# Study the effect of iron rust As liquid fertilizer on plant growth

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# Executive Summary

We applied this research to answer these questions:

1-How effective is the iron rust solution as liquid fertilizer on plant growth?

2-How much is the concentration of essential elements when using an iron rust solution as a liquid fertilizer?

3-How are the soil properties affected when using an iron rust solution as liquid fertilize?

This research was applied in Oman(Ibra)in the North Eastern Governorate,we used an iron rust solution as a liquid fertilizer and mixed it with the soil,then we measure the growth of the tomato plant and compared its growth with another tomato plant in soil free from the iron solution by applying the land cover.

We sent two samples(water-iron rust solution)to the soil and water research center to find out the focus of the major elements of plant growth

We also made a comparison between the soil samples taken from agricultural land,one of them contains an iron rust solution and the other is free from the solution and compared the properties of the two samples by applying the soil protocol(acidity,Quantity of calcium carbonate,roots and rocks)

The results showed the rust solution had a negative effect on plant growth.The growth rate of tomato in the soil free from rust solution(0.75cm)compared to its growth rate in soil with a rust solution(0.325cm)

Also,this solution lacks the essential elements of plant growth compared to water rich by these elements.

Also,we concluded the iron rust solution increases the acidity and salinity of the soil compared to the soil-free from this solution its acidity decreases and approaches the equivalent nature.

On the basis of the research results,the researchers recommend not to use an iron rust solution as fertilizer because of ion($Fe^{3+)}$that not dissolved in water(chemistry book grade12)so the plant tissues cannot absorbed it and closes the soil pores (Jubouri,2018).

# Terminologies and Definitions

- **Iron rust**: It is the triple iron oxide,and it is not dissolved in the water with reddish brown.Its chemical formula($Fe_2O_3.xH_2O$)(Chemistry book for 12,page 68)
- **Liquid fertilizer**:a material added to the soil in order to help the plant to grow, after adding water to it and using it in watering the plant.
- **The essential elements**:the basic elements of plant growth are nitrogen,phosphorous,potassium,calcium,magnesium and sulfur.

# Research questions

1- How effective is the iron rust solution as liquid fertilizer on plant growth?

2-How much is the concentration of essential elements when using an iron rust solution as a liquid fertilizer?

3-How are the soil properties affected when using an iron rust solution as liquid fertilize?

# Introduction and literature review

The plant is the secret of life on the surface of the earth,and if the plant is absent,life is absent on the ground even if the water is found.The plant is the one that is all the basic food components and is the main stabilizer of solar optical energy on Earth,which God Almighty has given from the live characteristics and vital interactions that are able to manufacture organic foodstuffs,vitamins and vital compounds that are boiled by human life.

There are many factors that plants need to support their growth process,the most important of which are:genetic factors,vital factors,and environmental factors(water,heat,light,ventilation,pH,soil content of nutrients)

In this research,we will study the soil content factor from the nutrients that the plant gets by adding fertilizers,as we have studied the effect of the use of an iron rust solution as a liquid fertilizer on the growth of the plant.As we have seen many videos on social media by those interested in agriculture that encourage the use of an iron rust solution in watering crops,thinking that it helps the plant to grow,so we wanted to make sure whether this method positively affects the growth of the plant.

According to the related studies that mentioned by Agricultural engineer Batool Al -Jubouri (Al -Jubouri,2018),putting iron around trees useless because the iron ion($Fe^{3+}$)are not dissolved in the water,so it cannot be entered into the tissues of the plant.

# Research methodology

1. **Research plan**

Table(1)below shows the research plan and schedule:

| Month | Tasks |
|---|---|
| Dec-Jan/2023 | Conduct field visits to farmers, formulate the research problem and identify the necessary tools |
| Jan/2023 | Data collection and analysis |
| Feb/2023 | Conclusion and writing the research report |
| Feb/2023 | Hand over final report |

**Table(1)Research Plan**

Table(2)below shows tasks and distribution of responsibilities among the researchers:

| Tasks | Responsible Research |
|---|---|
| Formulate the research problem and identify the necessary tools | **(Amna-Genan)** |
| Collect data through:<br>Field visits to interview farmers and application of land cover protocol.<br>Apply soil protocol and analyze data.<br>Entry of data to website. | **(Amna-Genan)** |
| Reach conclusions through data that have been compiled Drafting the abstract and writing the paper | **(Amna-Genan)** |

**Table(2)Distribution of Tasks & esponsibilities**

Search for information related to the subject of the research through the following resources:

