



Sultanate of Oman

Ministry of Education

Al Zahraa Primary School (1-9)

The Effect of Eggshell Extract on Tomato Growth in Muscat

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Abstract:

This research aims to study the effect of eggshells on tomato growth in Muscat. The research questions are :What is the effectiveness of eggshells in soil fertilization ?& How are the properties of the soil, to which eggshells are added, affected compared to the soil to which eggshells are not added?The research has been carried out in Muscat where some samples of the farm soil have been collected and studied inside the school. The eggshells have been dried and ground using a pestle. The extract has been used in fertilizing tomato plant comparing the growth rate in two soils. We have used eggshells in one soil, while we have not used the extract in the other. The study has been conducted by applying Soil & Land cover Protocol.

Through conducting our study, we have concluded that when adding extract to the soil, it has contributed to the growth of tomato plant increasing its branches and number of leaves. The highest growth rate has been 36.92 cm in the soil containing the extract, while the same has been 17.57 cm in the soil not containing the extract.

We also have found some differences in properties of the soil containing the extract and the soil not containing the extract in .We have found that the soil containing the extract is less acidic, saline and conductive than the soil not containing the extract.

Therefore, through the results obtained from measurements and interviews, we conclude that eggshells help the plant grow. Hence, we recommend owners of farms and farmers to use the natural extracts as natural fertilizers instead of chemical fertilizers to get a healthy natural product for the human.

Key Terms:

Extract: The product that contains the components of the main substances.

Fertilization: Addition of the extract to the soil for increasing its fertility.

Research Questions:

- 1- What is the effectiveness of eggshells in soil fertilization?
- 2- How are the properties of the soil, to which eggshells are added, affected compared to the soil to which eggshells are not added?

Introduction & Review of Literature:

Eggs are one of the most common foods in the world. People used to get rid of eggshells and throw them in the garbage, but they do not realize the benefits of eggshells to humans and plants.

Many studies showed that eggshell could be used in several fields due to their great benefits as eggshells include mineral salts necessary for plants to grow. (Alwsali, Muzaffar, 1971) Mentioned the importance of organic fertilizers in plant growth and its effect on increasing soil fertility. The study of (Al Shammari, 2014) also indicated the role of organic extracts necessary in germination and increased the total productivity of the plant.

The importance of this study lies in that it may benefit farmers, farm owners and those who have an interest in agriculture. It also directs them to the pattern of organic agriculture by replacing the chemical fertilizers with natural fertilizers made from household waste in order to improve soil fertilization as well as balancing soil acidity. Also, the importance of this study aims to adopt a new pattern in agriculture represented in the use of environmentally friendly materials and avoiding all substances that may pollute the agricultural environment.

Research Methods:

1- Research Plan:

The schedule of Research plan is as follows :

Month	Research Plan
November 2018	Choose the study subject, identify the problem to be studied and the study site and develop a plan for the distribution of tasks.
December 2018	Collect samples from the site to the school, start preparing the extract and planting tomato plant, and take primary measurements.
January 2019	Apply protocols and make interviews with those interested in agriculture.
December + January + February 2019	Collect data periodically
February 2019	Analyze data, complete the research and make an interview
March 2019	Complete and submit the research

Table (1) The Schedule of Research Plan

- Roles have been distributed on the Team to start work:

Month	Research Plan
Choose the study subject, identify the problem to be studied and the study site and develop a plan for the distribution of tasks.	<p>Durra Dareen Esraa</p>
Collect samples from the farm to the school, start preparing the extract and planting tomato plant, and take primary measurements.	<p>Durra Dareen Esraa</p>
Apply Soil & Land cover Protocols.	<p>Dura Darrn Esraa</p>
Collect data periodically	<p>Durra Darren Esraa</p>
Analyze data, complete the research and make an interview	<p>Durra Dareen Esraa</p>
Complete and submit the research	<p>Durra Dareen Esraa</p>

