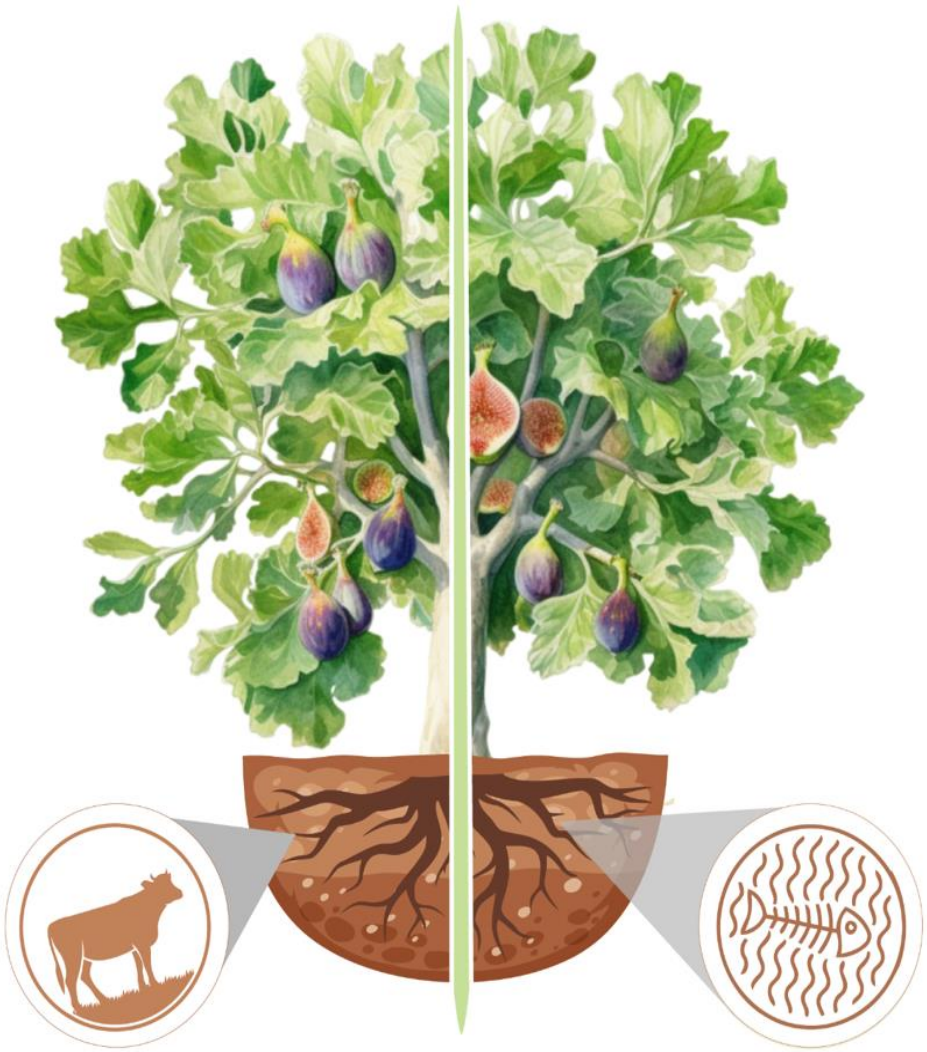
Al-Tarif School (5-9)

Ministry of Education
General Directorate of Education in North Al Batinah Governorate

Study on the Effect of Liquid Fish Emulsion Fertilization on Fig Tree Cultivation Compared to Cow Manure Fertilization



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Contents:

Abstract:

This study aims to compare two types of organic fertilizers used in organic agriculture, namely fish emulsion fertilizer and cow manure fertilizer, and their effects on soil properties and the cultivation of fig trees. Through this research,

1) Does fertilizing with fish emulsion have an impact on soil properties (salinity, acidity, conductivity) compared to fertilizing with cow manure?
2) How does fertilizing with fish emulsion affect the characteristics of fig fruit (size, mass, sweetness) compared to fertilizing with cow manure?

To answer the research questions, protocols from the GLOBE program were used, including the soil protocol, land cover protocol, and a study on the characteristics of fig fruit. The results demonstrated the superiority of using fish emulsion fertilizer in fig tree cultivation compared to using cow manure fertilizer, suggesting its potential for use in other crops. We recommend farmers collect fish waste from fish markets and shores and utilize it in the production of fish emulsion fertilizer.

