



Sultanate of Oman  
The Ministry of Education  
General Directorate of Education, Muscat Governorate  
Umm Al-Hakam Bint Al-Zubair Basic Education School (1-10)

***Study the effect of Temperature and Humidity on growth  
Frankincense tree in the farm's area in the state (Wilayat) of Qarayat***

*Prepared by, the two students:*

- 1. Hawraa bint Saif bin Nasser Al-Rawahiyah**
- 2. Remas bint Khaled bin Khalfan Al-Nayriyah**

*Umm Al-Hakam Bint Al-Zubair Basic Education School (1-10)*

*Supervised by: **Teacher Sheikha bint Abdullah bin Muhammad Al-Ma'awliyah***

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**Summary:**

This research aims **to study the effect of temperature and humidity on the growth of the frankincense tree in the farm area of state/ (Wilayat) Qurayat.**

To answer the following questions are below:

Q1. What are the appropriate conditions for growing the frankincense tree in terms of temperature and humidity?

Q2. For the growth of the frankincense tree, what are the characteristics of the suitable soil?

The study began by searching for suitable conditions of growing the frankincense tree in terms of temperature and humidity, students and I planted the tree it on the farm of a resident area, we applied the study by bringing a seedling from one of the Frankincense trees, then put it in the soil, watered, and took care of until it grew and began to flourish.

The Atmospheric protocol for measuring temperatures and humidity for September and October was applied, and as a result, we found that, the tree grows in an environment with different low temperatures and humidity, as well, the soil protocol we applied and found that, the frankincense tree grows in a different environment by low acidity, conductivity, and salinity. It grows in areas with stony and limestone soil, and more commonly even better grows in gravel soil than clay soil, especially, at the mountain slopes and valley bottoms.

Team required help from specialists in this field, the engineer. Zahra Abdullah Al-Hadidiya, who works at [the Center Agricultural Wealth and Water Resources](#), and Ghaida Al-Fazariyah is a volunteer in the field of agriculture were interviewed.

The most important results of the interview were, recommendations that must be done when planting a frankincense tree.

- To leave a distance of 5 meters between the frankincense trees.
- It must be fertilized, with a chemical fertilizer every 5 months, because the frankincense tree is considered fast-growing when taken care of at the beginning of its farming. It tolerates organic fertilization and drought.
- Preferable to be cultivated by establishing a strong root system that helps it to grow.

The benefits of our study concerned with the environment, by reducing the percentage of carbon dioxide that pollutes the environment, causes Global warming, and helps achieve zero carbon neutrality.

**Basic terms:**

**Frankincense tree:**

Frankincense tree, Kandar, sacred frankincense, or sacred boswellia (scientific name *Boswellia sacra*), It is a type of plant in the Frankincense genus of its family. The trees of the *Boswellia* family are small size, reaching a height of 2 to 8 meters with one or more stems.

**Zero carbon neutrality:**

Net zero emissions by reducing the level of greenhouse gas emissions (such as carbon dioxide carbon and methane) to the closest possible level to zero.

**Research questions:**

The research questions are mention above at the summary page.

**Research Plan:**

Time/Period	Objectives to be implemented	Mechanisms	Initiators
September 03 <sup>rd</sup> -07 <sup>th</sup> /09/2023	The choice of the research topic and the study of how to reach the results	The coordination with the school administration in Enabling study.	Program team (Hawraa). Spiritualism (Rimas Al-Nairiya)
September 14 <sup>th</sup> /09/2023	The collection information collection and references used in the research.	Previous studies viewed from the Resource Center Learning of the international network. The interviews with Some specialists (Eng. Zahra Abdullah Al-Hadidiya (working). At the Center for Agricultural Wealth (Water Resources, and Ms. Ghaida Al-Fazariya (Volunteer in the field of agriculture)	"
September to October 17 <sup>th</sup> /09/2023 - 31 <sup>st</sup> /10/2023	The atmosphere and soil protocols applications	The use an Analog hygrometer device to measure Air temperature and relative humidity. A device to measure acidity, salinity, and soil conductivity at the study spot.	"
November	The result discussions and transcribe recommendations.	Supervising teacher and team members meeting.	Supervising teacher: Sheikha Reliability Program Team: 1. Hawraa Al-Rawahiyah 2. Remas Al-Nairiya
December	Research review and final structure	Supervising teacher and team members meeting.	a.Sheikha Al Ma'awiyah
February	Prepare a research poster and submit the research.	Supervising teacher and team members meeting.	Program Team: Hawraa Al-Rawahiyah Remas Al-Nairiya Supervising teacher: a. Sheikha Al Ma'awiyah

