



The effect of soil type and characteristics on alfalfa plant growth

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Content:

Subject	Page number
Abstract	1
Research question	2
Introduction and literature review	2
Research methodology	3-6
Results	6-8
Result analysis	9
Recommendations	10
Conclusion	10
References	11

Abstract :

The effect of soil type and characteristics on alfalfa plant growth.

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My research aims to know the type of soil suitable for growing alfalfa plants using GLOBE protocols and following the scientific method in finding appropriate solutions to environmental problems by answering the following questions:

- 1- What is the effect of soil characteristics (acidity and salinity) on the growth of alfalfa plants?
- 2- What type of soil is suitable for growing alfalfa?

To answer this question, I decided to study the properties of the soil in two farms, one of which had alfalfa growing in a healthy way and the other where it had unhealthy growth. I applied the soil protocol to study the properties of each sample in terms of acidity, salinity, color, consistency, texture, amount of rocks, soil, and carbonates, and the water protocol to study the properties of the water source used to irrigate the soil in terms of salinity, acidity, and conductivity, and the land cover protocol to compare plant growth in the two farms

The results I obtained indicated that plant growth is affected by the characteristics of the soil, as the alfalfa plant in the farm (1) had healthy growth, as it had a longer stem and more leaves, while in the farm (2) its growth was unhealthy due to the difference in acidity and salinity of the soil in the two farms, as well as the type of soil, and since the alfalfa plant needs low alkaline soil so that it can absorb nutrients well from the soil, and it also grows best in sandy and clay soil

Based on the results, the researcher recommends that the farmers need to know the characteristics of the soil before planting any crop, in order to modify its properties in proportion to the appropriate conditions for the growth of the crop to obtain abundant and good production.

Key terminologies:

- Alfalfa plant: (scientific name: *Medicago sativa*) is a perennial flowering plant from the legume family that is grown as a fodder crop.
- Soil properties: It is a set of chemical and physical properties of the soil, including color, texture, structure, acidity, and salinity.

Research questions:

- 1- What is the effect of soil characteristics (acidity and salinity) on the growth of alfalfa plants?
- 2- What type of soil is suitable for growing alfalfa?

Introduction and literature review:

The Sultanate is famous for agriculture due to its fertile land and diverse terrain, as well as the presence of flowing water in some governorates throughout the year, represented by wells, springs, and aflaj that irrigate agricultural fields and orchards.

Among these agricultural crops is alfalfa, or what is known locally as “qat”... “qat” is a fodder crop that is also called the “king of fodder”, and in Oman it is also called (green gold) because of its great economic return.

The scientific name for clover is (*Medicago sativa*). It reaches a height of more than a meter if not mowed. Its root system is wedge-shaped and deep. Its stem is branched. Its leaves are compound and trifoliate. The leaflets are inverted oval, and the inflorescence is vertically clustered. The flowers are small, about 1.5 centimeters long, and their corolla is pink, blue, or purple. The fruit is an open spiral pod that contains a large number of seeds. The shape of the seed resembles a kidney.

In this research, I will compare the type of soil in two different farms, one of which has alfalfa growing in a healthy way and the other in an unhealthy way. Both are irrigated with the same water source (falaj water), using the soil protocol and the land cover protocol.

Among the previous researches in this field is a study entitled Alfalfa, where it was found that the alfalfa plant is considered one of the plants that tolerate drought, salinity, and cold. It is also adapted to a wide range of climatic conditions and optimal conditions for obtaining Vegetable crop productivity requires well-drained, low-alkaline, low-salinity soil to a depth of 1 meter or more. It is also preferable for the soil to be homogeneous in texture. Such soil ensures uniformity in its ability to retain moisture that helps the plant to grow for a long time. Alfalfa can also grow successfully in saline lands if the soil is washed before planting it, with abundant irrigation after planting so that the plant has a root system and increases its ability to tolerate salinity and the strength of its effect.

Research methodology:

Research plan:

1. Collect information on the subject of the research from the books available in the Learning Resource Center and from the internet
2. Develop a search plan.
3. Set a timetable for the implementation of the research plan.
4. Adopting experimental research to study the effect of soil characteristics on the growth of alfalfa plants.
5. Determine the protocols needed to perform the research.
6. Determine the necessary devices and tools to carry out the work (pH meter, salinity measuring device, metric tape, and soil color notebook).
7. Collect data and organize them in tables.
8. Insert data in the program's website
9. Data analysis and representation
10. Conclusions and recommendations.