Table (2): Distribution of Roles on the Work Team in the Research

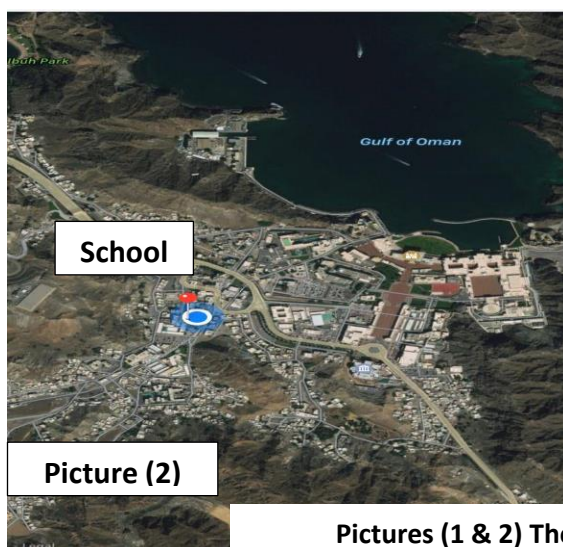
Research Plan (continued):

- 1- Collect information and external sources of research subject from LRC and the International Network as well as assist the supervisor of research.
- 2- Specify the devices and tools suitable for conducting the study.
- 3- Take samples from the soil in the study site and transfer them to the school for applying Soil Protocol.
- 4- Collect and dry eggshells, grind them with a pestle and keep them in glassware to start work.
- 5-Mix the eggshells extract in the first soil sample and plant tomato in that soil. In the other soil, the tomato has been planted without adding the extract.
- 6- Apply Soil & Water Protocol to the samples recording data.
- 7- Measure the length of tomato plants, regulate and record these measurements in a table.
- 8- Insert data of Soil & Water Protocol at the site of the GLOBE
- 9- Analyze and make charts for data.
- 10- Reach and discuss results.
- 11- Do interviews.
- 12-Write recommendations.

Research Methods:

2- Study Site:

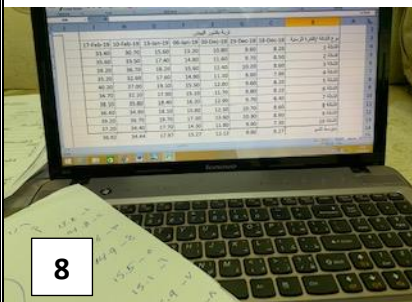
The research plan has been carried out in the Governorate of Muscat, where samples have been taken from the farm soil in the state and transferred to the school building. The tomato plant has been planted applying the Soil & Land cover Protocol. The required measurements have been taken and the results have been recorded: January - February 2019, temperature: 23 °C, the weather: cold.



Pictures (1 & 2) The Location of the Research Site

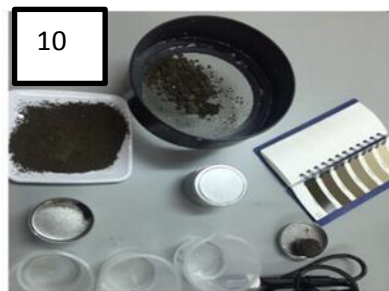
Methods: Data Collection and Analysis

Data related Research Questions has been collected by measuring the growth of tomato stalk over two months for ten seedlings by using (a ruler, pencil, data sheet, and rope) comparing the growth rates of the stalk in each soil. Both soils have been irrigated with the same amount of water but with the addition of eggshell extract to one of the two samples.



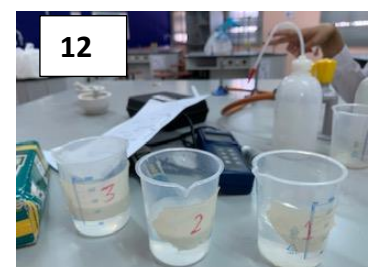
Pictures (3, 4, 5, 6, 7, & 8) Method of Work

Data of properties of the soil containing extract and the soil not extract has been collected in terms of (general properties, conductivity, acidity and salinity) comparing



Pictures (9, 10 & 11) Method of Work in Soil Protocol

Data of Water Protocol has been collected and water properties have been recorded .



Pictures (12, 13 & 14) Method of Work in Water Protocol

After collecting and recording data, we have used (**Microsoft Excel**) program to clarify the growth rate of plant in both soils and analyzed readings of charts and diagrams.