Table (1) shows the research plan

## Introduction and Literature Review:

The frankincense tree is the ancient oil of Oman and the economy of the promising future. It is a (Dhofari) tree that provides the world with treatment and the aromatic. Oman is well known for producing the fragrant types of frankincense trees, they are spread in different areas of the (Dhofar) Governorate, because it is a suitable place for these trees to grow, due to its appropriate climate and limestone soil.

Due to the availability of suitable soil conditions in Dhofar, it is preferable to plant frankincense trees during a period of low humidity temperature from September to March, avoiding planting during the summer period.

Frankincense trees grow in some coastal environments where it is not directly affected seasonal rains and dry climate prevails or semi-arid, suitable for its growth. **Al-Ghassani, 2008**

Planting Frankincense trees is one of the important themes, in terms of economic, historical, and medical. These trees are also found in the North Eastern corner of Somalia, specifically the Alula region and its surroundings.

The climatic conditions of humid climate and limestone soil played a role in the spread of frankincense trees. It started from along the way, extends parallel to the coast until the Khouria Moria Gulf and the western side. It gradually narrows until disappears, exactly, to the North of Ras Fartak, and throughout its journey.

The frankincense tree enjoyed a wonderful historical presence that made it a link, to communicate between the civilizations of the ancient world more than 7 thousand years ago. Trade caravans moved on hard paths from (Dhofar) in Southern Oman to the coasts of Southern Iraq, the Levant and ancient Egypt, and even coastal Palestinian Gaza,

**Dr. Ahmed bin Suhail Al-Hadari**, head of the branch of the Omani Agricultural Society in Dhofar Governorate confirmed that, Ships carried the fruits of the (Dhofari) tree to European countries, especially ancient Rome.

The statement to the **Oman News Agency** said that, it is necessary to take care of Omani frankincense trees due to its economic benefits, added that the cultivation of these trees has just succeeded in the Najd Region.

**Research methods:**

Through teamwork, information was collected from the **Learning Resource Center**, and the **World Wide Web**, and specialists interviews. The drawn up research plan and a timetable are explaining the progress of the plan, the tools, and protocols used and the important and necessary of measuring and serving the research.

The following table shows the mechanism for applying protocols with data to answer research’s questions:

Research questions	Protocols used	Application mechanism
What are the appropriate conditions for growing a frankincense tree? In terms of temperature and humidity?	The weather	The temperature and humidity measure during September and October with record notes
What are the characteristics of suitable soil for Frankincense tree growth?	Soil	Soil study properties in terms of Acidity, conductivity and salinity with its type in of (clay-gravel)

**Table (2) shows the research methods**

**Study site:**

The study was implemented in (Muscat Governorate - Quriyat Wilayat), where the atmospheric protocol was applied by taking the required observations, measurements and recording results during the months of September and October 2024, a degree in general, the temperature ranges from 34c to 39c degrees Celsius, a high-temperature area surrounded by mountains, and full of trees.



Pictures (1) and (2) show the geographical location

**Data Analysis:**

**First:** We brought a seedling from one of the frankincense trees, planted it in the soil, watered it, and took care of it until it grew and started to flourish.

**Second:** Observations and data related to the first question were collected by applying the atmospheric measurement protocol, temperatures, and humidity for September and October, and entering data on the GLOBE website.

**Third:** Observations and data related to the second question were collected by applying the soil protocol study, through conductivity, salinity, acidity, and solubility of oxygen and entering data into the GLOBE website.



