.54±11.88, 61.75±15.93, 58.35±16.04, 56.43±14.16, 52.97±12.95, and 51.89±9.02 millimeter, respectively.

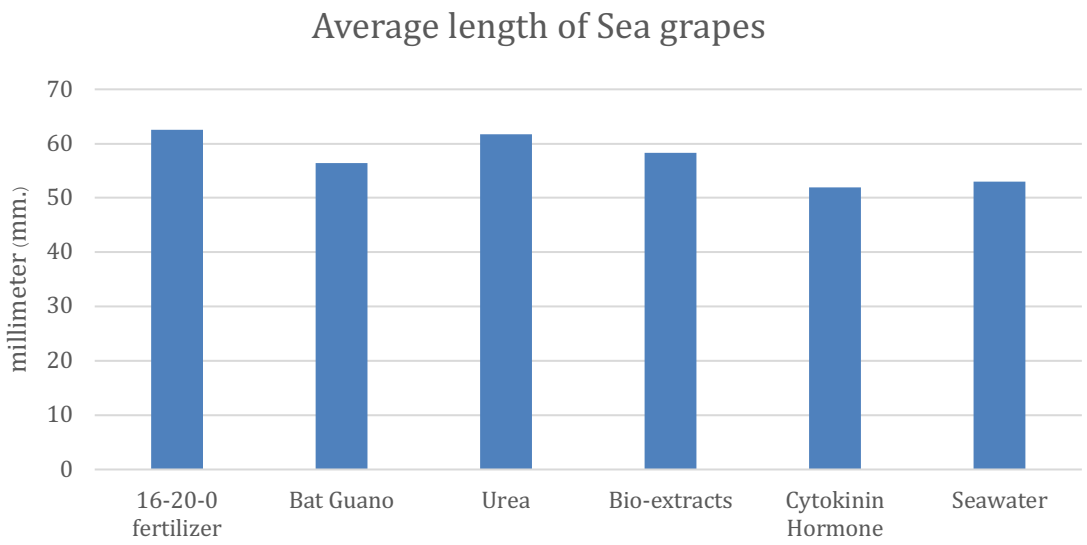
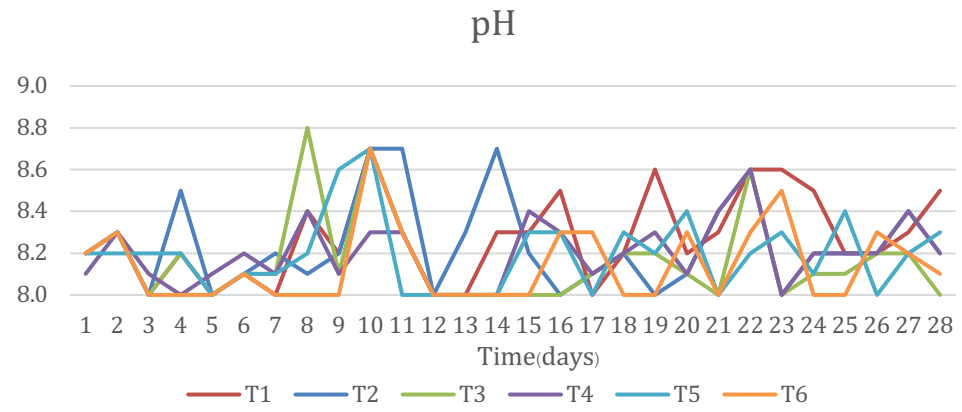