Timetable of the research plan implementation:

name	task	date
Bayan Alfarsi Alanood Alfarsi	Collect information on the research subject from various resources.	October 2024
Bayan Alfarsi Alanood Alfarsi	Determine the two farms to which we will apply the research tools.	November 2024
Bayan Alfarsi	Collecting samples of water and soil to apply different protocols to them	November 2024
Bayan Alfarsi Alanood Alfarsi	Interview with the rural womens guide in the Department of Agricultural Development in Yanqul	7 th January 2025
Bayan Alfarsi Alanood Alfarsi	Observe the results and write the research paper based on that.	10 th February 2025

Survey location

Sultanate of Oman – al Dhahera Governorate – Ibri – Dhaher al Fawares village – (latitude: 23.37, longitude: 56.38) in December and January – cold weather (Temperature: 9- 20 C) – water and land cover protocols used



Data collection and analysis:

The research question will be answered as follows:

Use the soil protocol to determine soil acidity (pH) using a pH meter, a salinity measuring device to measure soil salinity, a soil color notebook to determine soil color, determine soil texture, the amount of roots, rocks, and carbonates, a land cover protocol to observe alfalfa plant growth (size and length of the stem, number of leaves), and a water protocol to measure the acidity and salinity of the water source used to irrigate the soil.

Methods of data collection:

1- Interview with Ms. Salma Al-Muzahmiyah, a rural women's guide at the Agricultural Wealth Department in Yanqul, discussed with her the best times and the best soils for growing alfalfa and the role of the department in guiding farmers to obtain the best crop productivity.



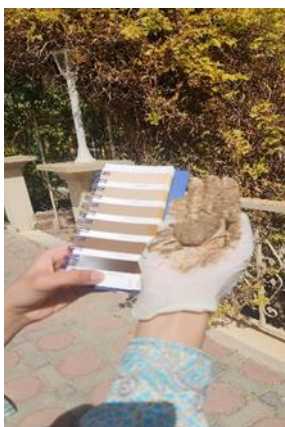
2- Identify two farms that are irrigated with the same water source and the same amount of water and are exposed to the same amount of light and planted with the same alfalfa seeds (fixed factors) and different alfalfa growth (independent factor).



2 - Water and soil samples were collected(at the same time from both farms) to measure acidity, salinity and conductivity using globe instruments.



3- Study of soil characteristics in the two farms.



3- Collect alfalfa samples (30 branches from each farm) and calculate the stem length and number of leaves for each sample.

4- Calculate the arithmetic mean of the number of leaves and stem length for each sample.

5- Comparing the growth of alfalfa plants on both farms and determining which soil is best for growing alfalfa.

Results:

First: Water properties data (fluorescence water) using GLOBE devices

characteristics	Value
Acidity(pH)	8.9
Salinity(ppm)	352
Conductivity(μ S/cm)	498

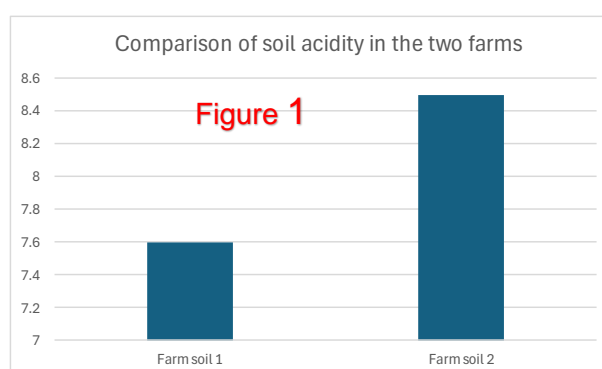
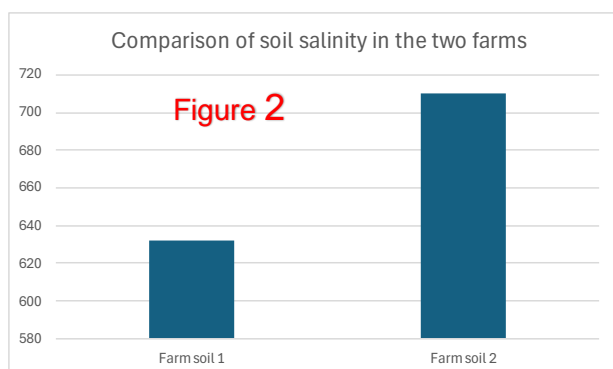
Table 1