Pictures (3) and (4) show the application of the protocol





Pictures (6 and 7) Gravel soil is suitable soil for planting the frankincense tree

**Results:**

Days	Dates September	Current Temperature	The maximum Temperature	The minimum Temperature	Humidity
Sun	17 <sup>th</sup>		39.3c	29.1c	
Mon	18 <sup>th</sup>	39.9c	41.9c	28.3c	34%
Tue	19 <sup>th</sup>		44.0c	28.9c	
Wed	20 <sup>th</sup>		40.8c	28.6c	
Thu	21 <sup>st</sup>	34.4c	43.4c	29.6c	36%
Fri	22 <sup>nd</sup>		42.7c	28.1c	
Sat	23 <sup>rd</sup>		41.4c	26.8c	
Sun	24 <sup>th</sup>		40.6c	25.1c	
Mon	25 <sup>th</sup>		42.3c	24.1c	
Tue	26 <sup>th</sup>		40.2c	23.3c	
Wed	27 <sup>th</sup>	39.1c	40.1c	22.8c	19%
Thu	28 <sup>th</sup>		42.8c	27.1c	
Fri	29 <sup>th</sup>		44.8c	29.1c	
Sat	30 <sup>th</sup>		42.4c	28.8c	

Table 3: Temperature and humidity data for September

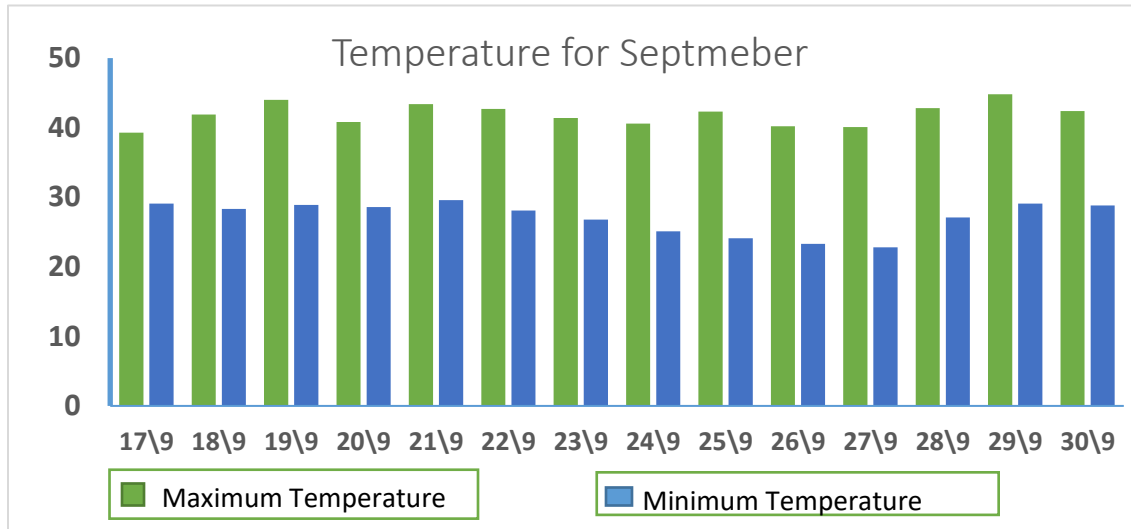


Chart 1: Temperatures for September

Days	Dates October	Current Temperature	The maximum Temperature	The minimum Temperature	Humidity
Sun	01 <sup>st</sup>		41.9c	25.6c	33%
Mon	02 <sup>nd</sup>		41.7c	27.1c	33%
Tue	03 <sup>rd</sup>	38.6c	40.4c	36.5c	27%
Wed	04 <sup>th</sup>		43.6c	27.9c	
Thu	05 <sup>th</sup>		46.7c	26.6c	
Fri	06 <sup>th</sup>		45.9c	28.0c	
Sat	07 <sup>th</sup>	34.2c	41.8c	28.3c	35%
Sun	08 <sup>th</sup>	39.9c	41.6c	27.4c	22%
Mon	09 <sup>th</sup>		41.6c	27.4c	19%
Tue	10 <sup>th</sup>	33.3c	42.2c	29.5c	19%
Wed	11 <sup>th</sup>	39.9c	39.7c	22.8c	
Thu	12 <sup>th</sup>		43.3c	37.0c	
Fri	13 <sup>th</sup>		42.3c	27.0c	
Sat	14 <sup>th</sup>		41.6c	25.9c	
Sun	15 <sup>th</sup>	36.3c	39.7c	37.7c	
Mon	16 <sup>th</sup>	38.1c	42.4c	34.4c	25%
Tue	17 <sup>th</sup>	38.8c	39.3c	33.3c	34%