Results:

Through the collected and recorded data being inserted into GLOBE site, we have reached the following results:

First: Data for lengths of tomato plant stalk in soil containing extract and soil not containing that extract:

Soil with Eggshells							
Type of Seedling/Period of Time	16-Dec-18	23-Dec-18	30-Dec-18	06-Jan-19	13-Jan-19	10-Feb-19	17-Feb-19
Seedling 1	8.20	9.60	10.80	13.20	15.60	30.70	33.40
Seedling 2	8.50	9.70	11.60	14.80	17.40	33.50	35.60
Seedling 3	8.60	10.20	12.40	15.60	18.20	36.70	39.20
Seedling 4	7.90	8.80	11.30	14.90	17.60	32.60	35.20
Seedling 5	8.20	9.60	12.80	15.50	19.10	37.00	40.20
Seedling 6	8.10	9.80	11.70	15.10	17.90	32.10	34.70
Seedling 7	8.40	9.70	12.90	16.20	18.40	35.80	38.10
Seedling 8	8.60	10.70	12.30	15.80	18.10	34.90	36.40
Seedling 9	8.90	10.30	13.60	17.30	19.70	36.70	39.20
Seedling 10	7.30	9.60	11.80	14.30	17.70	34.40	37.20
Average Growth	8.27	9.80	12.12	15.27	17.97	34.44	36.92

Table (3) Lengths of Tomato Stalk of Ten Seedlings in the Soil containing Eggshell Extract

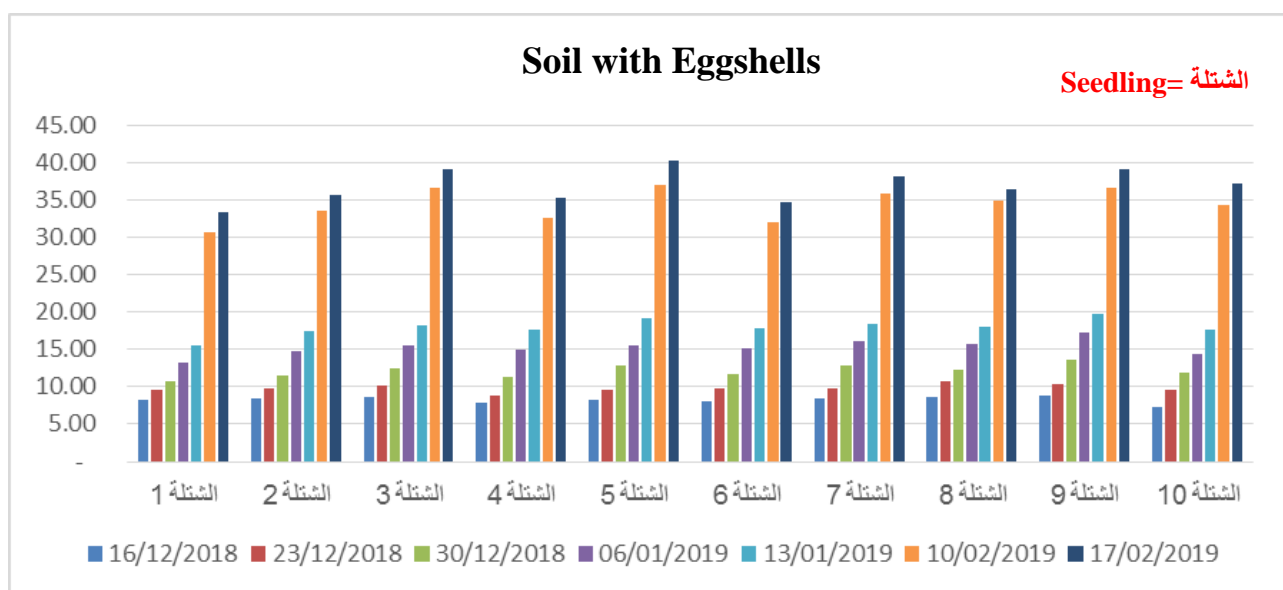


Chart (1) Lengths of Tomato Stalk of Ten Seedlings in a Soil containing Eggshell Extract

