



**The effect of adding sodium polyacrylate in the soil on
the growth of the (barley, rose and onion) plant in
Buraimi Governorate**

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**The effect of adding sodium polyacrylate in the soil on the growth of the
(barley, rose and onion) plant in Buraimi Governorate**

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Abstract

The research aims to study the effect of adding sodium polyacrylate (extracted from children's diapers) to soil properties, and their importance in reducing water consumption and maintaining soil moisture. The study also aims to investigate the effect of adding material to the soil on the growth of plants, such as barley, rose, and onion, in the Al Mulaqa area, Al Buraimi Governorate. The researcher used the experimental approach to study soil properties through the application of the environmental GLOBE program: the soil protocol, as well as the application of a water protocol to measure the properties of water used for irrigation in these areas (oxygen ratio, salinity, conductivity, and pH). And fixing the following factors: the quality of water and soil, the amount of water and light. A vegetation protocol was applied to note the effect of this on cultivated plants (barley, onion, rose) by taking a plant length measurement on a weekly basis for two months, and by observing the color and number of leaves of the plant. The results showed that sodium polyacrylate increases the ability of the soil to retain water and maintain mineral salts and nutrient oxides, and improves the pH appropriately ($\text{pH}=6-6.5$) which in turn helps the plant absorb iron and minerals and eliminate microbes, which makes the plant Capable of growing in dry areas with high quality. Therefore, the current study recommends the concerned authorities to apply the idea and take advantage of the disposable diapers to be converted into a fertilizer containing sodium polyacrylate for use in dry areas. As well as cooperating with the concerned authorities and the STEM team to prepare natural polymers in various technology methods such as electric yarn technology to treat the problem of water scarcity.

Key terms:

- 1) Sodium Polyacrylate: It is a kind of basic unit polymers, {monomer: $-\text{CH}_2-\text{CH}(\text{CO}_2\text{Na})-$ }, Environmentally friendly super absorbent material, sold as commercial names (crystal gel water, crystal super, gel plant) It improves the physical properties of the soil and maintains its mineral salts. (Chirani, Yahia, Gritsch, & Motta, 2015).
- 2) 3) Wadi Al-Jizzi areas in Al-Buraimi Governorate, Sultanate of Oman: they are considered dry areas, including Al-Mulaqa village, whose people depend on agriculture, through groundwater that started to decrease due to the lack of rain in recent years, which led to the death of many farms, and the people began to depend on resistance trees For drought that does not need much water such as palm trees and mango trees, and stops them from growing barley and vegetables.

Research questions:

- 1- What is the effect of adding sodium polyacrylate on soil properties?
- 2- What is the effect of sodium polyacrylate on growth

*Aljori plant

*Onions

*Barley

Introduction :

The Gulf region is semi-dry and the rain rate is less than 100 mm annually, and the current water deficit is estimated at 15 billion cubic meters. The Sultanate of Oman is located in the belt of dry and arid regions where the average rate of rainfall falls to less than 100 mm annually, and a low natural rate of water feeding Groundwater (less

than 10% of the total water used annually) in addition to the lack of permanent surface water sources that can be relied upon as a permanent source. Consequently, it resorted to providing water needs for human use through desalination of sea water, which is difficult to use to irrigate crops due to its high cost, and with increased water scarcity, agricultural production in the Sultanate decreased, especially in the regions of Al Buraimi Governorate, and it is noticeable that the people of these areas depend on planting drought-resistant trees such as palm trees and mangoes And stay away from the cultivation of barley, vegetables, and other plants that need water continuously (Fayrouz, 2012). Nevertheless, it is noticed in recent years that the production of palm fruit has decreased and its quality has decreased due to drought (Al-Juhani, 2018).