Wed	18 <sup>th</sup>	34.5c	40.3c	30.3c	
Thu	19 <sup>th</sup>		41.7c	33.3c	
Fri	20 <sup>th</sup>		37.9c	25.8c	19%
Sat	21 <sup>st</sup>		38.4c	21.3c	
Sun	22 <sup>nd</sup>		37.4c	24.6c	40%
Mon	23 <sup>rd</sup>		37.1c	23.9c	38%
Tue	24 <sup>th</sup>		37.6c	27.4c	29%
Wed	25 <sup>th</sup>		38.9c	27.6c	25%
Thu	26 <sup>th</sup>		34.2c	33.2c	
Fri	27 <sup>th</sup>		23.2c	35.9c	
Sat	28 <sup>th</sup>		21.7c	35.9c	
Sun	29 <sup>th</sup>		22.6c	35.9c	41%
Mon	30 <sup>th</sup>		22.7c	36.2c	38%
Tue	31 <sup>st</sup>		22.9c	35.8c	15%

Table 4: Temperature and humidity data for October

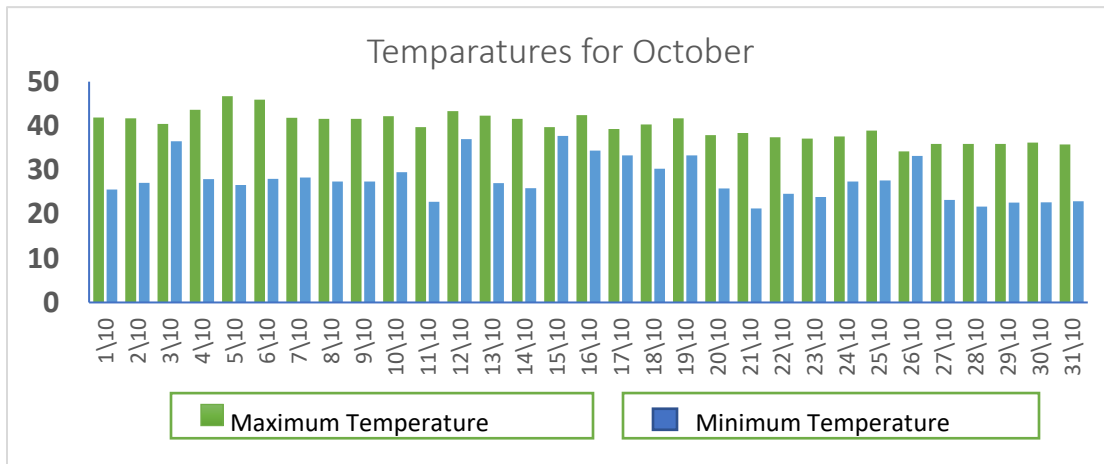


Chart 2: Temperatures for October

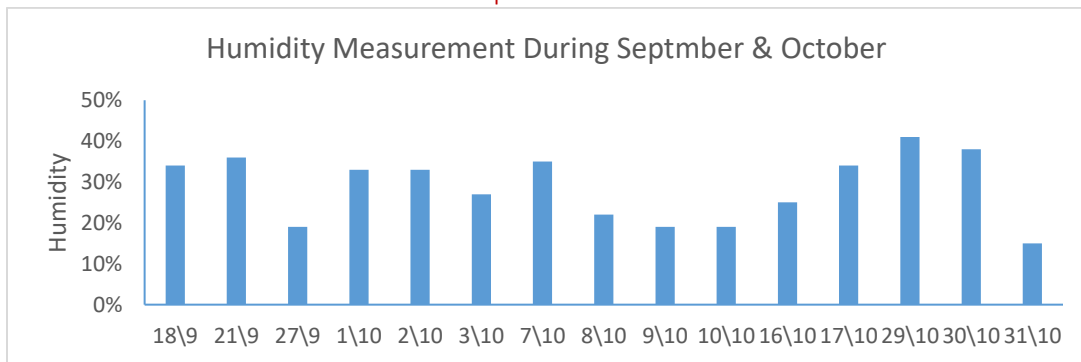


Chart 3: Humidity measurements during September and October

Soil protocol data:

Temperature	Acidity	Salinity	conductivity	Soil type
24,2	4,8	18,5	Mg/l49,7	Gallstones

Table (5) Soil protocol data

Location data:

The observed data were entered and recorded on-site and sent to the Globe program WWW. GLOBE.GOV

Station	Date	Min Air Temp (C)	Max Air Temp (C)
D1	2023-10-04	27.9	43.6
D2	2023-10-03	26.5	40.4
D3	2023-10-02	27.1	41.7
D4	2023-10-01	25.6	41.9
D5	2023-09-30	28.8	44.8
D5	2023-09-29	29.1	44.4

Picture 8

Station	Date	Min Air Temp (C)	Max Air Temp (C)
D1	2023-09-22	29.9	44
D2	2023-09-21	29.6	43.4
D3	2023-09-20	28.6	40.8
D4	2023-09-19	28.9	44
D5	2023-09-18	28.3	41.9
D6	2023-09-17	29.1	

Picture 9

Station	Date	Min Air Temp (C)	Max Air Temp (C)
D1	2023-10-24	27.4	37.6
D2	2023-10-23	29.1	35
D3	2023-10-22	20.3	37
D4	2023-10-21	21.3	38.4
D5	2023-10-20	25.8	37.9
D6	2023-10-19	26.7	

Picture 10

Station	Date	Min Air Temp (C)	Max Air Temp (C)
D1	2023-10-17	33.3	39.3
D2	2023-10-16	34.4	42.4
D3	2023-10-15	33	36.6
D4	2023-10-14	35	39.9
D5	2023-10-13	36.2	40.1
D6	2023-10-12	37	

Picture 11

Pictures (8, 9, 10, and 11) show temperature data on the GLOBE program website

**Interviews:**

We interviewed with Ms. Ghaida Al-Fazzaria, a **Developer in Agriculture**: she provided us information about:

- The differences in growing frankincense by seed or seedling in the appropriate
- The climate for its growth.

However, the tree found in Dhofar has a long history and is an ancient. Product, and human foot value it is not found in the Arabian Peninsula. It is recommended that, the Agriculture should pay attention on this matter in terms of encouraging students from first grade to farming and to protect Oman’s environment and economy .



Picture 12

Picture (12) shows the interview with Ms. Ghaida Al-Fazariya

Other interview was with Ms. Zahra Al-Hadidiya **Fisheries Center Wealth & Agriculture**, she give lecture to team managed to identified the status of the frankincense tree, its features, and the appropriate conditions for its growth. She present the most important of frankincense products, trailed by a field visit of tree-growing places.



Photos of the interview with Ms. Zahra Al Hadidiya

### Results Discussion:

Through the results reached in Tables (3 and 4) and chart (1, 2, and 3), we have answered all questions. It has been noticed that the temperatures **during September and October** are low and the humidity is average.

During our reviews of previous research, a study was conducted by **Dr. Ahmed Al-Hadary**, conducted the previous research study on the need of:

- Paying attention to Omani frankincense due to its benefits.
- The Various economic studies indicate that the stages of using frankincense evolved from incense to extracting Medical, therapeutic, and cosmetic preparations and entry into the perfume industry. Confirmed by
- He also underline the need for attention to Omani frankincense due to its economic benefits. He added that the cultivation of these trees has recently succeeded in the Al-Najd region due to the availability of suitable soil conditions.
- Preferable to plant frankincense in Dhofar, during a period of dropping temperatures from (Sept-Mar avoiding planting in the summer.
- In Dhofar Governorate, frankincense trees are growing in some coastal environment which is not directly affected by seasonal rains , dry climate or semi-arid conditions
- Due to the availability of suitable soil and climate conditions, he pointed out that approximately 15,000 frankincense trees were planted in some Najd farms, most of them now, have not reached the production stage.
- Attention needs to be paid to this tree, in terms of replanting and care, by establishing specialized projects for growing and producing frankincense in several different places, among them is the Najd region, where it is preferable to plant frankincense trees during the period mentioned above. [www.omaninfo.om](http://www.omaninfo.om)

Also, by applying the soil protocol to examine the soil sample, and the results are in Table (5), the second question was answered.