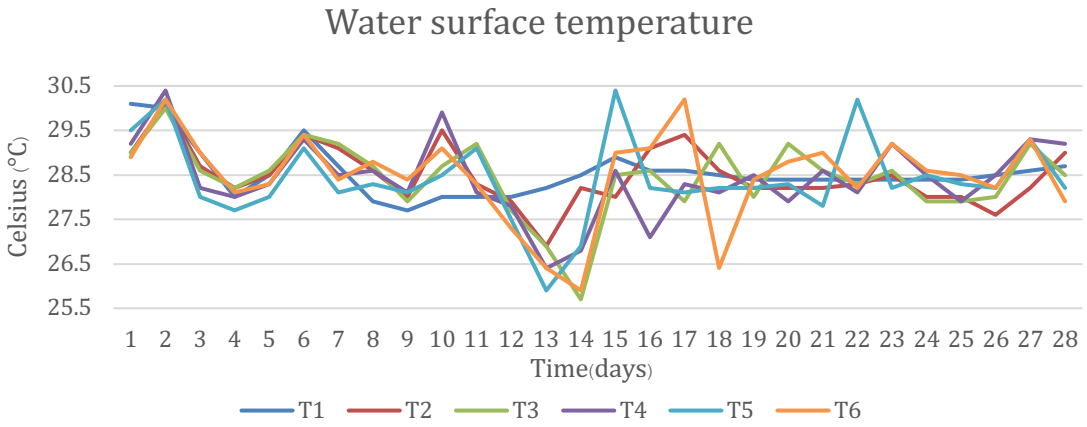

**Figure 4. the average length of sea grapes (millimeter) over a period of 4 weeks**

**Water quality**

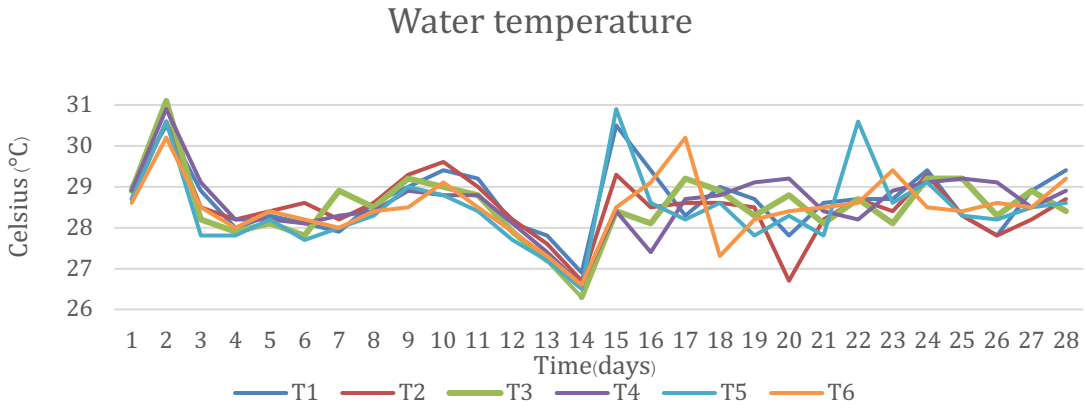
The study on water quality in the cultivation of sea grapes using different fertilizers shown that the average pH values for all sets were in the range of 8.0-9.0. The average water surface temperature for all sets ranged from 25.7-30.4 degrees, while the average water temperature for all sets ranged from 26.3-31.1 degrees. The average dissolved oxygen levels for all sets were in the range of 4.1-7.4 mg/L.


pH
9.0
8.8
8.6
8.4
8.2
8.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Time(days)
T1 T2 T3 T4 T5 T6

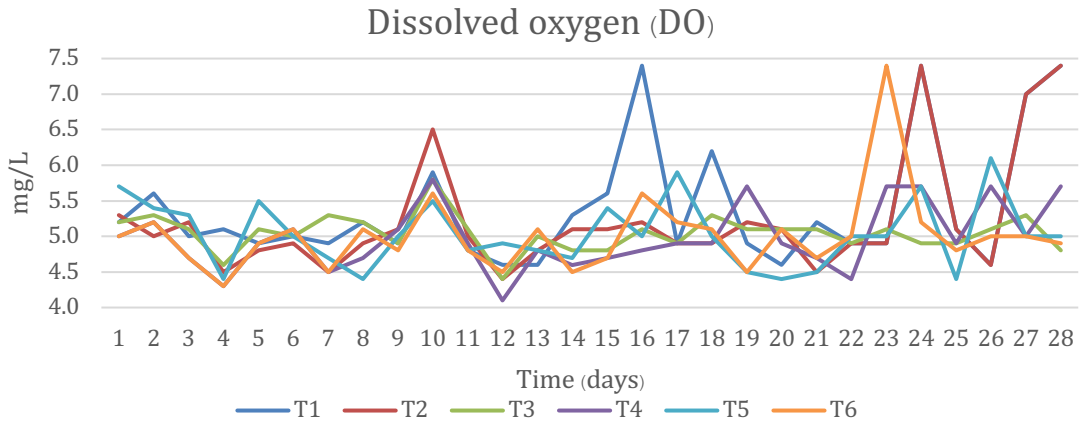
(a)