Many studies sought to study desertification as a study (Fayrouz, 2012; Najm and Salman, 2012; Alyan, 2005), treat drought and spread the culture of water conservation. The World Water Organization and the Ministry of Water in the Sultanate of Oman also called for guidance in water consumption, because the rate of water loss represents about 40% of the available water due to lack of awareness and misuse of water, whether in irrigation or human consumption. Therefore, scientists have tried to find ways to treat wastewater such as gray water, sewage refining and others to benefit from it again, and search for agricultural methods and modern irrigation strategies or the use of materials that help to reduce water consumption and maintain soil moisture, such as polymers that improve the ability of the soil to retain water.

Through communication with community institutions, STEM officials in the governorate, and my knowledge of the various learning sources, the following studies were used: (Tele, 2016), (Ekebafé, Ogbeifun, & Okieimen 2011), 1952 (Hedrick, & Mowry), and (Ekebafé, Ogbeifun, & Okieimen, 2001), (Zhu, Zheng, & Wang, 2015). To find a way to reduce water consumption and maintain soil moisture in order to help the people of arid regions to grow their agricultural needs of vegetables, fruits and other plants that are difficult to grow in light of the prevailing drought and the lack of underground stocks.

The idea of the study was to add sodium polyacrylate to the soil that can be extracted from industrial products, especially baby diapers and other products that are easy to extract and obtain this material at the lowest cost, and to study its effect on soil properties and the proportion of its water retention and the use of the experimental approach to study its effect on cultivated plants Then, the barley, onion and rose plant was chosen after consultation with the people of the area to find out the most important plants that were cultivated and they stopped growing them due to the lack of groundwater and lack of rain.

Study variables:

Control sample: soil from the suspended area// Experimental sample: soil with sodium polyacrylate added

Dependent variable: soil properties, plant growth// Constant variables: water and soil quality, amount and duration of watering, light

Search Plan:

- 1– Feeling the problem: Through the directions of the Ministry of Education, the Ministry of Water, and the Ministry of Information to spread the culture of water conservation, and to search for solutions to reduce desertification in the Sultanate, as well as by noting the extent of the drought in the area in which I live, the death of farmers and the lack of interest of the people in the agricultural side of what It was previously caused by water scarcity, and their dependence on imported agricultural products, especially vegetables.

- 2– Choosing a research problem: which was identified by me with the help of the people of the region and encouraging them to search for help solutions, and then discussed them with the Globe Environmental Program supervisor (Nawal Al Shamsi).
- 3– Determining the study tools: GPS, seedlings and seeds for plants (gori, barley, onions), soil blocks, PH measuring device, conductivity and salinity), and providing (sodium polyacryl) material from industrial products such as diapers and a metric tape .
- 4– Official address: to the Ministry of Regional Municipalities and Water Resources, as well as the Ministry of Agriculture and Fisheries to present the project idea and cooperate with them to implement the project.
- 5– Implementing a meeting: with officials from the Department of Agriculture and some seedlings stores to learn about plant types and soil properties suitable for growing each species, and to discuss them on the best ways to conserve water during irrigation, and how to water it properly, as well as conducting a discussion session with STEM officials in the governorate to search for Ideas to make the soil hold water longer.
- 6– Determine the study places using the GPS device.
- 7– Application of a protocol: soil and water and data entry in the GLOBE site.<https://www.globe.gov/>
- 8– Collecting, analyzing and converting data into graphs.
- 9– Extracting, interpreting and comparing results with other research results and writing recommendations.

The meeting was held with the official of the GLOBE Environmental Activity and the development of a research plan and the necessary measurements and determining the protocols of the GLOBE program that will be applied to study the problem. Also, experimental and experimental soil samples that were mixed with certain proportions of sodium polyacrylate, cultivation of seedlings and seedlings provided by the Ministry of Agriculture were collected. Al-Buraimi Governorate and following its growth.

