



The effectiveness of using rice water as a liquid fertilizer on the growth of Omani lemon.

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The summery of project:

This study was conducted to test the effectiveness of using rice water as a liquid fertilizer on the growth of Omani lemon. Three questions were answered:

- 1. (What are the components of rice water and the active ingredients that may affect the growth of Omani lemon?)
- 2. (What is the effect of rice water on the growth of the Omani lemon plant in terms of length and number of leaves?)
- 3. (What are the soil properties of the Omani lemon plant that has been fertilized with rice water?)

The summery of project:

This research aims to study the effect of rice water when used on Omani lemons, in terms of increasing the number of leaves and length, and its effect on soil properties. ➡


Because there is, a study confirming that rice water-soaked contains various vitamins and minerals beneficial to the plant (11). ➡

Therefore, in this procedural research, the effect of rice water infusion on the Omani lemon plant was tested by following up on the change in the rice water plant compared to the organic fertilizer and the control plant, in terms of height and number of leaves, in addition to analyzing a sample of rice water in the laboratory. The soil properties of the rice water plant were also studied and it was concluded that the rice water soil possesses suitable properties for the growth of lemon. Omani lemon plant Experiments have proven the possibility of using rice water as a liquid fertilizer on Omani lemon, as it contributes to increasing the number of leaves and plant length with high efficiency compared to chemical fertilizer. ➡

Several experiments have been carried out in the school, and cooperation has been made with the laboratory of the College of Agricultural and Marine Sciences at Sultan University to conduct a chromatographic analysis of rice water sample. ➡



Key terms:

- Rice water: is the water in which rice is soaked before cooking.
 - Chromatographic analysis: a modern method for separating a sample.
 - Phenolic acids: are organic compounds that contain two functional groups.
- 




Introduction:

The Omani lemon is one of the agricultural crops that the Sultanate of Oman is famous for, which is a source of income for the country and the citizen alike. Therefore, the Sultanate of Oman's production of Omani lemons increased from 6,216 tons in 2016 to 7,112 tons in 2018 (National Center for Statistics and Information, 2019). Fertilizers are important for the plant to grow in a strong, correct manner, and make the agricultural land more fertile, and thus will give a strong plant and a high-quality crop. Fertilizers are classified into two types: organic (natural) fertilizers and chemical (industrial) fertilizers. Natural fertilizers include animal and plant waste, while chemical fertilizers are prepared from mineral and chemical materials in specialized factories prepared for this purpose (Mostfa and k, 2018).



Introduction:

This research sought to find a fertilizer Organic at a lower cost and greater effectiveness by recycling cooking waste at home. Since rice is one of the daily dishes in Omani cuisine, the water resulting from cooking or soaking rice was the target of this research. Thus to study its effectiveness as a liquid fertilizer for Omani lemons, since research in this field leads to the production of fertilizer is far from the damage that chemical fertilizer may cause in terms of production and consumption. A study indicated that soaking rice can lose up to 7% protein, 65% crude fat, 30% crude fiber, 26% calcium, 47% phosphorous, 47% iron, 11% zinc, 70% magnesium, 41% potassium in the form of leachate (Juliano and B, 1993). This loss of elements means that this liquid can be used as a liquid fertilizer (Abba et al, 2021).



Research questions:

1. What are the components of rice water and the active ingredients that may affect the growth of Omani lemon?
2. What is the effect of rice water on the growth of the Omani lemon plant in terms of length and number of leaves
3. What are the soil properties of the Omani lemon plant that has been fertilized with rice water



Introduction:

Previous studies have indicated that rice water has a clear effect on the plant, as it increases plant height, stem diameter and productivity of many crops such as tomatoes, spinach and hot peppers, lettuce productivity and root weight. Also mushroom growth has also been observed, and the number of leaves has increased in mustard plant (Abba). et al, 2021).

This study is concerned with the effect of filtrate resulting from soaking or cooking rice on plant growth by observing the increase in plant height and number of leaves compared to another lemon plant that used organic fertilizer and another control plant.