Water surface temperature
Celsius (°C)
30.5
29.5
28.5
27.5
26.5
25.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Time(days)
T1 T2 T3 T4 T5 T6

(b)


Water temperature
Celsius (°C)
31
30
29
28
27
26
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Time(days)
T1 T2 T3 T4 T5 T6

(c)




(d)

**Figure 4.** Water Quality and Environmental Factors: pH value (a), water surface temperature (b), water temperature (c), and dissolved oxygen in water (d) in the system where sea grapes are cultivated for 4 weeks.

**Discussion:**

A study of the average weight of sea grapes cultivated over a 4-week period revealed that the use of different fertilizers had varying effects on the average weight. Statistical analysis showed that the experimental set using urea fertilizer did not differ significantly ($P > 0.05$) from using bio-extract, 16-20-0 fertilizer, and bat guano but differed significantly ($P < 0.05$) from the experimental set without fertilizer and cytokinin hormone. The average length of sea grapes fronds showed that 16-20-0 fertilizer did not differ significantly from urea ($P > 0.05$) but differed significantly from other experimental sets ($P < 0.05$). The water quality in the experiment, with weekly water changes, showed that the water temperature ranged from 25 to 35 degrees, pH ranged widely from 8 to 9, and salinity ranged from 28 to 30 parts per thousand, which are suitable conditions for sea grapes growth. The study showed that the varying average frond lengths may be attributed to nutrient elements such as nitrogen, phosphorus, potassium, which accelerate leaf, stem, and photosynthesis processes in each experimental set.

**Conclusion:**

The study on the effects of different types of fertilizers on the growth of sea grapes found that the experimental set fertilized with urea had the highest average weight, followed by bio-extract, bat guano, 16-20-0 fertilizer, cytokinin hormone, and no fertilizer. The set fertilized with 16-20-0 fertilizer had the longest average length, followed by urea, bio-extract, bat guano, no fertilizer, and cytokinin hormone. There was no statistically significant difference ($P>0.05$) in the length between using urea and bio-extract. The set fertilized with bio-extract had characteristics such as densely arranged rhizomes, beautiful and large flower clusters, shorter size, and darker green color compared to other experimental sets.

The water quality in the experiments, including water surface temperature, water temperature, pH, and dissolved oxygen concentration, was found to be suitable for the growth of sea grapes.

In conclusion, the set fertilized with bio-extract can effectively promote the growth of sea grapes, similar to the use of urea. Bio-extract is another option for cultivating sea grapes to produce safe food as an alternative to nutrients from the sea and natural soil, ensuring consistent and high-quality yields.

**Acknowledgments**

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**Citations**

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**Badge Descriptions**

**I am a collaborator**:

This research received collaboration from external organizations for data collection in the field. Mr. Jirawut Wongthepwanich, from Ban Suan Na Nin, Tha Kham Subdistrict, Mueang District, Trang Province, provided assistance in providing knowledge about factors in cultivating sea grapes and collecting environmental data. This data was recorded in GLOBE Applications. Additionally, assistance was provided by Assoc. Prof. Dr.Manoch Khamcharoen from Rajamangala University of Technology Srivijaya, Trang Campus, in providing knowledge about cultivating sea grapes and experimental design. Furthermore, water and sea grapes were conducted with his assistance.

**I make an impact:**

Cultivating sea grapes in closed systems is predominantly done using chemical fertilizers, which often contain residual chemicals harmful to consumers. Therefore, there has been a study on using organic fertilizers as alternatives. This approach has yielded comparable results to using chemical fertilizers, benefiting the community by increasing sea grapes cultivation, boosting sea grapes exports, generating income for local communities, and promoting consumer and environmental well-being. Cultivating sea grapes with organic fertilizers helps reduce accumulated contaminants in sea grapes.

**I am a Data Scientist**:

In this research, data has been collected to be analyzed and statistically compared to identify differences and variability in each experimental set by ANOVA One-way analysis. This includes studying previous research works to provide discussion and summarize experimental results that align with the research questions set forth. This serves as a guideline for future research endeavors.