Soil without Eggshell Extract

Type of Seedling/Period of Time	16-Dec-19	23-Dec-18	30-Dec-18	06-Jan-19	13-Jan-19	10-Feb-19	17-Feb-19
Seedling 1	8.30	8.90	9.70	11.20	13.60	24.20	26.10
Seedling 2	8.20	8.90	9.80	12.40	13.80	25.60	26.70
Seedling 3	8.50	9.70	11.20	13.90	14.20	28.30	30.60
Seedling 4	8.10	9.40	10.30	12.80	13.60	13.40	13.40
Seedling 5	7.80	8.40	9.50	11.60	12.70	20.40	22.10
Seedling 6	7.20	8.30	8.40	8.30	8.30	8.30	8.30
Seedling 7	8.30	9.10	9.80	10.30	10.20	10.20	10.20
Seedling 8	7.80	8.60	10.60	12.10	12.10	12.10	12.10
Seedling 9	8.50	9.70	11.40	13.10	13.00	13.00	13.00
Seedling 10	7.70	8.50	11.10	12.90	13.70	13.20	13.20
Average Growth	8.04	8.95	10.18	11.86	12.52	16.87	17.57

Table (4) Lengths of Tomato Stalk of Ten Seedlings in the Soil not containing Eggshell Extract

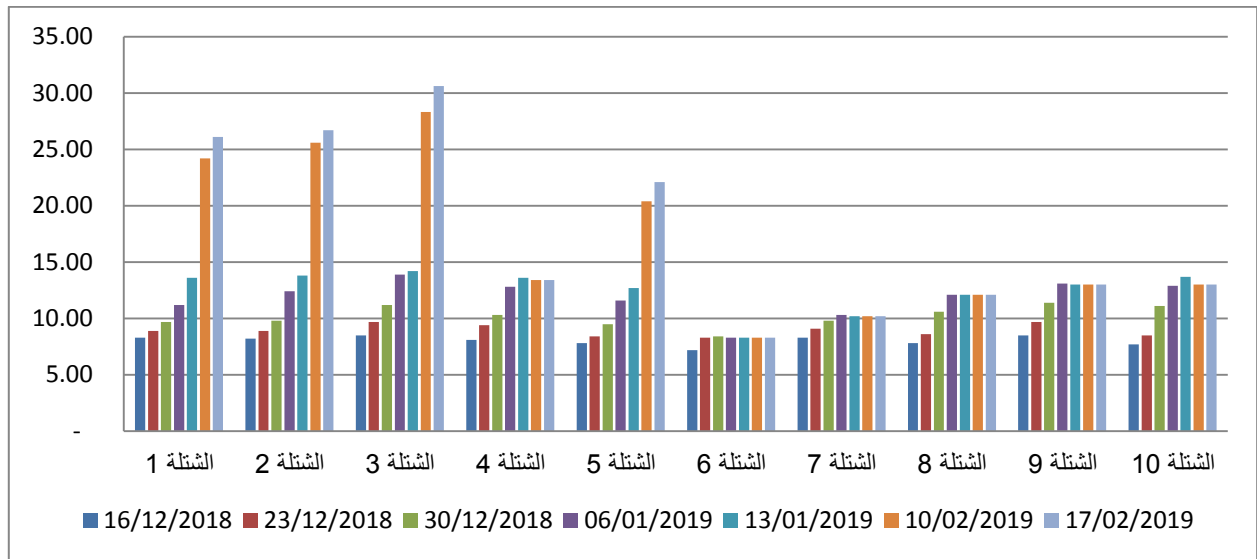


Chart (2) Lengths of Tomato Stalk of Ten Seedlings in a Soil not containing Eggshell Extract

Second:

Data of difference in growth rate of tomato plant stalk in the soil containing eggshell extract and the soil not containing that extract:

Type of Soil/Period of Time	16-Dec-18	23-Dec-18	30-Dec-18	06-Jan-19	13-Jan-19	10-Feb-19	17-Feb-19
Soil containing Eggshells	cm8.27	cm9.80	cm12.12	cm15.27	cm17.97	cm34.44	cm36.92
Soil not containing Eggshells	cm8.04	cm8.95	cm10.18	cm11.86	cm12.52	cm16.87	cm17.57

Table (5) The Difference in Growth Rate of Tomato Plant of Ten Seedlings in the Two Soil