We noticed that low acidity, salinity, and conductivity, and the soil type is stony, so the frankincense tree needs shade and medium humidity in the soil. By reviewing the Global Network, we discover that apart from the humidity soil condition, these trees are growing better in more gravel, clay soil especially at mountains slopes and valley bottoms

A research study published in the Scientific Journal of King Faisal University in Saudi Arabia, conducted by **Mr. Ali Salem Bait Saeed**, showed Researcher in Natural Resources Management at the Environmental Conservation Office at the Diwan of Royal Court and several professors at the Science Center Desert and arid lands at the Arabian Gulf University that, Frankincense trees are so weak to extinction that average production are reduced from 10 Kgs per tree to 3.3 Kgs, while the thickness of those trees decreased in the (Jabal Samhan) reserve.

According to the study, the natural habitat in (Dhofar) decreased by about 85% during the last period since the beginning of the millennium. There may be error sources in the temperature data on the thermometer because, the device has been outdated for some time, a period of up to 8 years. Perhaps mistakes can be in soil measurements properties (acidity, conductivity, or salinity) between the school Lab and the Ministry equipment used in Laboratories, with exactness devices.

**Conclusion:**

We would like to Thank God for the completion of this research, In terms of the effect of temperature and humidity on the growth of the frankincense tree in the farm area in the state of (Quriyat),

We managed to implement the atmosphere protocol, to measure air temperature and humidity during September and October, field visits, and had interviews with people concerned about the project.

By applying the atmosphere and humidity protocol, we arrived at the point that, temperatures during September and October have low humidity, and this climate is suitable for planting the frankincense tree and the importance of multiplying it.

We understood that to reduce the carbon content will enable Frankincense's trees leaves and continue availability and the rank of medical and economics will boost.

During the interviews, we concluded that, Frankincense trees are available since early times and were the most important commercial products in countries.

The world studies and researches confirmed that the parts of the frankincense trees are the elements that make up frankincense treats cancer, also the tree produces oils, powders, perfumes, and candles to use.

This research can be re-applied by studying healing preparations from parts of the frankincense tree, in an additional Vegetation Protocol study.

[The Center for Agricultural Wealth and Water Resources](#) in the (Wilayat of Quriyat) recommended, the distribution of frankincense seedlings to Citizens free of charge, to encourage them, plant these trees. In addition, fencing some sites special, for these trees and preserve them in their locations



### Thanks and appreciation:

Praise be to God, and prayers and peace be upon the purest of His prophets, Muhammad, may God bless him and grant him peace

We are pleased to extend our sincere thanks to everyone who contributed to the completion of this research:

1. **Mr. Ahmed Al Balushi:**  
The National Coordinator of the Globe Environmental Program in the Sultanate of Oman for giving all the valuable information.
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For providing support and facilities to carry out this research, especially Ms. Amna Al-Zadjali, Ms. Asmaa Al-Lazami, a field teacher secondly, program, Ms. Sheikha Al-Ma'awliyya, the supervisor of the globe and Ms. Sheikha Al-Kaabiya, the Arabic language teacher, audited the research.
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4. **Ms. Zahra Al-Hadidiya the Engineer an agricultural extension specialist** who works at the Center for Agricultural Wealth, Water Resources, Ms. **Ghaida Al-Harithiya**, a volunteer, and **Ms. Rahma Al-Batashiya**, who provided us with value information through the interview and help us complete our tasks.

### References

1. Al-Balushi, Yacoub. (2016). Explanation of water protocols for the training program for teachers. Environmental GLOBE. Office of International Learning Programs.
2. Al-Ghassani, Abdul Qadir. (2008)(Dhofar, the land of frankincense. Sultanate of Oman: General Directorate of Youth Affairs.
3. Haddad, Khaled. (2006). the Cultural Encyclopedia of the Young Plant World (ed.). 64 (Syria: Dar Al-Irshad Publishing.
4. Mahmoud, Muhammad, and Fahmy. 2009. Basics of General Botany. Egypt: Dar Al-Fikr Al-Arabi.
5. Electronic references: The information was collected on Thursday 2/8/2024 at exactly
  - a. [www.omaninfo.om](http://www.omaninfo.om)
  - b. [www.alhurra.com](http://www.alhurra.com)
  - c. Ar.wikipedia.org