Key Terms

Fig: The scientific name (Ficus), belonging to the family Moraceae in the order Rosales. (Younes, 2021)

Fish Emulsion Fertilizer: A fast-acting liquid organic fertilizer made from byproducts of the fishery industry and fish oil. It is a concentrated fertilizer that is diluted with water for use, rich in nitrogen, phosphorus, and potassium. (Hamad, 2022)

Brix Value: The Brix value indicates the amount of sugar present in a liquid. It is measured using a refractometer, which measures the refractive index and indicates the sugar content based on the angle formed by light. A refractometer can determine the amount of sugar in the liquid. (Organic Farming Blog, 2022)

Research Questions

We compared two types of organic fertilizers, fish emulsion and cow manure, studying their impact on fig tree cultivation. This served as a preliminary step to address the following research questions:

1- Does fertilizing with fish emulsion have an impact on soil properties (salinity, acidity, conductivity) compared to fertilizing with cow manure?

2- How does fertilizing with fish emulsion affect the characteristics of fig fruit (size, mass, sweetness) compared to fertilizing with cow manure?

Introduction and Literature Review

Organic farming is considered a modern and sustainable agricultural system that relies on the use of organic materials within the farm, derived from crop residues, animal husbandry, legume cultivation, or food waste. It steers clear of chemical inputs in fertilization or pest control, leading to the production of safe, clean, and nutritious food with high nutritional value, free from chemical residues, promoting food security. Moreover, it is an agricultural approach that preserves and enhances natural resources by improving soil fertility and characteristics, enhancing biodiversity and ecological cycles, while also safeguarding the environment from pollution. This makes organic farming play a significant role in meeting food needs and achieving sustainable development (Albourini, 2018).

Therefore, the quest for the best practices in organic farming contributes to solving many issues related to sustainable production.

Research Problem:

Some farmers face negative consequences resulting from certain organic fertilizers, notably the high microbial content in dry organic fertilizer, which adversely affects the soil. This high microbial content promotes the growth of unwanted weeds and grasses. Additionally, if the fertilizer is left accumulated, it becomes a favorable environment for various insects to breed, leading to unpleasant odors. This study aims to investigate two types of organic fertilizers and compare their effects on soil and plants in order to address this issue.

Research Methods

Data for this research will be collected through the following methods:

1) Interviews: Expertise in dealing with organic fertilizers will be sought through interviews with Mr. Yousef bin Mohammed Al Muqabali, the owner of a fig farm. The following questions will be posed:
    a) What organic fertilizers are used on the farm?
    b) What is the effect of these fertilizers on tree characteristics and crop yield?
2) Experimentation: Two areas within the farm (Area 1 and Area 2) will be identified. The same variety of fig trees will be planted in both areas simultaneously, irrigated with the same water source and quantity, and exposed to the same amount of light (constant factors). The difference will lie in the type of fertilizer used: Area 1 will be fertilized with fish emulsion fertilizer, while Area 2 will be fertilized with cow manure. Samples of water and soil will be collected to measure pH, salinity, and conductivity using GLOBE program devices. Additionally, the overall appearance of the trees in both areas will be compared, and samples of fig fruits will be collected from both areas to compare their characteristics in terms of size, mass, and sweetness.

Research Steps:

The research will be organized as follows:

1) Gathering information from available books at the Learning Resources Center and online sources.
2) Developing a research plan and timeline for its implementation.
3) Identifying the location for conducting the experimental study.
4) Determining the necessary protocols for conducting the research.
5) Identifying the devices and tools needed for the work: pH meter, salinity and conductivity meter, measuring tape, Brix refractometer, and electronic scale.
6) Conducting an interview with Mr. Yousef Al Muqabali, the fig farm owner.
7) Adopting experimental research to study the effect of fertilizer types on soil characteristics and fig tree growth.
8) Collecting and organizing data and facts in tables.
9) Entering data into the program's website.
10) Analyzing and discussing the data and graphically representing it.

11) Drawing conclusions and making recommendations.

Research Plan and Timeline for Implementation:

Table (1) illustrates the timeline for implementing the research plan.