Research importance:

The importance of this research lies in:

- Trying to find a liquid fertilizer resulting from daily cooking waste that is environmentally friendly and has a good effect on plants.
- Encouraging farmers to use this type of inexpensive fertilizer.
- Opening the door for deep researches and studies on rice water fertilizer and its effectiveness on plant growth.



Research goals:

This research aims to:

1. Studying the effectiveness of using rice water as a liquid fertilizer on the growth of Omani lemon.
2. Note its effect on:
 - a) plant growth (stem length)
 - b) number of leaves
 - c) soil properties



Hypotheses:

1. Rice water is used as a fertilizer to increase:
 - a) Plant length (stem length).
 - b) Number of leaves.

2. Rice water positively affects soil properties (acidity, salinity, carbonate).



Research problems:

Chemical fertilizers are classified into many types, including nitrogen fertilizers, urea fertilizers and phosphate fertilizers. Although there are benefits to chemical fertilizers, there are serious drawbacks that reduce the desire to use them, as they contain components that affect human health. Many studies show the relationship between the components of some fertilizers that sometimes leak into drinking water to increase the risks of pancreatic cancer, brain cancer, large intestine cancer, bladder cancer and thyroid cancer.



Materials used:


In this research, three lemon plants of the same type were used, soil of the same type, organic fertilizer, rice water, a ruler and a metric tape to measure the length of seedlings, a graduated tester, a paper and a pen to record the results, a pH meter and a salinity meter, vinegar to measure the amount of carbonate.

Variables:

| | |
|--------------------------|---|
| The independent variable | the type of fertilizer (organic fertilizer or rice water) |
| The dependent variable | plant height, number of leaves |
| Control variables | plant type, soil type, amount of irrigation water, location |

Table (1) Variables

- Independent variable: A variable that affects one or more other variables.
- Dependent variable: The variable that follows the independent variable.
- Control variables: the variables that are validated in all samples.



Research method:

The research was implemented in the school, where we set the goal of the research and set a timetable for the research plan, with the research starting in October 2021 and ending in December 2021.

Research method:

| month | work plan |
|---------------|--|
| October 2021 | <ul style="list-style-type: none">-Think about the research topic.-Determine the topic of the research.-Planning to start the search.-Determine the objective of the research.- Identify and bring materials and tools. |
| November 2021 | <ul style="list-style-type: none">-Starting to apply the research by bringing seedlings and coding them.-Water the plants every two days with water/rice water.-Weekly collection of plant length and leaf number data. |
| December 2021 | <ul style="list-style-type: none">-Analyze length data in tables.- Analyze the data of the number of leaves in a graph.-Visiting the laboratory of Sultan Qaboos University to obtain the analysis of a sample of rice water.- Draw conclusions.-Writing the research.-Submit the research. |

Table (2) Timeline of the research plan

Research method:

The study site: Sultanate of Oman - Al Dhahirah Governorate - Ibri, Al Driz village (latitude 23.33 and longitude 56.61) from October to December, and the temperature ranges between 12-20 °C. The soil and land cover protocol were used.



Picture (1) the study site

Research method:

After that, roles were distributed to the work team, represented in bringing seedlings, field application, and weekly data collection.

| The task | The performer student |
|------------------|--|
| Mariya | - Formulating the objective of the research and identifying the required materials, tools and bringing them. |
| Mariya and Qabas | - Watering plants and collecting data weekly. |
| Mariya and Qabas | - Draw conclusions through the collected data, and from them formulate conclusions and write the research. |


Table (3) Distribution of roles to the work team

Research method:

Then we started the research application. Where plants were brought and ensured that they were of the same height then coding the plants: The control plant (A), the rice water plant (B), the compost plant (C). Then we added the fertilizer to the organic fertilizer plant and watered the rice water plant with 50 ml of rice water. Then watered all the plants with 50 ml of water and this process was repeated every two days. Then, every week we would collect data on the plants, the height of each plant and the number of leaves.



pictures (2-3) students during data collection



Research method:

After that, some sources related to the subject of the research were reviewed, such as collecting information from the school's Learning Resource Center, and using the Internet to obtain some information that supports the research.

