

Saudi Arabia
The Ministry of Education
First Arqah High School, Riyadh city

The salinity of water in the Kingdom of Saudi Arabia and its impact on plant growth, water acidity, and conductivity

1 Mar 2021



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Abstract

This study aimed at exposing the extent of the impact in the water salinity in the Kingdom of Saudi Arabia on the electrical conductivity and acidity as well as the impact on plant growth. This research is limited to observing the effect of water salinity on plant growth in **Arqah** Secondary School, Al-Riyadh, Saudi Arabia, over three months starting from December 2020 towards February 2021 at the same time every day.

This study has been dependent on an experimental approach, by measuring the protocol of water salinity, acidity, and electrical conductivity as well as exposing the impact of salty water on plant growth.

It has been found in this study that the increase in salinity in the water of the Kingdom of Saudi Arabia is inversely proportional to the acidity of the water, remarking that the water reaches a state of saturation due to the constant pH value. Moreover, the increase in salinity leads to the stability of the conductivity in water. However, the relationship between the water salinity added to the soil and the degree of plant germination is an inverse relationship. Thus, the more salinity in the water, the lower the plant growth rate since the high concentrations of salt harms plants.

Finally, the present study recommends major studies and research on the effectiveness of using pottery during plant irrigation in reducing salinity and its impact on plant growth.

Introduction

From a physiological point of view, water has a significant influence on plants since it is a fundamental factor for the success of plant growth, including the success of the process of photosynthesis and many other dynamic processes such as growth, respiration, etc., Thus, to advance plant growth and improve productive behavior, it is essential to understand the behavior of plant growth and the influence of water on it. (Geraldo and Henrique, 2014).

The salts can be found in a melted form in the water where the sodium and chloride ions separate, which may replace other mineral nutrients in the soil and absorbing them by plants instead of the necessary phytonutrients such as potassium and phosphorus, and chloride ions can transfer to the leaves where they inhibit with the process of assimilation. Photosynthesis and production of chlorophyll (Mandy and Geoffrey, 2015)

Henceforward, the relationship between the level of salinity in the waters of the Kingdom of Saudi Arabia and its effect on conductivity and acidity on the growth of the plant sector should be exposed. Therefore, in this study, we are to investigate the effect of the salinity of Saudi Arabia water on the value of conductivity and acidity (pH) as well as the relationship between them. Not only this but also the effect of water quality on plant growth, in the first secondary school called **Irqah** - Al- Riyadh, Saudi Arabia.

The Problem of the Study

This study seeks to find out the influence of the water salinity in Saudi Arabia on conductivity and acidity and its influence on plant growth and productivity level. Due to its paramount significance, this issue can adjust the appropriate water properties for plant growth and the best production can be achieved.

The Research Questions

The main research question in this study can be determined by the following question:

- 1- What is the impact of water salinity in the Kingdom of Saudi Arabia on plant growth?

This question is sub-divided into the following three questions:

- 1- Does the level of salinity in the water of the Kingdom of Saudi Arabia affect the growth of plants?
- 2- Does the level of salinity in the water of the Kingdom of Saudi Arabia affect the acidity of the water?
- 3- Does the level of salinity in the water of the Kingdom of Saudi Arabia affect the water conductivity?

The hypotheses

- 1- The level of salinity in the water of the Kingdom of Saudi Arabia affects the germination of plants.
- 2- The level of salinity in the water of the Kingdom of Saudi Arabia affects the acidity of the water.
- 3- The salinity level in the waters of the Kingdom of Saudi Arabia affects water conductivity.

The limits of the study

This study is limited to revealing the effect of water salinity on plant growth in **Irqah** Secondary School, Al-Riyadh-Saudi Arabia, according to the following limits:

Temporal Restrictions

This study has been conducted over three months, from December (2020) to February (2021), at the same time every day at 12:30 pm.

Spatial Restrictions: High School **Irqah**, Riyadh, Saudi Arabia

Objective Restrictions: To note the effect of water salinity on plant growth.

Definitions of Study Terms

Salinity: this refers to the number of dissolved salts in water. The salinity of the water that exists naturally varies from pure water that is almost free of salts, as in melting ice, to the saturated solutions in salty lakes such as the Dead Sea (Michael, 2018).

Conductivity: refers to the ability of a material to transfer an electric current (Anne, 2020).

PH: It is an abbreviation for "hydrogen strength" and it measures the concentration of hydrogen ions in water (Michael, 2018)

Research Methodology

This study was based on the experimental approach, particularly it aimed at measuring the protocol of water salinity, acidity, and conductivity during a period of three months (December 2020 - February 2021) in the same place, and during this period the impact of saltwater on plant growth was observed.