Student's Name	Task	Execution Date
Taima Badr Al-Muqbalia	Choosing the research topic	October 2023
Taima Badr Al-Muqbalia, Shaimaa Saeed Al-Omrania	Gathering information about the research topic from various sources	October 2023
Taima Badr Al-Muqbalia, Shaimaa Saeed Al-Omrania	Conducting an interview with the farm owner	October 2023
Taima Badr Al-Muqbalia, Shaimaa Saeed Al-Omrania	Collecting soil and water samples for protocol application	November 2023, December 2023, January 2024
Taima Badr Al-Muqbalia, Shaimaa Saeed Al-Omrania	Observing and recording results, and entering data on the website	November 2023, December 2023, January 2024
Taima Badr Al-Muqbalia, Shaimaa Saeed Al-Omrania	Writing the research and interpreting the results	January 2024, February 2024

Table (1): Timeline for implementing the research plan

Study Site:

The research will be conducted at "Khyarat Sohar" farm, owned by Mr. Yousef bin Mohammed Al Muqabali. This farm has been selected as the site for the experimental study due to its specialized laboratory for fish emulsion production. It is situated in the Falaj Al Awahi area within the Sohar in North Al Batinah Governorate. The climate in this area is predominantly hot and humid throughout most of the year. The farm encompasses approximately 4000 fig trees spread across an area of 16 acres.

The protocols used in this study will include:

1) Water Protocol: This will be used to measure the pH, salinity, and conductivity of the water source used for plant irrigation.
2) Soil Protocol: This will be employed to determine the soil acidity using a pH meter, as well as to measure soil salinity and conductivity using appropriate devices.
3) Ground Cover Protocol: This will be utilized to observe the overall appearance of the trees.

Other devices will also be used to assess the quality of the fruits.

The necessary devices and tools for conducting the study:

will include several instruments to measure soil properties as well as plant and fruit characteristics. Table (2) outlines the most important of these devices and their uses.

Device	Image	Usage
pH Measurement Device		Measuring soil acidity
Salinity and Conductivity Meter		Measuring soil salinity and conductivity
Metric Tape Measure		Measuring lengths
Brix Refractometer		Measuring fruit sweetness (Brix level)
Electronic Scale		Measuring fruit mass

Table (2): devices and their uses

Results

First: Interview with Mr. Yousef bin Mohammed Al Muqabali, owner of the fig farm.

Mr. Yousef explained the method of preparing fish emulsion, which he manufactures on his own farm by using leftovers from fish markets, mixing them with molasses, and adding a specific type of anaerobic bacteria. He leaves this mixture to decompose for no more than 20 days, after which the fertilizer becomes ready for use. He mentioned that he uses a special network of pipes to pump the liquid fertilizer in suitable quantities. He praised the effectiveness of this fertilizer, as it does not require time to decompose in the soil but is directly absorbed for immediate benefit. He also added that this type of fertilizer has helped in obtaining a good yield of organic figs free from insecticides. The average annual production ranges from 6 to 9 kilograms per tree, and the mass of each fig fruit reaches over 70 grams at the peak of the harvest season (January).

Second: Characteristics of the water used for irrigating the trees (well water)

Samples were taken from the water source used for irrigating the fig trees on the farm and examined using specialized devices. The results are presented in Table (3) as follows:

Characteristic	Value
Conductivity (µS/cm)	686
Salinity (ppm)	431
pH	7.5
Dissolved Oxygen	6

Table (3): The results of the water source used for irrigating the fig

Table (1) illustrates the properties of the water used in terms of conductivity, salinity, and pH. Three readings were taken to obtain the average and ensure accurate data.