The timeline for preparing the research is as follows:

الملاحظات	الخطوة	the month
Addressing the concerned authorities with the school correspondence system to determine the date of the visit + providing seedlings and seeds)GPS , seedlings and seeds in cooperation with the Ministry of Agriculture, soil catalogs, pH meter, conductivity and salinity, oxygen measuring device, provision of sodium polyacryl from diapers, bringing soil samples and metric tape)	*Defining the problem *Correspondence with the awareness section of the General Directorate of Education in Al Buraimi Governorate to coordinate with the Ministry of Municipal and Water Resources, the Ministry of Agriculture and My Environment. * Provide project tools	September
Project tools provided Apply the water and soil protocol once a week for two months	Apply the water and soil protocol at the specific locations of the study	October
Disseminating research findings to the external community and supporting institutions	Analyze and interpret data, extract findings, make recommendations, write and review research.	Nov
The cost of the poster is approximately (15) riyals Conducting seminars and lectures in cooperation with the Department of Agricultural Society	GLOBE Action data entry poster on site	January
https://www.globe.gov/news-events/globe-events/virtual-conferences/2020-international-virtual-science-symposium	Participation by research in the local and international competition	February

Second: Study location: (Sultanate of Oman, Al Buraimi Governorate), Latitude 24.11854, (Longitude 56.12325), (Elevation 1887m). The months of September and October, the weather is moderate, the (Water and Soil) protocol was implemented.

THE GLOBE PROGRAM SCIENCE Data Entry Welcome nawal alshamsi

Data Entry Home / Um thar alghifni basic school / Alrabai_umthar2

Add site type Alrabai_umthar2

Site ID 146256

Coordinates

Latitude * 24.254476 Longitude * 56.126404 Elevation * 503 m

Source of Coordinates Data * GPS Other

Map **Satellite**

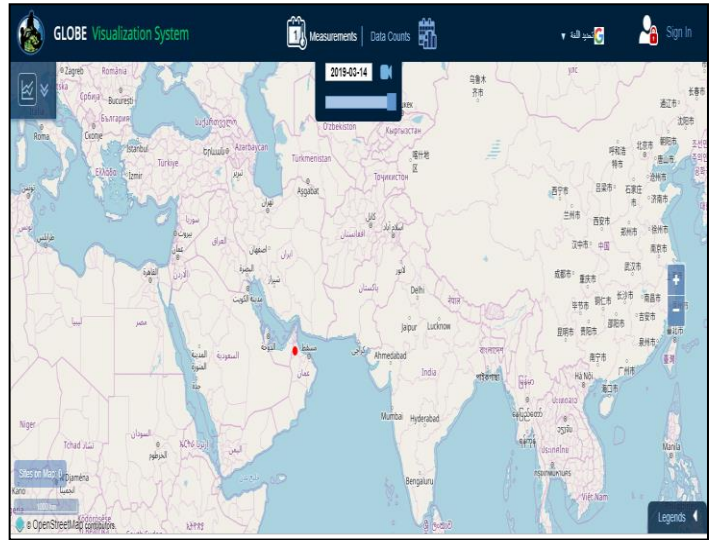
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Hydrosphere
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Biosphere
☐ Land Cover
☐ Greening
☐ Phenological Gardens
☐ Lilacs
☐ Carbon Cycle

Pedosphere
☐ Frost Tube
☐ Soil Characterization
☐ Soil Moisture and Temperature

Photos +



THE GLOBE PROGRAM SCIENCE Data Entry Welcome n

Data Entry Home / Um thar alghifni basic school / Alrabai_umthar2

Add site type

Atmosphere
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☐ Surface Temperature

Hydrosphere
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Biosphere
☐ Land Cover
☐ Greening
☐ Phenological Gardens
☐ Lilacs
☐ Carbon Cycle

Pedosphere
☐ Frost Tube
☐ Soil Characterization
☐ Soil Moisture and Temperature

Map **Satellite**

Map data ©2019 Google, Imagery ©2019 Google, Inst. Geogr. Nacional, Mapa GISrael, ORION-ME Terms of Use



Third: data collection and analysis

The Department of Water Analysis Laboratories at the General Directorate of Regional Municipalities and Water Resources, the STEM team in Al Buraimi Governorate as well as an environmental waste management company, were visited to identify the correct methods of irrigation and methods for preserving the soil from drought and to discuss the method of adding sodium polyacrylate to the soil and the mechanism of its extraction and its consequences.