In addition, the team visited Sultan Qaboos University in Muscat to conduct a chromatographic analysis of a sample of rice water.

Then, we analyzed the collected data and represented it graphically.

Research method:

Next, the team worked on drying the rice water and making the rice water powder product.



Picture (4) Product

Research method:

Then entered the data and sent it to the program's website



The screenshot shows a web form with the following fields:

- رمز اللون الرئيسي (Main color code):
- رمز اللون الثانوي (Secondary color code):
- الإحتمية تقدير (Probability estimate):
- تقدير ملمس التربة في الحقل (Soil texture estimate in the field):
- تقدير كمية الجذر (Root quantity estimate):
- تقدير كمية الصخور (Rock quantity estimate):
- الكربونات (Carbonates):
- تعليقات (Comments):
- إرسال البيانات (Submit data):

Finally, writing the research, reviewing, proofreading, and then submitting it.



Data analysis:

1. Chemical analysis of rice water sample:

By analyzing a sample of rice water (chromatographic analysis), an analysis of the elements as well as the analysis of the acids in the sample was obtained.

Data analysis:

| Item name | PPM |
|----------------|----------|
| zinc (Zn) | 11.42 |
| Barium (Ba) | 8.58 |
| Iron (Fe) | 238.59 |
| Boron (B) | 78.07 |
| Manganese(Mn) | 21.17 |
| Magnesium (Mg) | 3621.58 |
| Calcium (Ca) | 20853.61 |
| Copper (Cu) | 4.32 |
| Aluminum (Al) | 188.21 |
| Strontium (Sr) | 521.83 |
| Sodium (Na) | 518.77 |

Table (4) The elements presented in rice water in parts per million (PPM)



Data analysis:

Table No. (4) shows an analysis of the elements that are found in the rice water. Through the analysis, it was found that potassium (K), calcium (Ca) and magnesium (Mg) are the most abundant elements in rice water. They contains (20853.61) parts per million of calcium and (29525.35) parts per million of potassium, while magnesium (3621.61) parts per million.

It is also noted that copper and barium are the least abundant elements in rice water, as they constitute (4.32) parts per million and (8.58) parts per million, respectively.

Data analysis:

| N | Compound Name | Concentration (ppm) |
|----|--------------------------|---------------------|
| 1 | Gallic acid | 2.416271114 |
| 2 | 3,4Dihydroxybenzoic acid | 0.292895933 |
| 3 | Chlorogenic acid | 11.9181359 |
| 4 | Vanillic acid | 0.710050696 |
| 5 | Caffeic acid | 0.342688558 |
| 6 | Syringic acid | 0.03428666 |
| 7 | P-Coumaric | 1.39684528 |
| 8 | Ferulic acid | 0.853064724 |
| 10 | 2-Hydroxycinnamic acid | 0.149950699 |

Table (5) concentration of phenolic acids in rice water in ppm.



Data analysis:

Table (5) shows an analysis of the acids in the rice water sample. It was found that chlorogenic acid forms the highest concentration than the rest of the acids, as it constitutes (2.41627) parts per million, followed by gallic acid, which has a concentration in the rice water sample. 2.41627) ppm, while it is noted that the concentration of hydroxycinnamic acid is (1.3968) ppm.