- World Wide Web
- Globe Notes to the Soil Protocol
- Chemistry book for grade 12 and Soil fertility and plant feeding book
- Identification of different study sites in preparation for the application process in order to collect data necessary for research

| Task | Site |
| --- | --- |
| Cultivation of tomato.<br>observing the effectiveness of iron rust solution<br>in its growth by applying the land cover protocol | **School Garden** |
| Examine the samples and find concentration<br>essential elements in two samples(water only-iron<br>rust solution) | **Soil and Water Research Center** |
| Study of soil characteristics by application of the<br>soil protocol on two samples of a house garden<br>(soil only-soil with iron rust solution) | **Farm in Ibra city** |

## Table(3)Application of the Research Plan

Determination of the appropriate equipment and tools to carry out the work(pH meter,GPS,electronic balance,ruler,paper,pen,computer, vinegar,plantation vessels,distilled water)

Application of sampling research through the implementation of appropriate protocol activities(land cover and soil).

Design a table(Annexes1)to record the measurements of the leg length,measurements were taken every six days.

Data collection and processing.

Soil Protocol application data were entered to(www.glob.gov)web site.

| Application Mechanism | Protocol | Research Question |
|---|---|---|
| Cultivation of tomato in same type of soil and watering the same amount of water and receive the same amount of light in two vessels<br>1-vessele(1)water only<br>2-vessele(2)iron rust solution<br>two vessele were placed in the school garden | Land Cover | Question(1) |
| Send two samples(water only-iron rust solution)to the center of soil and water research to find the concentration essential elements in each sample | | Question(2) |
| Study soil properties(acidity, amount of calcium carbonate,rocks and roots)on two samples of a house garden(soil only-soil with iron rust solution) | Soil | Question(3) |

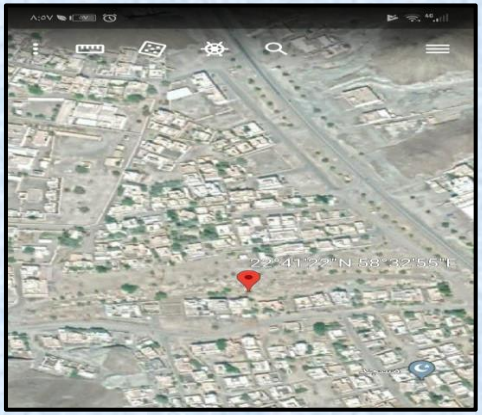
**Table(4)Mechanisms of protocols application for data collection**

2.**Interview**

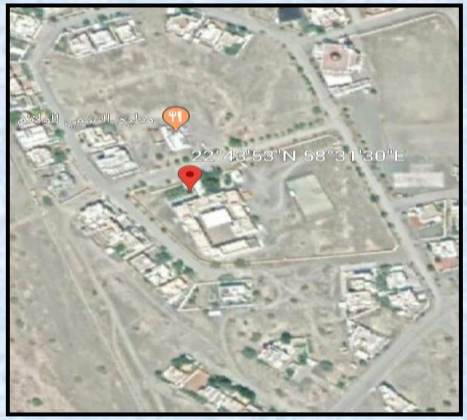
Interview Engineer Naser AL wahibi to discuss the results of sample analysis.

## Research site

The research was carried out in Ebra city during the period of(January- February)where the temperatures range(24-29).The tomato was planted in the school garden by applying the land cover protocol and two samples were taken from a farm in Ibra city(soil-soil and rust solution)to apply soil protocol.


**Image(1)and(2)the geographical location farm(Ibra)**


**Image(3)and(4)the geographical location of the Al -Thabiti School Park**

# Collecting and analyzing data

**The first question** data was collected by measuring the growth of the tomato plant in the school garden.All two vessels were irrigated with the same amount and type of water, same number of tomato seeds were planted, same amount and type of soil was added ,same amount of light was received except that one of them was added to it iron rust solution as a liquid fertilizer and the other was not added to it solution. After that we compared the plant  growth by observation and write there growth in notes every six days.