Then soil was taken from its dry (suspended) areas located in Buraimi Governorate, adding sodium polyacrylate, and then studying soil properties before and after adding the material



Cultivation of the Juri plant in a pot that contains ordinary soil, and a pot that contains soil with sodium acrylate added to it, and follow-up changes to the plant on a weekly basis.



The barley plant was planted in a pot containing regular soil and a pot containing soil with sodium acrylate added to it and following up the changes for the weekly plant



The onion plant was planted in a pot containing regular soil, and a pot containing soil with sodium acrylate added to it and following up the changes for the weekly plant.



Results:

Table 1

The characteristics of the water used for irrigation of crops is considered a constant factor

Odor	Taste	the color	Dissolved oxygen content	Water temperature (C)	Electrical conductivity (μs)	Density Mg/l	Salinity (PPM)	Ph	The fixed factor
No smell	No taste	No color	(8-10)	23.7	290	205	135	8.35	The quality and quantity of water

Table 2

Comparison of soil properties of control soils and modified soils (to which sodium polyacrylate is added)

temperature	Soil color	Density	conductivity	Salinity	PH	Soil type
33.4	7.6YR2.511	488	674	327	8.55	Control
33.4	7.5YR2.512	632	910	415	7.41	Experimental

Applying the soil protocol on a weekly basis to the soil to which sodium polyacrylate is added and studying soil properties:

Table 3

Results of measuring soil properties after adding the material to the soil

Soil moisture	temperature	Soil color	Density	conductivity	Salinity	PH	Date
Damp	32.4	7.5YR2.512	632	910	415	6.51	2019/10/4
Damp	29.3	7.5YR2.512	661	1126	737	6.60	2019/10/11
Damp	24.1	7.5YR2.512	665	1116	740	6.63	2019/10/18
Damp	24.1	7.5YR2.512	665	1116	740	6.50	2019/10/25
Damp	24.1	7.5YR2.512	665	1116	740	6.23	2019 /11/1

Measuring the effect of plant growth on the original soil and the soil to which the sodium polyacrylate is added.

Table 4

The measurement of height and color of the barley plant is shown in both the experimental and experimental samples

Barley (experimental sample)		Barley (control sample)		Date
the color	Length (cm)	Length Cm	the color	
light green	1	0	Light yellow	2019/10/4
	3	0.5		2019/10/11
dark green	5	2	dark green	2019/10/18
	7.5	4		2019/10/25
	10	6		2019 /11/1

Figure 1

A graph showing the length of the barley plant in both the experimental and experimental samples