Second: soil

characteristics data in the two farms:

Area	farm(1)	farm(2)
Characteristics		
Acidity(pH)	7.6	8.5
Salinity(ppm)	326	710

Table 2



Third: Data on soil characteristics in the two regions:

sample	Depth(cm)	colour	النسيج	الإتساق	roots	rocks	carbonate
Soil (1)	20	7.5YR:3/4	Loamy sand	loose	less	less	less
Soil(2)	20	7.5YR:5/3	Clay loam		more	more	less

Fourth: Observing the growth of alfalfa plants in the two soils in terms of their general appearance:



soil	farm(1)	farm(2)
General appearance	Thick and long stem, dark green leaves, many in number.	Its stem is weak and medium length, and its leaves are light green tending to yellow in color and are few in number.
photo		

Table 3

Fourth: Calculating the arithmetic average of stem length and number of leaves for a random sample consisting of (30) alfalfa branches from each soil.

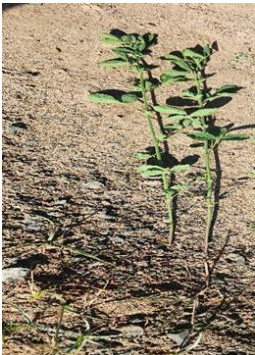

Soil in farm (1)		Soil in farm (2)		No.
No. of leaves	Length of stem(cm)	No. of leaves	Length of stem(cm)	
13	90	9	70	Average
<p style="text-align: center;">farm 1</p> 		<p style="text-align: center;">farm 2</p> 		pictures

Table 4

Average number of leaves

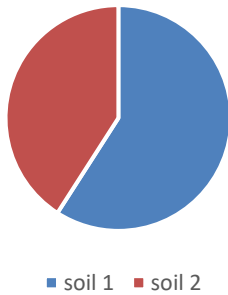


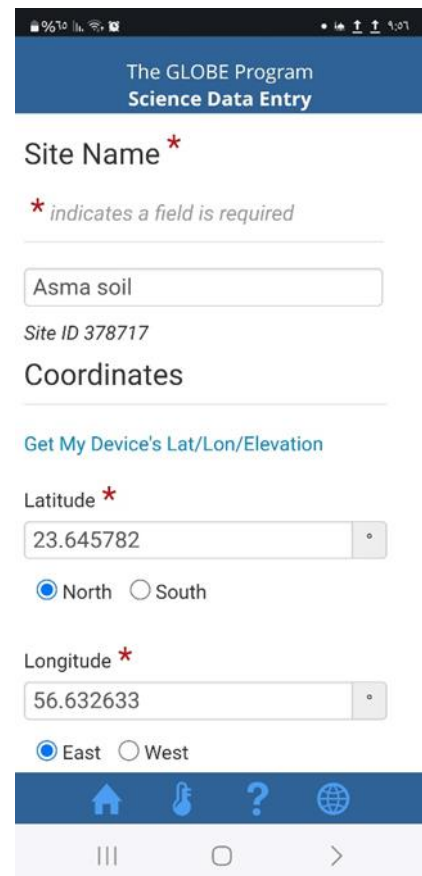
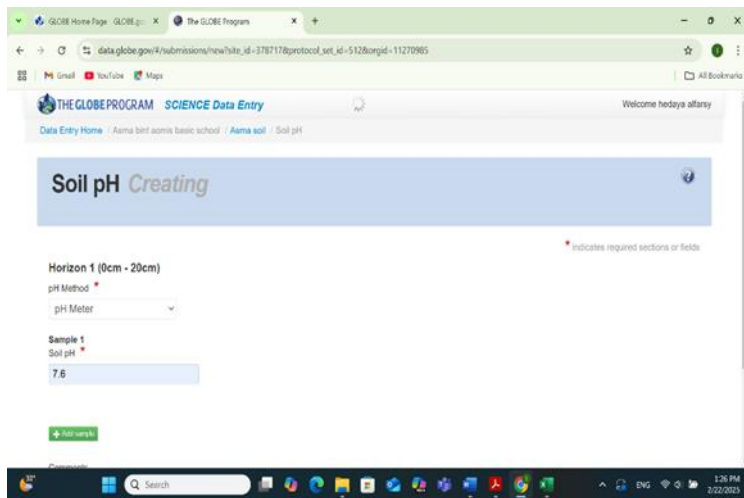
Figure 4

Average stem length



Figure 3

The data have been inserted and sent to the program website (www.globe.gov) through the application (DATA ENTRY).