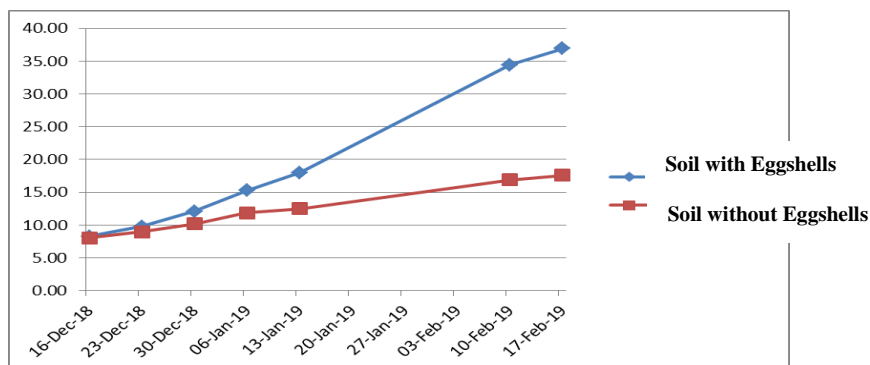


Chart (3) Growth Rate of Tomato Plant in the Two Soils throughout the Study

Third:

Data indicates the differences in properties of the soil containing the extract and the soil not containing the extract .

Comparison	Acidity	Salinity	Conductivity
Soil with eggshells	6.8	360	594
Soil without Eggshells	5.8	538	711

Table (6) The Difference in Properties of the Soil

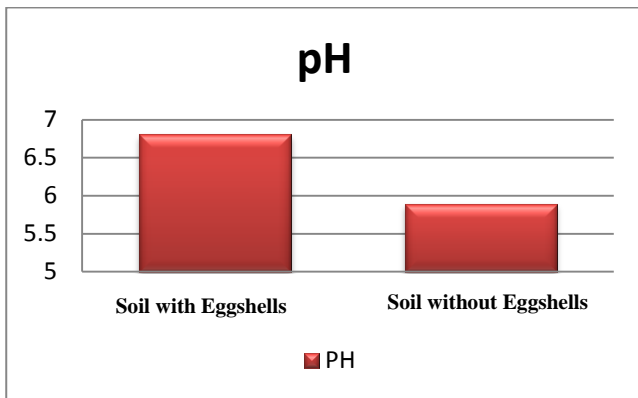


Chart (3) the Difference in Acidity

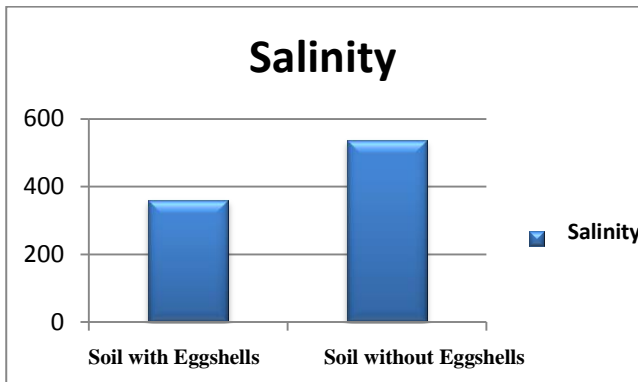


Chart (5) The Difference in Salinity

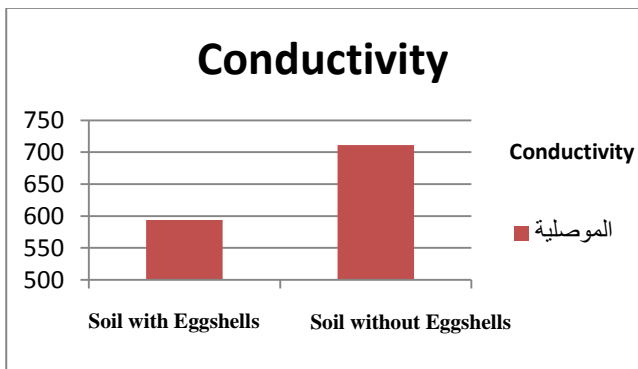


Chart (6) The Difference in Conductivity

Fourth: Data of properties of water used to irrigate tomato plants daily with the same amount of water.