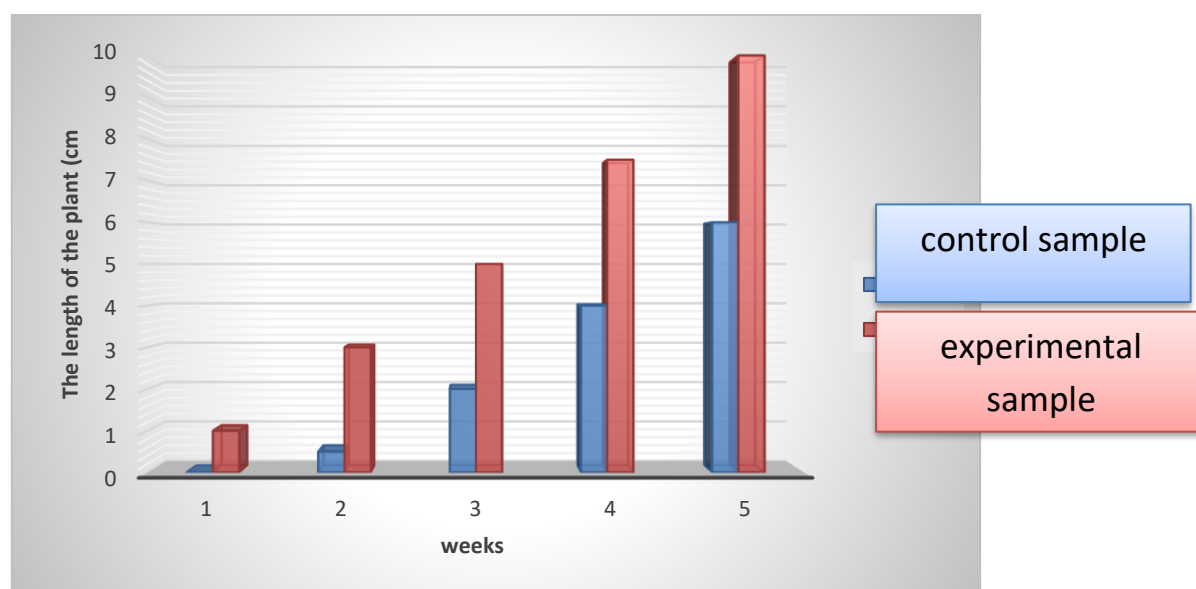


Table 5

Measurement of height and color of onion plant are shown in both control and experimental samples

Onions (experimental sample)		Onions (control sample)		Date
the color	Length cm	Length Cm	the color	
green	2	0	–	2019/10/4
Dark green and more branched	7.5	3	light green	2019/10/11
	11	5	dark green	2019/10/18
	14	7		2019/10/25
	21	10		2019 /11/1