Results analysis:

According to the data collected, we noticed the following:

- ❖ • Plant growth is affected by the characteristics of the soil in which it is grown, as the data in Table No. (2) indicates an increase in the pH value of the farm's soil (2), reaching (8.5), which negatively affected the growth of the alfalfa plant, as we noticed the weakness of the stem, the yellow color of the leaves, and the lack of vegetative total of the plant. The average stem length is (70) and the average number of leaves is (9), as in Table (4), this is due to the fact that increasing the pH value (Figure (1)) leads to a decrease in absorption and dissolution of nutrients in water and thus increases the concentration of salts in the soil, which affects plant growth . Clay soil also does not allow oxygen molecules to enter the plant roots, causing them to rot and thus the plant to weaken and die (Table (3)). There may be other reasons that we did not discuss in this research.

- ❖ • While the plant in the farm (2) grew better, as we noticed good growth of the stem (thick) and leaves (dark green), and its vegetative group was large, as in Table (4). The average length of the stem was (90) and the average number of leaves was (13), as shown in Table (5) and Figure (3) this is due to the pH value of the farm's soil (1), which reached (7.6), which is suitable for good growth of clover plants, as they grow best in low-alkaline soil and sandy-clay soil (Table (3)) . This point was also confirmed by the engineer in the Agricultural Development Department, Yanqul.

- ❖ ∞ Accordingly, we believe that farmers must be made aware of the necessity of knowing the characteristics of the soil before planting any crop in it and knowing the appropriate factors for the growth of this crop so that they can modify the characteristics of the soil before planting to obtain a good and abundant crop by adding the appropriate type and quantity of fertilizer to adjust the acidity of the soil in proportion to the acidity appropriate for the growth of a crop, or washing the soil before planting it to reduce its salinity.

Conclusion:

I thank God Almighty for completing this research, in which I used the GLOBE protocols (the soil protocol, the ground cover protocol, and the water protocol) to compare the characteristics and type of soil in two different farms and their impact on the growth of the alfalfa plant, as this crop is widely cultivated in these months of the year and for its economic importance to farmers. I noticed that plant growth was affected by different soil characteristics, and I learned that this plant needs a low-alkaline, sandy-clay soil in order to give good production

These conclusions lead us to the need for farmers to know the appropriate soil properties for each crop before planting, so that the soil properties are modified before planting to ensure obtaining a good, marketable crop

If I have the opportunity, next year, God willing, I will study the characteristics of the water source and its effect on the characteristics of the soil.

Thanks and Appreciation:

I extend my sincere thanks and appreciation to the honorable acting principal of the school for her continued cooperation and constant support for the GLOBE program team. We also thank the honorable Mr. Badr Al-Maamari, a scientific innovation specialist, for his continuous follow-up and tireless efforts to highlight the program's activities. Thanks also go to the specialists from the Binqul Agricultural Development Department for their cooperation with us in providing important information Related to the results of the research and their full readiness to educate farmers about the necessity of knowing the properties of the soil suitable for each crop before planting and modifying the properties of the soil accordingly. I thank all the faculty members who cooperated with me at the school, and thanks, of course, to teacher Hidaya Al-Farsi for giving me the opportunity to conduct this research and following up with me during its preparation.

Badges selection :

1 – I AM A COLLABORATED: The timetable for implementing the research plan explains the role of each student in the research and the cooperation of the two students in analyzing the data and reaching conclusions.

2 – I WORK WITH A STEM PROFESSINAL: through cooperation with the Agricultural Wealth Department, Yanqul, to learn the best conditions for growing alfalfa and the department's role in educating farmers to obtain the best productivity.

3 – I AM A DATA SCIENTIST: by collecting data for calculating stem length and number of leaves for plants that were used in practical experiments in research, organizing the data into tables and graphs, analyzing it, and reviewing studies related to the research topic.

4- I AM AN EARTH SYSTEM SCIENTIST: I used several protocols to answer the research questions, namely the soil protocol and the land cover protocol.

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