Conductivity	
Measured Date:	2023-11-20
Organization Name:	Altraif basic school
Site ID:	338059
Site Name:	khyrat Sohar farm
Latitude:	24.39825
Longitude:	56.65165
Elevation:	16.6m
Measured At:	2023-11-20T14:10:00
Conductivity Micro Siemens per cm:	686 µS/cm
Water Body State:	normal
Electrical Conductivity Model:	1000

pH	
Measured Date:	2023-11-20
Organization Name:	Altraif basic school
Site ID:	338059
Site Name:	khyrat Sohar farm
Latitude:	24.39825
Longitude:	56.65165
Elevation:	16.6m
Measured At:	2023-11-20T14:10:00
Water Body pH:	7.5 pH units
Water Body State:	normal
pH Method:	meter

Salinity	
Measured Date:	2023-11-20
Organization Name:	Altraif basic school
Site ID:	338059
Site Name:	khyrat Sohar farm
Latitude:	24.39825
Longitude:	56.65165
Elevation:	16.6m
Measured At:	2023-11-20T14:10:00
Water Body State:	normal
Salinity via Hydrometer:	4.3 ppt
Salinity Kit Mfg:	other
Salinity Kit Model:	EC400

Documenting the input of water properties used for irrigation on the GLOBE program website (www.globe.gov).

Thirdly: Soil Properties in Region (1) and Region (2)

Samples of soil were collected from the two selected regions for the study, one week after fertilization in November, December, and January. These samples were analyzed using specialized devices and tools, and the average readings were recorded. The results are presented in Table (2) and Graphs(1 ,2 ,3) .

Studying Soil Characteristics

Data Recording

Properties	Region (1)				Region (2)			
	November 2023	December 2023	**January 2024**	**Average**	**November 2023**	December 2023	**January 2024**	**Average**
Conductivity (µS/cm)	**746**	**756**	**748**	**750**	**912**	**925**	**887**	**908**
Salinity (ppm)	**533**	**536**	**530**	**533**	**630**	**630**	**610**	**623**
pH	**7.5**	**8.7**	**8**	**8.1**	**6.8**	**7.1**	**7.6**	**7.2**

Table (4): Soil Properties in the Study Regions

Table (4) presents the average measurements of soil properties for samples collected from Region (1) and Region (2), including conductivity, salinity, and pH. These measurements differ depending on the type of fertilizer used in each region while maintaining all other factors constant.

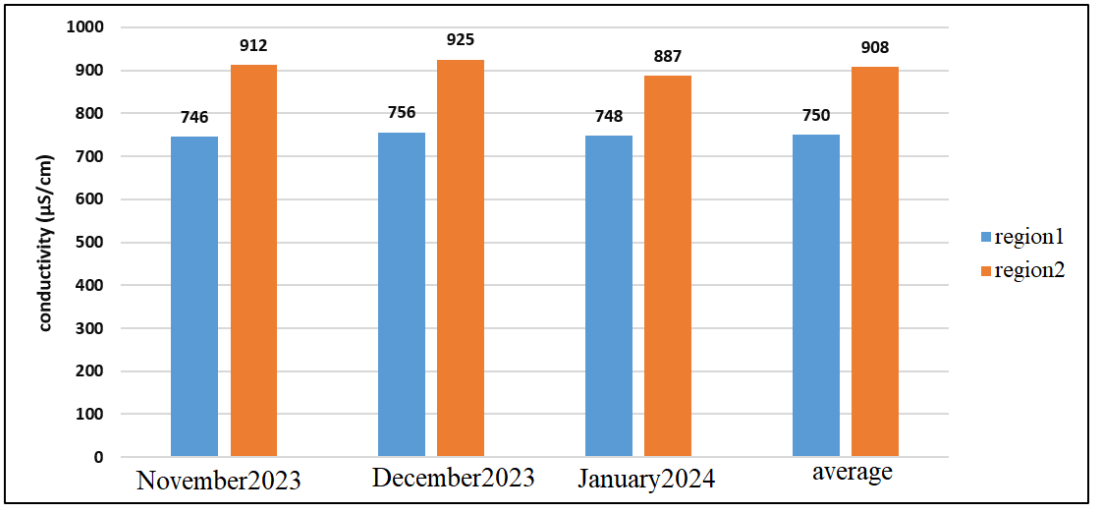


Figure (1): Comparison of Soil Conductivity in

Graph (1) illustrates that conductivity readings are higher in Region (2), with an average reading of approximately 908 µS/cm compared to 750 µS/cm in Region (1).

Figure (1) illustrates that conductivity readings are higher in Region (2), with an average reading of approximately 908 µS/cm compared to 750 µS/cm in Region (1).