Research Methods

Globe devices

- 1- Hydrometer: is used to measure specific gravity.
- 2- Alcoholic scale: is used to measure water temperature.
- 3- Conductivity device: is used to measure electrical conductivity.
- 4- Salinity tables are used for measuring water salinity.
- 5- Water acidity (PH) meter.
- 6- Pens and papers
- 7- A computer for readings inputting and analyzing data
- 8- Glass tube



Figure (2) Measuring Conductivity



Figure (1): Measuring Temperature



Figure (3) Measuring Salinity**Figure (4) Measuring ph****The Experiment:**

First of all, the term **tap water** refers to the use of (tap water) installed in the school. The term **saltwater** refers to water that was brought from the **Quwaiyah** region according to the following coordinates for the area (24.010319 North, 44.956268 East).

In this study, mint plants have been irrigated with *tap water* and gradually we increased their quantity with salt water over three months, and measurements were made daily at the same time. The results recorded noted the effect on plant growth, by following these steps:

- 200 ml of tap water was placed in a glass tube and these measurements were made:
- Measuring water temperature using an alcohol thermometer.
- Using Water specific gravity hydrometer.
- Finding the salinity level in the water in which the plants using the Globe Salinity Tables will be irrigated
- Measuring the acidity of water using a water acid meter (PH).
- Measuring the level of electrical conductivity of water by using the conductivity device.

Accordingly, this was considered as a sample of the water that has been used in the first-period plant irrigation. After that, the salty water that was brought from the Al-Quwaiyah region was added to the irrigation water sample, so that the increase is gradual for the regular water.

Finally, we irrigate the plants every period to notice the effect of the saltwater on plants growing up.

2-Secondly, only 60 ml of saltwater was added to 200 ml of plain water. Then we have taken the same measurements as above and high salinity and low acidity were observed.

3- In the third time, 120 ml of saline water was added to 200 ml of plain water and the same measurements were made above. It was found that the level of salinity increased whereas the acidity of the water decreased while it remained the same throughout the experiment.

4-When excessive repeated experiment, we noted that the saltwater percentage was increased, while the acidity of the water reached the saturation level and have not changed from the third to the sixth time of the irrigation process. Finally, the conductivity remained stable from the second time to the sixth process of irrigation



Figure (5)



Figure (6): Mint Plant at the beginning of Experiment



Figure (7) Mint Plant at the end of the experiment

The Results

Attempt	Plain water ml	Salty water ml	Temperature (°C)	Typical Intensity	Salinity	Water Acidity
1	200 ml	Without adding salty water	22	0.999	1,5	9.1
2	200 ml	60 ml	22	1001	3,8	8.6
3	200 ml	120 ml	22.5	1001	4	8.4
4	200 ml	180 ml	23	1001	4,1	8.4
5	200 ml	210 ml	23.5	1001	4,2	8.4
6	200 ml	240 ml	24	1003	7,2	8.4

Table (1) The relationship between acidity and Salinity

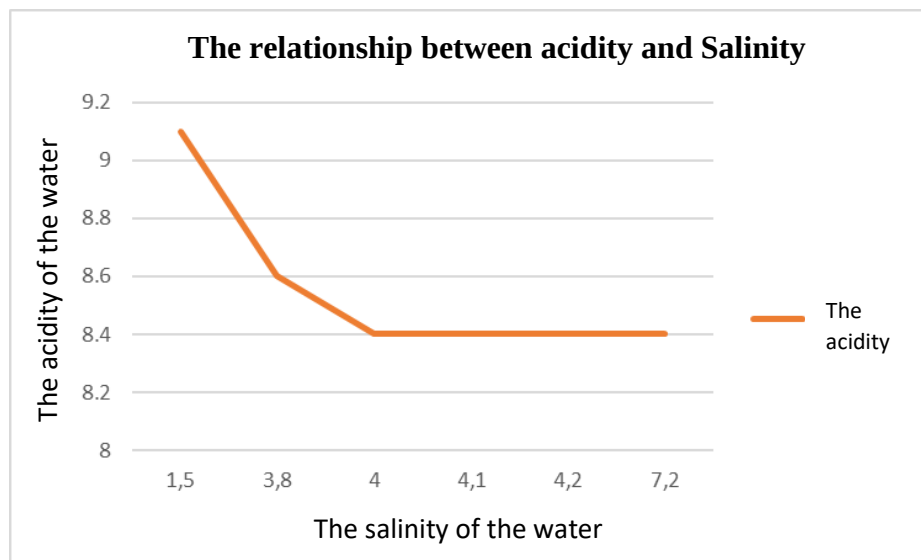


Chart (1)

This chart shows that the existence of increasing salinity correlates conversely with water acidity. It is also noted that water reached a stage of saturation starting from the second attempt in the experiment till the sixth attempt because of the stability of acidity value.