**Pictures(5),(6)and(7)shows the application of activities on tomato plants in the school garden**

**The second question** data was collected by sending two samples to (soil and water research center) and a analysis to find out the focus of the major elements (water- iron rust solution)

**Image (8) shows the two samples**

**As for the third question** of the research,the data was collected by applying the soil protocol on two samples(soil-soil and rust solution)and comparing their properties (Quantity of roots,rocks,calcium carbonate and acidity)



**Pictures (9,10,11)shows the soil protocol application**

The following table also shows the characteristics(soil-soil and rust solution)from a farm on a break

| Soil + iron rust solution | soil | Comparison |
|---|---|---|
| High | High | **Quantity of rocks** |
| High | High | **Quantity of roots** |
| Medium | Medium | **Quantity of calcium carbonate** |
| 5.4 | 6.2 | **Acidity** |

**Table(5)soil samples data according to the materials added to them**

# Interviews

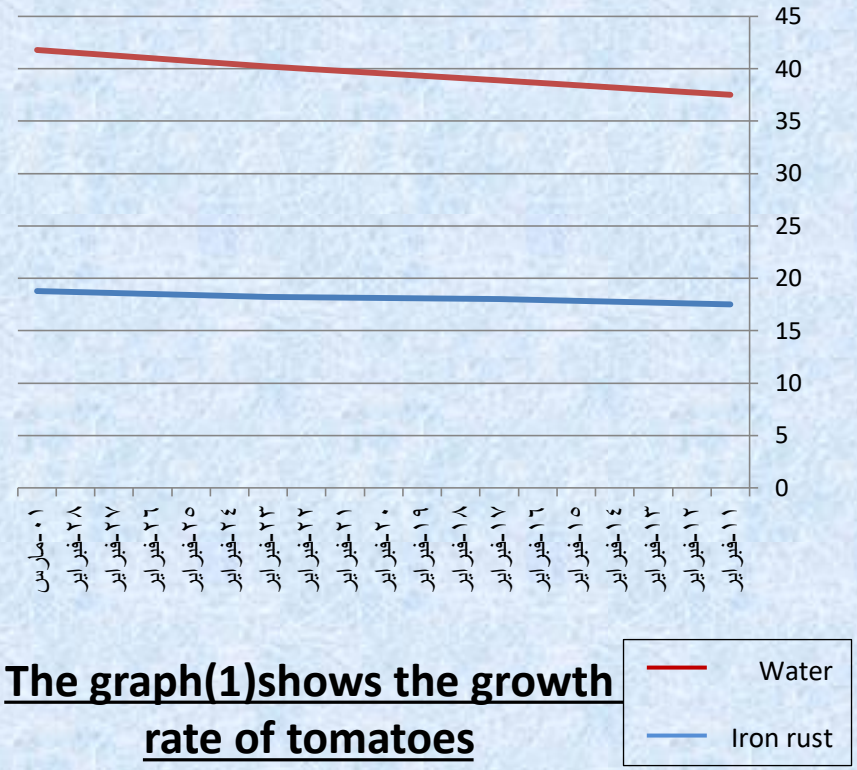
An interview was conducted with the engineer/Nasser Al -Wihibi, a plant nutrition researcher, and he reported that the use of iron rust as a liquid fertilizer is not beneficial for the plant. The iron here is in the form of a triple iron that is not dissolved in the water and the plant cannot  absorb it.

# Results

## The results of the first question

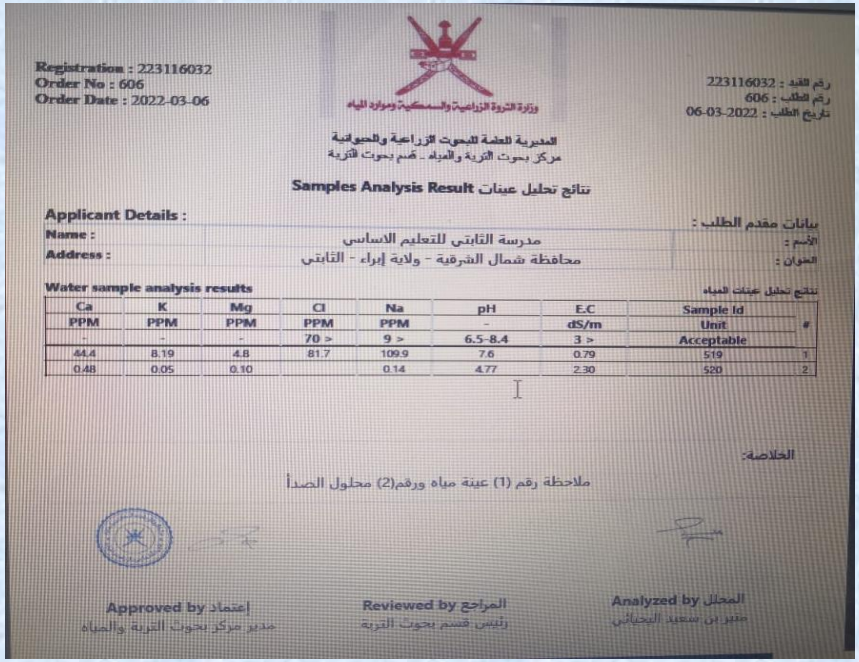
| Liquid iron rust fertilizer | Water (cm) | Plant type | Date |
|---|---|---|---|
| 17.5 | 20 | tomato | 11/2 |
| 18 | 20.9 | tomato | 17/2 |
| 18.2 | 22 | tomato | 23/2 |
| 18.8 | 23 | tomato | 1/3 |
| 0.325 | 0.75 | tomato | Growth Rate |