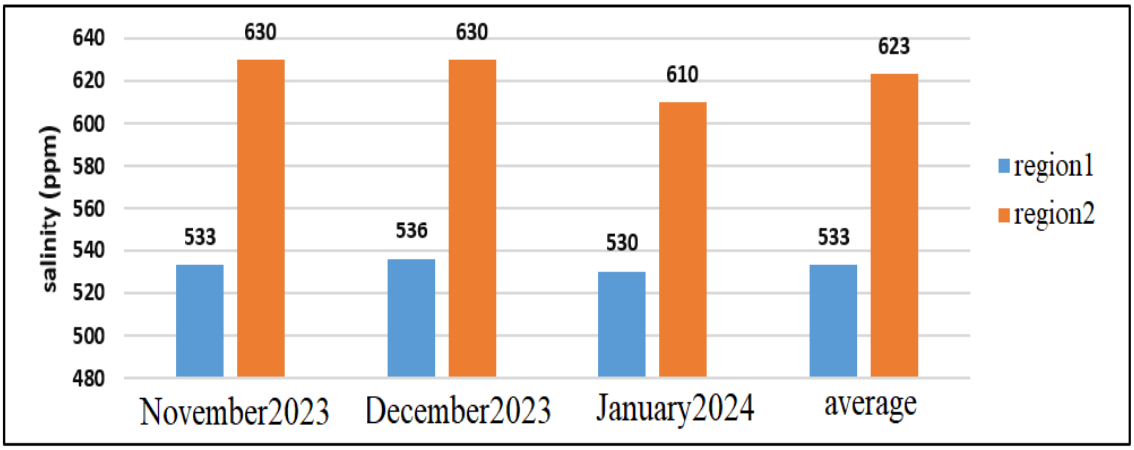


Figure (2) compares the salinity of the soil in the two study regions.

Graph (2) demonstrates that salinity readings are higher in Region (2) compared to Region (1), with an average salinity reading in Region (2) of about 623, while this value decreases for soil samples in Region (1) to reach 533. Additionally, the graph shows a slight decrease in salinity levels in the third month of the study compared to the first month, indicating that the type of fertilizer leads to differences in salinity levels.

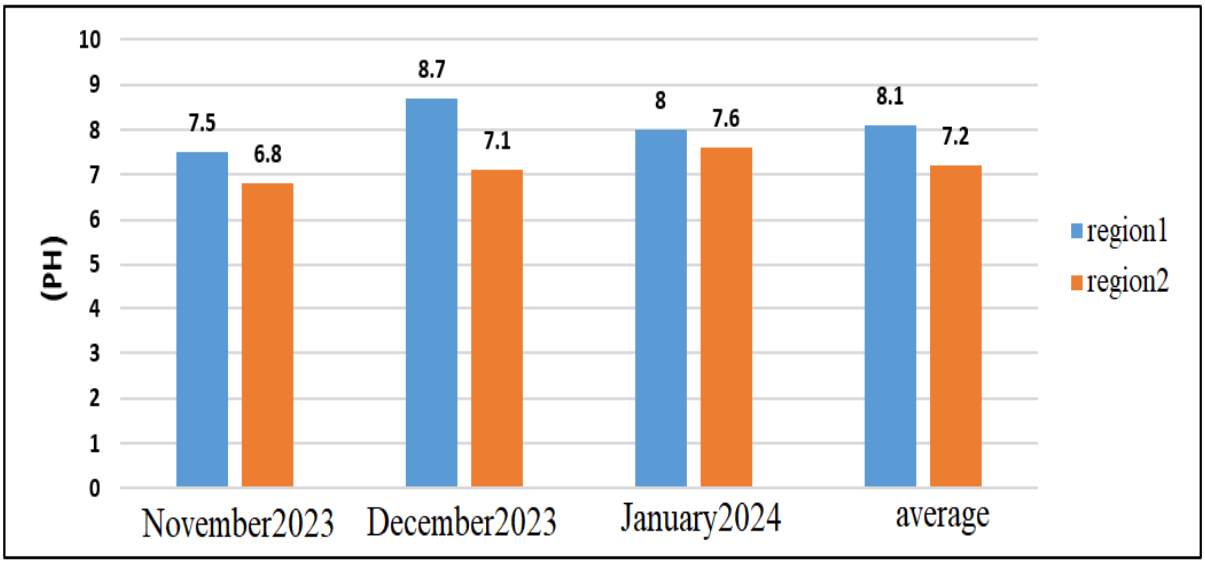


Figure (3) compares the pH values of the soil in the two study

Graph (3) depicts the variation in pH values between soil samples from Region (1) and Region (2). The average pH value for Region (1) soil samples increases to 8.1, while it decreases in Region (2) to reach 7.2.