Data analysis:

1. The results of using rice water as a fertilizer on Omani lemons:
 - a) The length of the lemon tree:

| | Plant length by weeks | | | |
|--------------------------|-----------------------|-------------|------------|-------------|
| type of plant | First week | Second week | Third week | Fourth week |
| control plant | 40 | 40.5 | 41 | 41.5 |
| Organic fertilizer plant | 40 | 41 | 42 | 42.5 |
| rice water plant | 40 | 41.5 | 42.5 | 44 |

Table (6) The height of the three lemon trees during a month measured in centimeters



Data analysis:

The previous table shows the length of the lemon tree in which rice water was used as fertilizer (the rice water plant), the lemon tree that was fertilized with an organic fertilizer, which is animal manure (the organic fertilizer plant), and a lemon tree that was not fertilized for the length of the experiment (the control plant). All lemon plants at the beginning of the experiment were equal in length (40 cm). It is noticeable that the control plant in the second week reached a length of (40.5 cm), while the organic fertilizer plant and rice water plant became (41 cm) (41.5 cm) in length, respectively. While in the fourth week the length of the rice water plant reached (44 cm), thus it is greater than the length of the organic fertilizer plant and the control plant.

Data analysis:

b) The increase in the number of leaves of lemon trees:

| Number of extra papers by weeks | | | | |
|---------------------------------|------------|-------------|------------|-------------|
| type of plant | First week | Second week | Third week | Fourth week |
| control plant | 1 | 2 | 3 | 4 |
| Organic fertilizer plant | 2 | 3 | 4 | 5 |
| rice water plant | 2 | 4 | 6 | 8 |

Table (7) The increase in the number of leaves of lemon trees



Data analysis:

From table (7), it is noticeable that the increase in the number of leaves in the first week of the rice water plant was two leaves, while in the fourth week (8) leaves. In the organic fertilizer plant and the control plant, it reached in the fourth week to (5) and (4) leaves respectively.

Data analysis:

c) Analysis of soil properties in rice water plant:

| Soil properties | Before using rice water | After using rice water |
|-----------------|-------------------------|------------------------|
| PH | 7.3 | 6 |
| Salinity | 0.552 ppm | 0.788 ppm |
| Carbonate | medium few | few |

Table (8) Effect of rice water on the soil properties of rice water plant

A decrease in the amount of acidity carbonates is noticed, while there is an increase in salinity.



Data analysis:

1. Results of chemical analysis:

Through Table (4) and Table (5), the chemical analysis shows the presence of many elements such as potassium, aluminum, gallium, sodium and magnesium in rice water, which is of great importance in the healthy growth of plants. For example, magnesium is a necessary element for plants to form the chlorophyll molecule. As for calcium, it increases the plant's resistance to diseases, while iron plays the role of a mediator for the formation of chlorophyll (Agricultural art, 2014). The amino acids or phenolic acids in rice water, the absorption of the plant enables it to germinate vegetative growth and root growth. It also has a role in protecting the plant from fungal diseases and Bacterial (Baha Dabbous, 1972).

Data analysis:

2. Results of the data of the number of leaves of lemon tree:

By plotting the data in Table (7), we get Fig. (1)