**Table(6)shows the growth of the tomato plant**




**The graph(1)shows the growth rate of tomatoes**

# Results of the second question



Registration : 223116032
Order No : 606
Order Date : 2022-03-06

رقم القيد : 223116032
رقم الطلب : 606
تاريخ الطلب : 06-03-2022

وزارة الثروة الزراعية والسمكية وموارد المياه

المديرية العامة للبحوث الزراعية والحيوانية
مركز بحوث التربة والمياه - قسم بحوث التربة

Samples Analysis Result نتائج تحليل عينات

Applicant Details : بيانات مقدم الطلب :

Name : الأسم : مدرسة القابتي للتعليم الاساسي

Address : العنوان : محافظة شمال الشرقية - ولاية إبراء - القابتي

Water sample analysis results نتائج تحليل عينات المياه

| Ca | K | Mg | Cl | Na | pH | E.C | Sample Id | |
|---|---|---|---|---|---|---|---|---|
| PPM | PPM | PPM | PPM | PPM | - | dS/m | Unit | # |
| - | - | - | 70 > | 9 > | 6.5-8.4 | 3 > | Acceptable | |
| 44.4 | 8.19 | 4.8 | 81.7 | 109.9 | 7.6 | 0.79 | 519 | 1 |
| 0.48 | 0.05 | 0.10 | | 0.14 | 4.77 | 2.30 | 520 | 2 |

الخلاصة:

ملاحظة رقم (1) عينة مياه ورقم(2) محلول الصدأ

Approved by اعتماد
مدير مركز بحوث التربة والمياه

Reviewed by المراجع
رئيس قسم بحوث التربة

Analyzed by المحلل
منير بن سعيد البحيائي

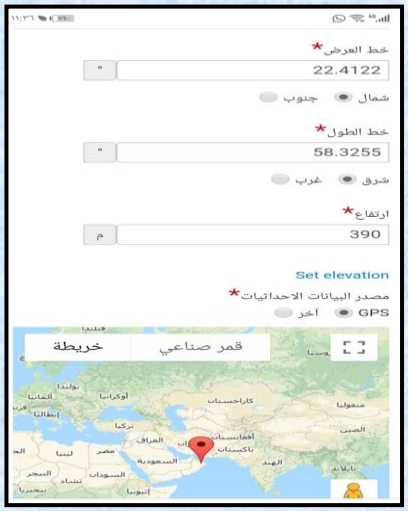
**Table(7)concentrations of major elements**

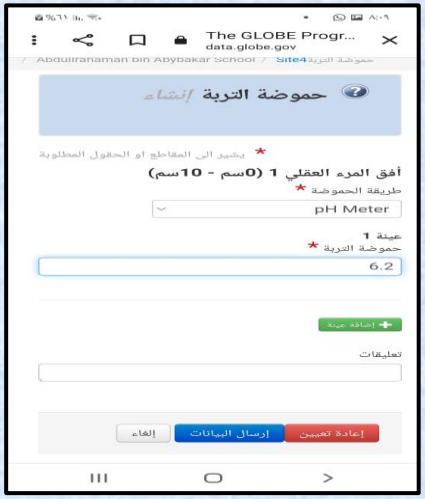
# :Results of the third question

The table also shows the properties(soil-soil and .iron rust solution) from a farm in Ibra

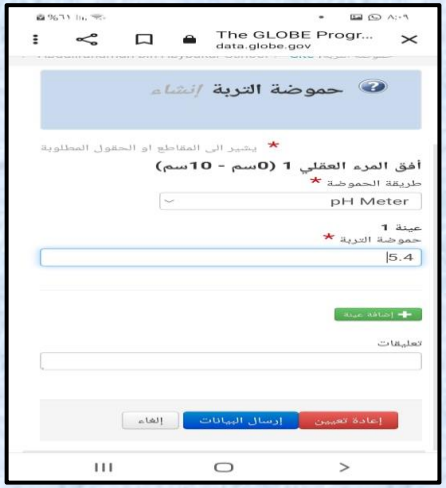
| Soil + iron rust solution | soil | Comparison |
|---|---|---|
| High | High | Quantity of rocks |
| High | High | Quantity of roots |
| Medium | Medium | Quantity of calcium carbonate |
| 5.4 | 6.2 | Acidity |