Properties	Measurements
Acidity	6.33
Salinity	333 ppm
Conductivity	688 μ s.
Transparency	More than 120 cm
Temperature	25
Oxygen Solubility	8-10

Table (7) The Properties of Water

The data has been entered and posted on GLOBE website (WWW.GLOBE.gov), which has been collected in the research. The following pictures show data entry.

This screenshot shows the initial data entry form. The 'Site Name' field contains 'the farm soil'. Under 'Coordinates', the latitude is 23.36, longitude is -58.35, and elevation is 17.3 m. A map of South America is displayed with a red pin indicating the location.

This screenshot shows the 'Main Color Code' set to '10YR 3/3' and 'Secondary Color Code' set to '10YR'. The 'Consistence Estimate' is 'friable', 'Texture Field Estimate' is 'sandy loam', 'Root Quantity Estimate' is 'many', and 'Rock Quantity Estimate' is 'few'. The 'Carbonates' section is also visible.

This screenshot shows the 'Date of Soil Collection' as '2018-11-13'. The 'Top Depth' is 0 cm and the 'Bottom Depth' is 10 cm. The 'Moisture Estimate' is 'moist' and the 'Structure Estimate' is 'granular'. A note about printing errors is visible.

This screenshot shows the 'Main Color Code' as '10YR:3/4' and 'Secondary Color Code' as '10YR:3/4'. The 'Consistence Estimate' is 'friable', 'Texture Field Estimate' is 'sandy loam', 'Root Quantity Estimate' is 'many', and 'Rock Quantity Estimate' is also 'many'.

This screenshot shows the 'Date of Soil Collection' as '2018-11-13'. The 'Top Depth' is 0 cm and the 'Bottom Depth' is 10 cm. The 'Moisture Estimate' is 'dry', and the 'Structure Estimate' is 'granular'. A note about printing errors is visible.

This screenshot shows the 'Direction to closest point of water body within 100m of site' dropdown menu. Below it, the 'Landscape Position' section has radio buttons for A. Summit, B. Slope, C. Depression, D. Large Flat Area, and E. Stream Bank. A diagram of a landscape with points A, B, C, D, and E is shown. The 'Surface Cover' section is also visible.

Pictures indicating how data has been entered in the Website.

An interview with a senior soil researcher at the Soil and Water Research Center, an interview with the trainer of gardening and landscaping.

An interview has been made with Eng. Nasser Salim Al-Wahaibi, a Senior Soil Researcher at the Soil and Water Research Center at the General Directorate of Agricultural and Animal Research, the Ministry of Agriculture and Fisheries..

Another interview has been made with Ms. Samia Al-Rahbiya, the trainer of gardening and landscapingin. These interviews have been conducted via social media since we have provided each one of the interviewees with an overview about the study and some questions to help in results discussion:

Questions:

- 1- Have you heard about using eggshells as an alternative fertilizer for chemical fertilizers?**
- 2- Do you recommend using eggshells as organic fertilizer instead of chemical fertilizer?**

Eng. Al-Wahaibi has answered as follows:

First: Regarding the use of eggshells as fertilizers, yes, we heard about it, but we cannot rely entirely on organic fertilizers only in feeding plants because the nutrients existing in the organic fertilizers are little and not enough for abundant productivity. In addition, eggshell and other organic fertilizers, such as fish, poultry and animal residues are not only alternatives but also complementary to chemical fertilizers in the production process..

Second : Yes, I recommended using eggshells as organic fertilizer but in combination with chemical fertilizers, in order to get a healthy plant, and good flowers and fruits.

While Ms. Al-Rahbiya has answered as follows:

First: Yes, I have heard about the use of eggshells as natural fertilizer instead of industrial fertilizers, since eggshells are rich in calcium, which improves plant growth.

secound: Yes, I recommended using eggshells as organic fertilizer because they are natural substances not harmful to the environment and the plant and they give plant adequate food. Eggshells have also another function that is protecting the plant from agricultural pests.

Discussion of Results:

The first question was answered through the concluded results. In Tables (3 & 4), when adding eggshells to the soil, we noticed a difference in the length of tomato stalks, number of branches and leaves. The highest growth rate of tomato has been 36.92 cm in the soil containing the extract, while the same has been 17.57 cm in the soil not containing the extract. Therefore, the eggshell extract has provided the nutrients suitable for the growth of plants.