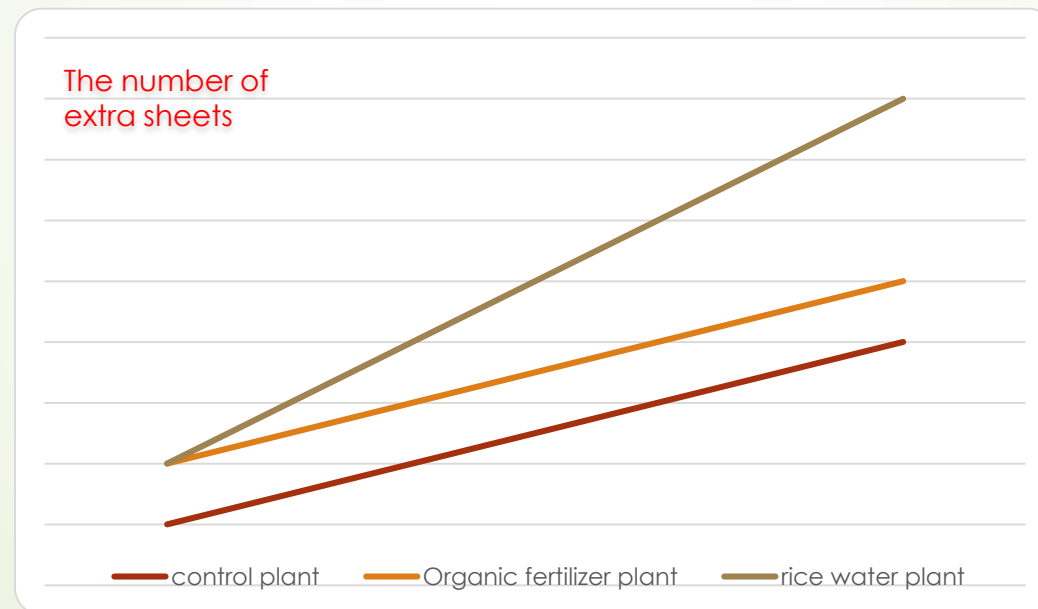
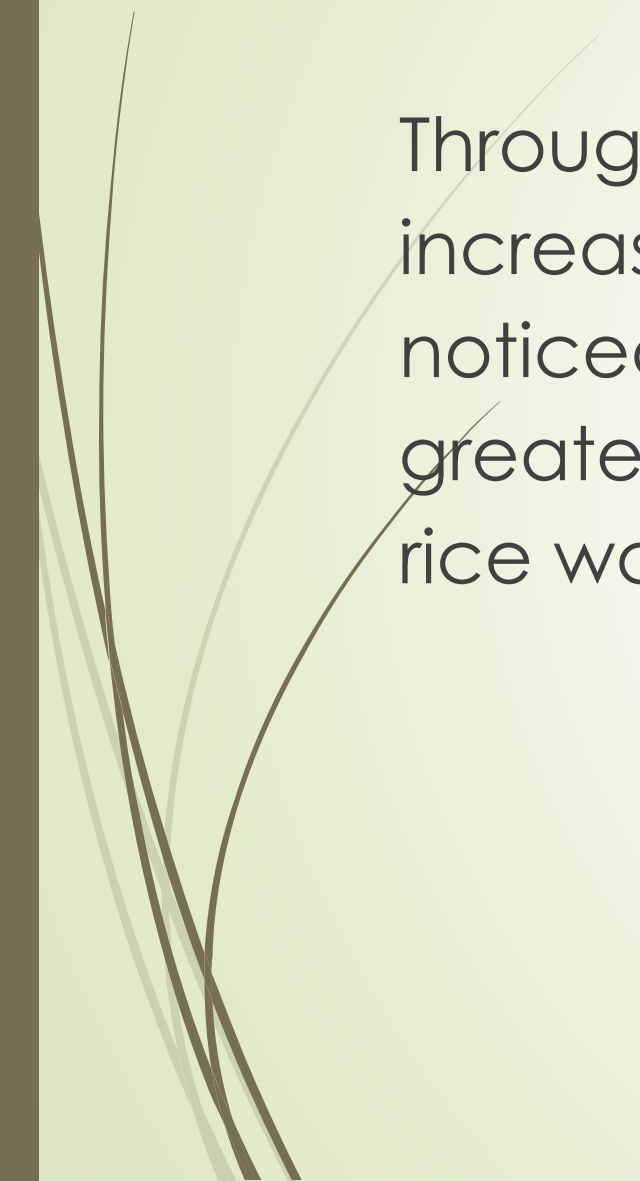


Figure (1) The graph shows the increase in the number of leaves of the three plants over the weeks



Data analysis:

Through the graph, it is clear that the number of leaves increases in the three plants over time, but it is noticeable that the number of leaves increased by a greater amount for the plant that was fertilized with rice water.



Data analysis:

3. Results of lemongrass plant length data:

By plotting the data in Table (6), we get Figure (2).