Figure 2

It shows the length of the onion plant in both control and experimental samples

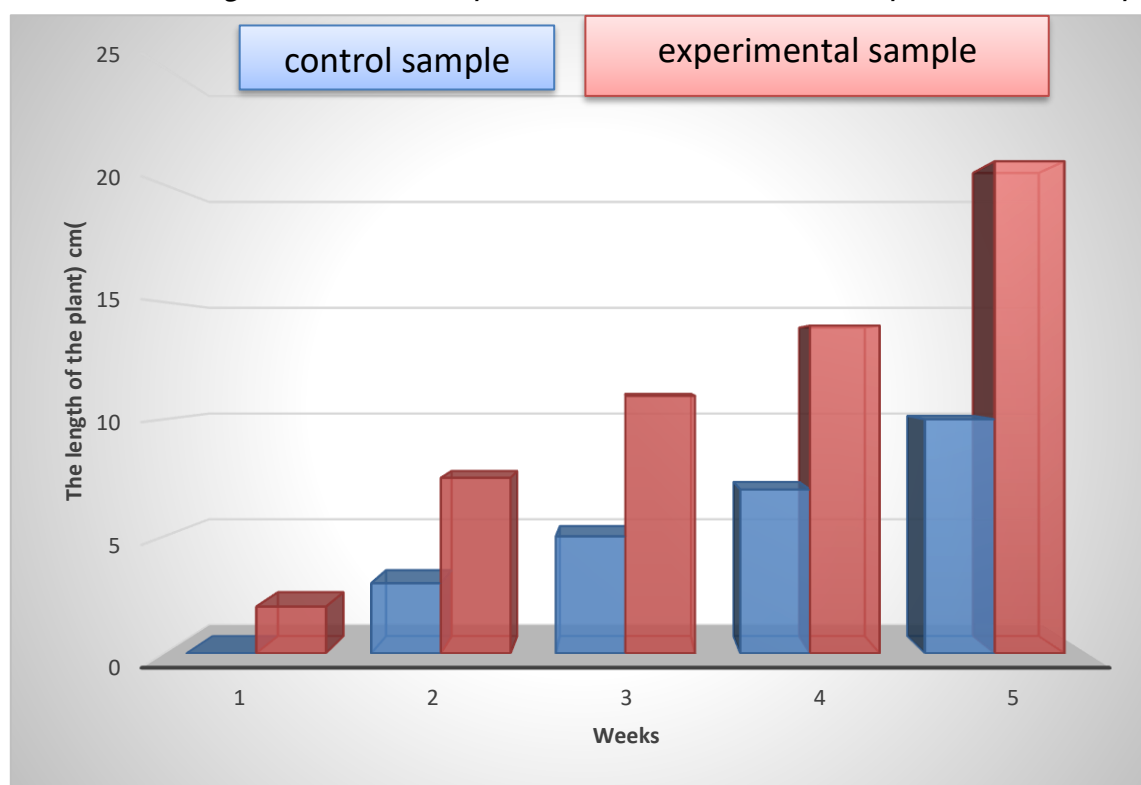


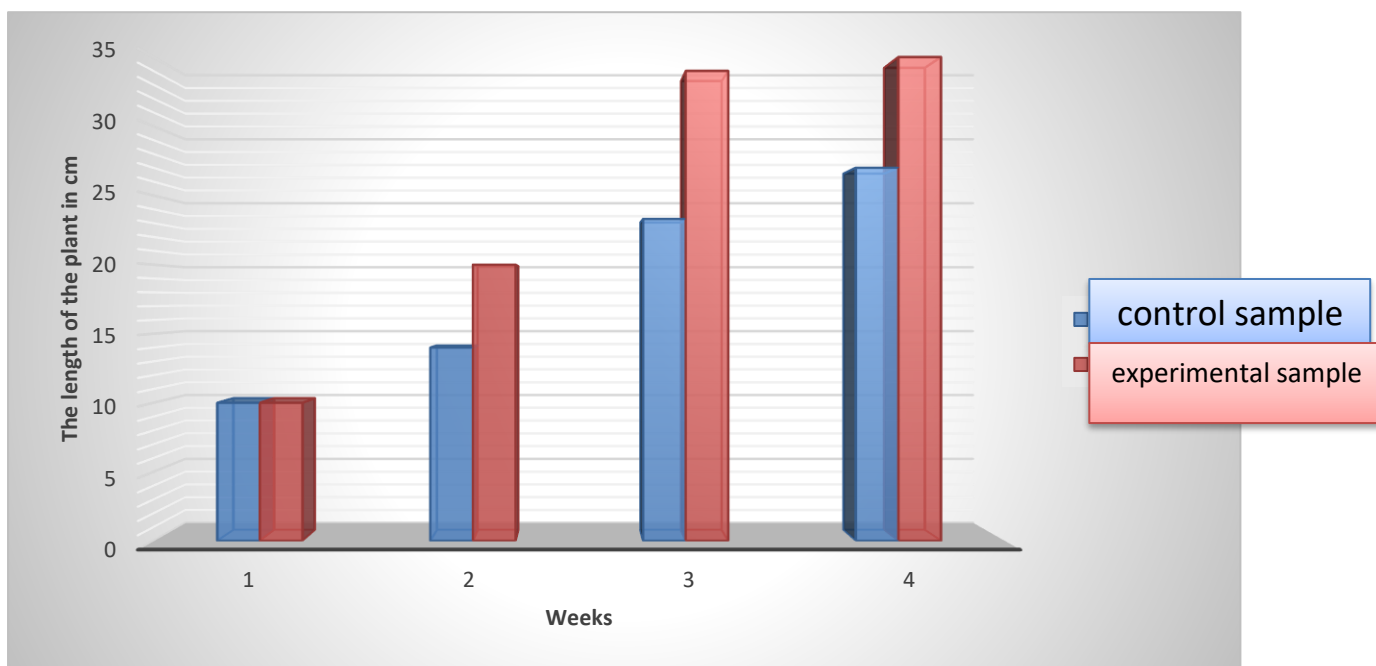
Table 6

Measurement of the length and color of the rose is shown in both the experimental and experimental samples