The study of (The Effect of Garlic, Eggshell and Banana Extracts on Plant Growth, 2017-2018) has indicated that eggshells provide the plant with full nutrition. It is reported that when leaving the eggshells in water for 24 hours, calcium, potassium and a small amount of phosphorus magnesium appear; all are nutrients to the plant improving the growth of stalks and leaves and the formation of flowers and fruits. In addition, in her interview, Ms. Samia Al-Rahbiya has indicated that eggshells are rich in calcium, which turns into calcium carbonate improving plant growth.

The recorded and analyzed results answer the second question. We have noticed a difference between the soil to which we have added the eggshell extract and the soil to which we have not added the eggshell extract in terms of acidity, salinity, and conductivity. Through measurements, we have found that the soil not containing the eggshell extract is much acidic (PH =5.3), while the soil containing the eggshell extract is less acidic (PH =6.8). This is because of the eggshell extract effect as it is used as an alternative to lime in balancing soil acidity, so soil containing the extract is better than other soil. Eng. Nasser Al-Wahaibi has indicated that if the eggshell extract is added in large quantities to the soil, it reduces soil acidity making cultivable and helps the plants grow.

We have also found a difference in the value of salinity and conductivity of the two soils since the salinity of soil containing the extract is (ppm 360), and its conductivity is (μs 594). On the other hand, the salinity of soil not containing the extract is (ppm 538), and its conductivity is (μs 711). Therefore, according to the previous studies, the eggshell extract is essential because it is one of the environmentally friendly materials containing no harmful effect on the environment as chemical fertilizers. Concerning water properties, results indicate that it is potable water and is suitable for plant.

Conclusion:

Through applying the GLOBE protocols, we have explored the importance and effectiveness of the use of natural fertilizers made from household organic waste in the plant growth as an alternative for chemical fertilizers. The eggshell extract has positively affected the growth of tomato plant increasing its length and the number of branches and leaves. It also has positively affected soil properties, such as acidity, salinity and conductivity.

We can also apply the research again but using other organic waste, such as garlic and banana peels as natural fertilizer because they contain valuable nutrients improving plant growth, flowering and fruit formation. We can also apply the Atmosphere Protocol due to the effect of temperature on plant growth as well as the Soil and land cover Protocol.

Through our good results, we encourage and urge farmers and workers in agriculture to use food waste as natural fertilizer instead of chemical fertilizers because chemical fertilizers cause negative environmental damages for being accumulated in the soil.

We also recommend farmers and workers in agriculture to seek help of agricultural engineers and innovators to create and design inexpensive solar furnaces to dry the food waste and to create machines for grinding these wastes with environmentally friendly materials.

Acknowledgment:

We present our very sincere thanks and appreciation to all those who have helped us and raised our curiosity to research, inquiry, and work. To Ms. Naderah Al-Harithia, the National Coordinator of the Environment (GLOBE) program in the Sultanate of Oman. To the members of the Central Team of the Program, Mr. Ahmed Al-Balushi, and Ms. Fatima Al-Muqimyia, for their continued assistance and encouragement to prepare and appropriately conduct the research. We also present our sincere thanks to Mr. Majed Al Busafi, our supervisor in Muscat Governorate, as well as, our dear teachers for their constant support. Many thanks from our deep heart to everyone helped us complete the research.

References:

- 1- Alwsali •Muzaffar. (1971). **Alkamel in fertilizers and fertilization**. Lebanon (Dar Al Kotob Al Ilmiyah).
- 2- Ministry of Education .**Science book (8th Grade)** , Edition of 2017-2018.
- 3- Al Shammari, Aziz.(2013). **The Effect of spraying by organic nutrients**. Agricultural Sciences Journal, (238-294).
- 4- Environment GLOBE Program. **Soil research**. Teacher's guide (GLOBE).
- 5- Alqadri, Faten, Alwar, Muna, Shabeer, Maha (2017-2018). **The Effect of garlic extract, Eggshells & Banana on the growth of bean & pepper plants**. has been retrieved on (December 2018 - Feb 2019) by www.mohe.ps/research