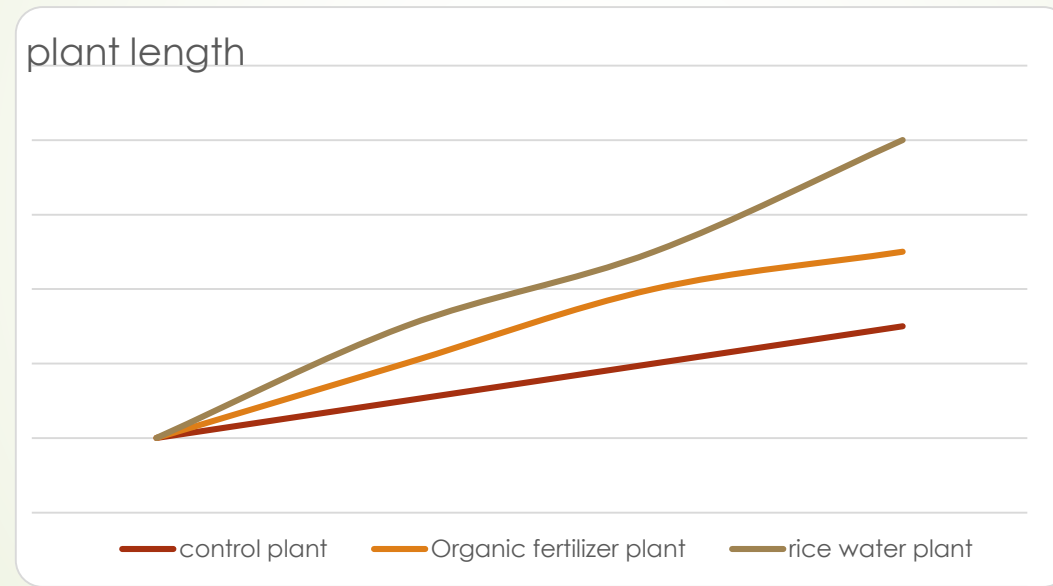
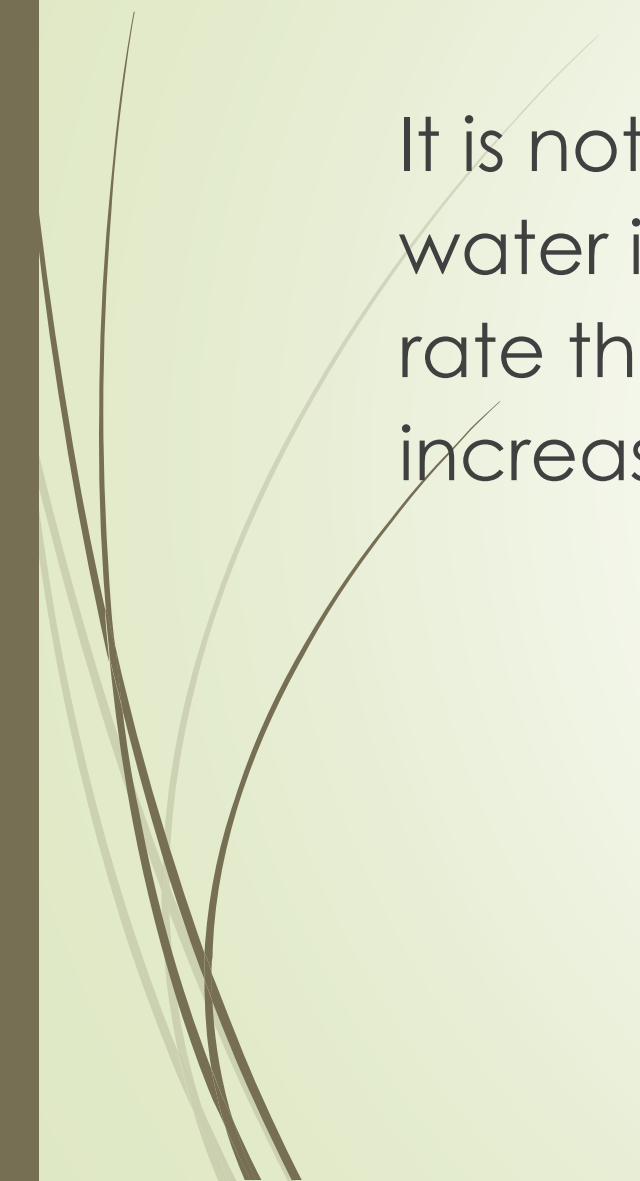