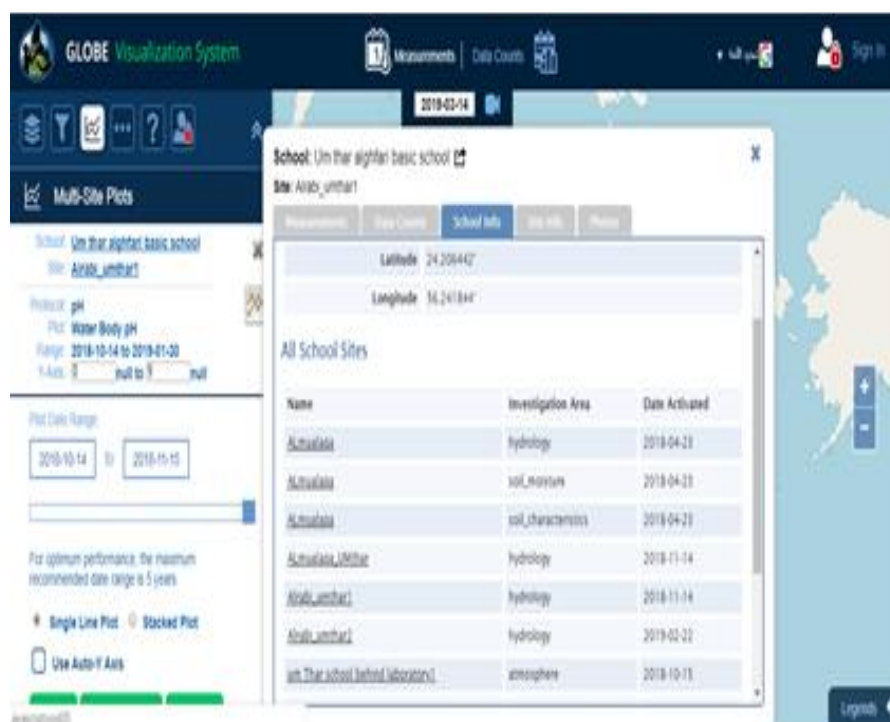
Al-Jouri (Experimental Sample)		Al-Jouri (Control Sample)		Date
the color	Length Cm	Length cm	the color	
dark green	10	10	dark green	2019/10/4
Dense leaves and branches	20	14	Few branches and leaves	2019/10/11
	34	23.3		2019/10/18
	35	29		2019/10/25
	46.4	33.2		2019 /11/1

Figure 3

It shows the length of the onion plant in both control and experimental samples



The data was entered and sent to the program's website (www.GLOBE.gov) via the DATA ENTRY application where a new site was added and the water protocol data collected was entered into the research.



Discuss the results:

After obtaining the results, they were presented to the STEM officials and science teachers at the school and the engineer Mohammed Al Shamsi to interpret the results. To answer the first question, the data of Table No. (2) and Table No. (3) were observed. It turned out that the sodium acrylate substance changed slightly from the soil properties, as it increases the acidity of the breed appropriately, where we note that the pH changed from (8.02 to 6), and this is very suitable for the growth of vegetables that need acidic soil ranging between (6.5–6). Also, we notice from Table 2 and 3 the increase in soil salinity by (413ppm) and as a result, the conductivity increased by (442 μ s), It is known that acidic soils help the plant to absorb and benefit from the minerals present in the soil, and this does not indicate a study mechanism (Al-Juhani, 2018) and (Al-Wakeel, 2010), It is noted from Table 3 that the soil to which the sodium acrylate substance is added remains moist throughout the week and maintains water, unlike the control soil which during one day you find that the soil has become dry as a result of water leaking into the soil or evaporating it, and thus the plant suffers from dehydration and finds no need for water to grow And branching until the time of irrigation.