Attempt	Plain Water ml	Acid water ml	Temperature celsius)	Typical Intensity	Acidity	Conductivity
1	150 ml	Without adding salty water	22	0.999	1,5	1001
2	150 ml	60 ml	22	1001	3,8	1
3	150 ml	120 ml	22.5	1001	4	1
4	150 ml	180 ml	23	1001	4,1	1
5	150 ml	210 ml	23.5	1001	4,2	1
6	150 ml	240 ml	24	1003	7,2	1

Table (2): The Relation between Water Acidity and Conductivity

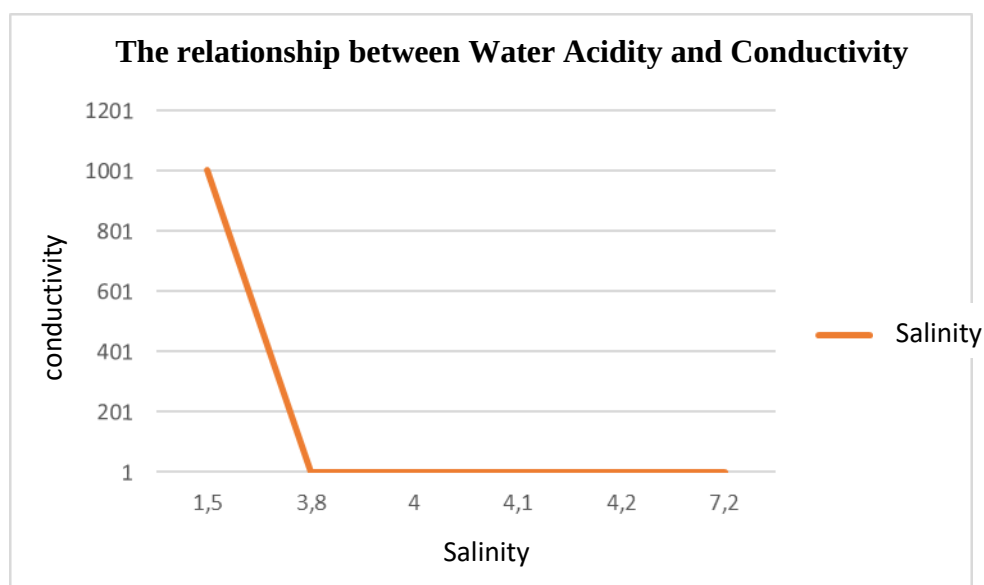


Chart (2)

We have noted from the figure above that the increasing water salinity leads to the stability of water conductivity.

Conclusion

- It has been found that increasing water acidity in the water of KSA correlates conversely with water salinity; bearing in mind that water reaches a full saturation due to the stability of acidity value. Furthermore, the increasing water acidity leads to the stability of water conductivity.
- The relationship between the salty water added to the soil and the temperature of planting is a converse relation. The more increase in the percentage of acidity, the lower the growth of the plant as shown in figure (6) for a mint plant, and in figure (7) for the same plant at the end of the experiment. The high concentration of salt harms the plant from two sides: the first lies in the feature of osmosis whereas the other lies in the poison ions.
- The salts found in the soil can absorb the water that serves in reducing the quantity of required water for absorbing it by the plants as well as leading to the water tension and roots drying out. This has been referred to as physiological drought, which, if not corrected, can lead to reduced plant growth (Mandy and Geoffrey, 2015).
- Furthermore, salt stress can cause the plant to a drought that leads to a rise in plant osmosis. Soil salinity or irrigation water obstructs the absorption of some elements by plants. The relationship between the salinity of the water added to the plant and the rate of accumulation of harmful ions is a positive relationship so that destructive ions (such as boron ions) are formulated. In the soil, as a result of adding saltwater, these ions accrue in the stems and leaves, causing a phenomenon known as combustion or leaf burning, where the ends of the leaves erode and turn brown and lose their vitality (Zaki, 2017).
- We all aware that not all plants are affected by high salinity, but rather the majority, but some plants are tolerant to salt and need them to grow but they are not present in abundance in our environment.

The Recommendations

At the end of this study, we recommend conducting studies and research on the use of pottery in the irrigation of plants and its consequence on diluting water salinity and absorption of sodium ions.

Acknowledgment

At the end of this research, we thank the Globe Environmental Program for providing us with the opportunity to join the team and do many experiments and research.

We also thank T. Nourah Fahaad al-Subaie, coordinator of the Globe program at Al-First Arqah High School in Riyadh, for their cooperation and follow-up data entry and coordination with various entities.

We are also pleased to thank T. Nada Ibrahim Al Habib, Globe Program Supervisor at The West Riyadh Office for supervising the stages of testing, providing us with the necessary tools, and following the progress of the research process.

We also thank T. Najla Abdul Aziz Al-Thamiri, a computer teacher at Al-First Arqah High School for supervising the preparation and writing of scientific research and reviewing it.

Finally, we thank King Saud University in Riyadh for providing the opportunity to use its laboratories for water sampling purposes.

Badges

Collaboration

We contacted the computer teacher A / Najla Al-Thumairi to help us design the logo and engineering drawings to find relationships between the variables and the Globe researcher A / Nada Al-Habib to help in conducting experiments and confirming the results and Professor Al-Olayan for their contribution in writing a research paper.

Engineering

We analyzed the data obtained from the experiments that we conducted and wrote this data in the Globe website and in Excel, and we performed engineering analysis by Excel to show the relationship between the variables>

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