Figure 2 is a graph showing the increase in the length of the three plants over time



Data analysis:

It is noticeable that the lemon plant, to which rice water is added, has increased in length at a greater rate than the rest of the plants. The difference has increased significantly in the fourth week.





Data analysis:

4. Results of soil properties data on the plant to which rice water is added:

Through the results, we find that rice water has improved the properties of the soil, adjusting the acidity to the ideal rate from 6-7 to be 6. This made the soil neutral, and the salinity and carbonate changed to become in the ideal rate for the growth of lemongrass (Al-Nuaimi, 2012).



Results discussion:

To answer the first question (what are the components of rice water and the active ingredients that may affect the growth of Omani lemons?) The research team visited a laboratory at Sultan Qaboos University and a chromatographic analysis of a sample of rice water was conducted there. Based on the results of the analysis table 4 and 5, we found that rice water contains a group of mineral salts that have an effective role in increasing the length of the plant and the number of its leaves, such as sodium and potassium. They play an important role in the transfer of sugars and protein in the plant and affect the storage of carbohydrates in storage organs (Mohammed Amine, 2018), iron, as well as some organic compounds and phenolic acids.



Results discussion:

To answer the second question (What is the effect of rice water on the growth of the Omani lemon plant in terms of height and number of leaves?)

Referring to the data and results (table 6 and 7, Chart 1 and 2), rice water has an effective and clear effect on the growth of lemongrass in terms of height and number of leaves compared to the compost plant and the control plant.



Results discussion:

To answer the third question (What are the characteristics of the soil in the Omani lemon plant that was fertilized with rice water?) We found that the soil properties of rice water are very suitable. It was found that the pH is approximately 6 and this is the appropriate degree for the growth of the lemon plant (Iyad Hani, 2017). As well as after taking a measurement the salinity of the soil shows us that the soil has a very suitable salinity for the growth of the Omani lemons, as well as a low carbonate ratio, and this means that it is a soil that possesses suitable properties for the growth of the Omani lemon plant (Table 8).



Conclusion:

1. The number of leaves and the length of the Omani lemon plant increases because rice water contains organic compounds and salts.
2. The soil has excellent properties in terms of acidity, salinity and carbonate.




Application:

Through the results of the study, a product was manufactured through the process of evaporation of rice water liquid and then drying, which is rice water powder as a fertilizer that can be used on plants where every one liter of rice water liquid produces 1.5 g of rice water powder.



Economic feasibility of the project:

The rice water powder that we manufactured is very useful for the growth of the Omani lemon plant, which is a very important source of income for the country. Therefore, its fruits can be sold locally and exported to neighboring countries, thus raising the income of the country.






Recommendations and Suggestions:

1. We advise farmers to recycle rice water by using it to irrigate plants because of its effect on increasing their growth.
2. We recommend companies to manufacture a product (liquid fertilizer from rice water) and distribute it to farmers.
3. We recommend the researchers to expand the study by studying the effect of rice water on the growth of other acidic plants such as quince and orange.
4. We also advise those interested in manufacturing a device to distribute rice water that is filled with rice water and distributes rice water on the trees evenly.



Difficulties and challenges:

One of the difficulties that we faced during this study is the climatic fluctuations, as the area was exposed to rain with strong winds and thus led to the death of the plant in that period, so we repeated the experiment.





Badge Selection:

Be a collaborator. ▶

Be a Data Scientist. ▶

Be s STEM Professional. ▶



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