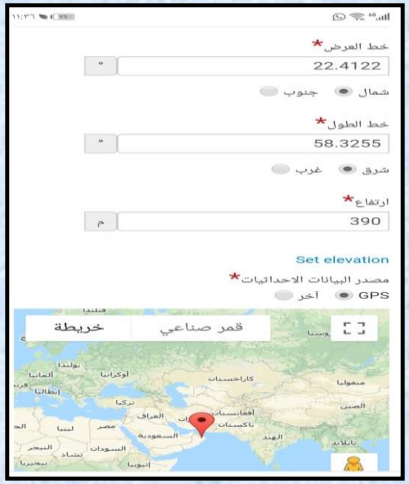
**Table(8)soil sample data according to the materials added to it**


## Pictures(13,14,15)Enter soil data on the site


## Pictures(16,17and18)Enter data(soil and rust solution)on the site

# Discuss of results

**To answer the first question in the research:**

To answer this question,we planted the tomato plant in two vessels, where all factors were fixed except that one of them was added to it iron rust solution as a liquid fertilizer and the other was not added to it this solution. By looking at table(6)and graphic(1): The growth rate of plant when watered with water(0.75) is fastre than the other plant(0.325)by double.

From here we conclude that the use of an iron rust solution has a negative effect on the growth of the plant when using it as a liquid fertilizer.

Through the interviews we had,Eng.Nasser Al - Wahaibi(Nutrition and Plant Researcher)stated that the use of iron rust is not beneficial to the plant, as the iron is a triple ion that is not dissolved in water that cannot be entered into the tissues of the plant.

**To answer the second question of the research**

By looking at Table(7)for sample(water- iron rust solution)can be noticed:

a.The salinity of the water sample is low compared to the salinity of the iron rust solution.

b.The pH of pure water is(7.6)which higher than PH of the rust solution(4.7)and became acidic nature.

c.The elements in water such as:(sodium-potassium-calcium-magnesium-chlorine) are higher than rust solution.

From here we find that the growth of the plant when watered with water is better than the rust solution because the presence of elements (sodium-potassium-calcium-magnesium-chlorine)is a higher rate that has a positive effect on the growth of the plant,it is important for the plant because it enters into the composition of the cell and some of them in the composition of chlorophyll components and the figuration of organic compounds Like sugars and proteins and facilitating vital interactions (soil fertility and plant feeding,2013)

As for the solution of iron rust with a formula(Fe2O3.xH 2O)the presence of  iron in this way makes it not dissolved in water(a chemistry book for grade 12)and therefore the plant tissue cannot absorb it,but rather a danger to the plant by closing the soil pores, which deprives some roots of breathing and weakens growth The plant based on what Nasser Al-Wahaibi indicated

**To answer the third question:**

By looking at table (8), both samples contain a high amount of rocks, roots and a medium amount of calcium carbonate but the acidity of soil that mixed by rust solution is increased compared the other soil.

# Conclusion

The results of the research indicated that the iron rust solution has a negative effect on the growth of the plant,as the growth of the tomato plant in the soil mixed with a rust solution(0.325 cm) compared to its growth rate in other soil(0.75 cm)

The iron rust solution lacks the major essential elements of plant growth compared to water rich in these elements. In addition,we concluded that the soil acidity increases by adding an iron rust solution compared to other soils that reduce its acidity and approach the equal nature.

On the basis of the research results,the researchers recommend that the iron rust solution cannot be used as a liquid fertilization because of iron ion($Fe^{3+}$)that is not dissolved in water,so the tissues of the plant are not absorbed,but it closes the soil pores,therefore it prevents the plant from breathing and the plant weakens.

# References


1.Ministry of Education (2018).Chemistry book for the twelve grade.

2.GLOBE Technical Office (2012)Memorandum of Soil Protocol for GLOBE Training Program.

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4.Articles from the Internet

Al -Jubouri, Batoul. (2018,Sebtember 30).***Methods of inserting the Iron for the Soil***, Retrieved February 11, 2023 from https://flesteen.news/p/35150