To answer the second question, we have observed through the data of Table (4), (5) and (6) that clarify the effect of sodium polyacrylate on the growth of a plant (barley, onion, and rose) and the color of the plant and its branches. We note from Figure 1. that a plant Barley in the experimental sample added to the soil, sodium acrylate, from the first week to the fifth week, ranged from (1–10) cm, While barley plant in the control sample (soil without any additions) that the length of the plant ranged from (0–6) cm, in addition that the greenness, glasses and number of leaves of barley plant in the experimental sample is better than the control sample, as we also note from Table 5

and Figure 2. The growth of onions in the experimental sample ranged from (2–21) cm, While its length ranged from (0–10) cm during the five–week period, and also we notice from Table 6 and Figure 3, the growth of the rose plant in the control sample ranged from (10–23.3) cm, while the experimental sample was (10–46.4) cm, and we conclude during This is because the growth of the plant and its abundance in terms of color, number of branches and leaves are better in the soil where sodium polyacrylate is added.

As the result of the research is identical to the research (Tilli, 2016) that studied the effect of polymers in Syria on faba bean, totem and pepper, and it was found that polymers increase the soil's ability to retain water and maintain gastric salts and nutrient oxides in the soil and appropriately improve the pH, which makes the plant It is of high quality in the dry areas.

Conclusion:

Water is the lifeblood, and it must be maintained, and search for ways to reduce water consumption, as well as search for ways to maintain soil moisture for the longest possible period of time, so that people in dry areas can grow their agricultural needs of vegetables, fruits and barley.

Through this research, the importance of adding sodium acrylate in the soil to maintain water and keep the soil moist for a longer period of time was reached, as it changes the pH of the soil to become its value (6–6.5), which is the appropriate number to grow many plants because it facilitates the absorption of minerals from Soil affects the plant positively by providing a need for water throughout the week and providing an environment that helps in absorbing minerals and getting rid of some microbes, as

sodium polyacrylate can be provided from industrial products after consumption and re-treatment such as diapers.

We recommend spreading the idea of research to the Omani community to benefit from it, and transfer the idea to the environmental company to play an active role in recycling products that contain sodium acrylate and convert it into fertilizer for use in dry areas, as well as transfer the idea to the Ministry of Agriculture to adopt the idea and add this material to industrial fertilizers.

The strengths of the research from my point of view are contributing to solving an environmental problem (desertification), preserving water, and helping the people of the region grow better agricultural crops. The research also contributed to developing the cognitive and skill aspect, and research and experimentation strategies to find environmental solutions.

We see that this research is very useful and could contribute to treating a Gulf problem in general if the project was adopted and further developed and the proposals taken. Through cooperation with STEM officials in the governor and Dr. Shaher Al-Olayyan from the University of Sohar, it was proposed to manufacture a material from palm fronds and natural environmentally friendly fibers to conserve water in the soil, or to create natural pomers using electric spinning technology in cooperation with Sultan Qaboos University that can be tested and utilized in research coming.

Thanks and appreciation

We are pleased to extend our sincere thanks and appreciation to Professor Nadira Al Harthy, National Coordinator of the GLOBE Environmental Program in the Sultanate of Oman, for all the information provided and to the distinguished Ahmed Al Balushi and Fatima Al Muqeemy, members of the central team of the program and the program team by maintaining their follow-up and continuing encouragement to prepare the research and produce it in the appropriate way.

We also thank Professor Nawal Al Shamsi, teacher of the program at Umm Dhar Al-Ghaffari School for providing us with the opportunity to prepare this research, and to Professor / Rahma Al Badi, the laboratory specialist at Umm Dhar Al-Ghaffari School, for her cooperation with us and her role in providing advice and guidance for everything related to the research.

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