Soil pH	
Measured Date:	2023-11-14
Organization Name:	Altraif basic school
Site ID:	338059
Site Name:	khyrat Sohar farm
Latitude:	24.39825
Longitude:	56.65165
Elevation:	16.6m
Collected On:	2023-11-14T00:00:00
pH:	7.2
Horizon Bottom Depth:	10 cm
Horizon Number:	1
Reference Depth Level5cm:	true
Reference Depth Level10cm:	true

Soil pH	
Measured Date:	2023-11-14
Organization Name:	Altraif basic school
Site ID:	338059
Site Name:	khyrat Sohar farm
Latitude:	24.39825
Longitude:	56.65165
Elevation:	16.6m
Collected On:	2023-11-14T00:00:00
pH:	8.1
Horizon Bottom Depth:	10 cm
Horizon Number:	1
Reference Depth Level5cm:	true
Reference Depth Level10cm:	true

Documentation of data entry on the website (www.globe.gov).

Fourthly: General Appearance Observation of the Tree After 9 Months of Planting

The designated areas for the study were examined, where observations were made on the overall appearance of the fig trees. Additionally, the fruit count was recorded for each tree, and the results are presented in the table below.

Studying Soil Characteristics

Data Recording

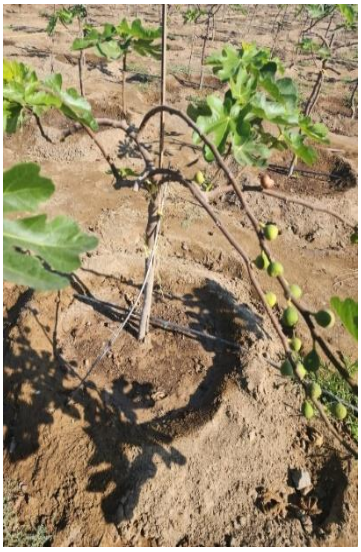
Property	Trees in Area Soil (1)	Trees in Area Soil (2)
General Appearance	Trees grow without any weeds or agricultural pests	Trees grow with a lot of harmful weeds
Average Number of Fruits per Tree	50	30
Images		

Table (5) comparison of some recorded characteristics for the study areas

The table number (5) provides a comparison of some recorded characteristics for the study areas. It was observed in area (1) the absence of harmful weeds around the fig trees and the absence of agricultural pests, while these weeds abound around the fig trees in area (2). The table also illustrates an increase in fig production in area (1) compared to area (2), where the average number of figs per tree in area (1) reached 50 figs, while the number decreased in the trees of area (2) to 30 figs per tree.

Fifth: Fig Fruit Characteristics

Eight random samples of fig fruits were taken from the two designated study areas at the peak of the harvest season (January 2024) to study and determine their specifications regarding fruit circumference, mass, and sweetness level. The results are presented in Table (6) :

Sample Number	Area (1)			Area (2)		
	Fruit Sweetness Level (Brix)	Mass of Fig Fruit (g)	Circumference of Fig Fruit (cm)	Fruit Sweetness Level (Brix)	Mass of Fig Fruit (g)	Circumference of Fig Fruit (cm)
1	12	53.4	17	11	26.6	13
2	13	55.3	17.2	12	40.2	15.3
3	14	57.8	17.5	11	30	14.3
4	11	48.1	16.2	12	33.1	15
5	14	53.6	16.9	11	32.1	14.7
6	13	50	16.2	11	33.7	15
7	14	59	18.1	12	39.3	14.2
8	13	53.6	17.1	11	33.2	14.2
Average	13	53.9	17	11	33.5	14.8

Table (6): Comparison of Fig Fruit Characteristics from the Two Areas

The table number (6) demonstrates that the characteristics of fig fruits vary depending on the area they were taken from. Fruits taken from area (1) exhibit superior characteristics in terms of circumference, mass, and sweetness level compared to those from area(2) .

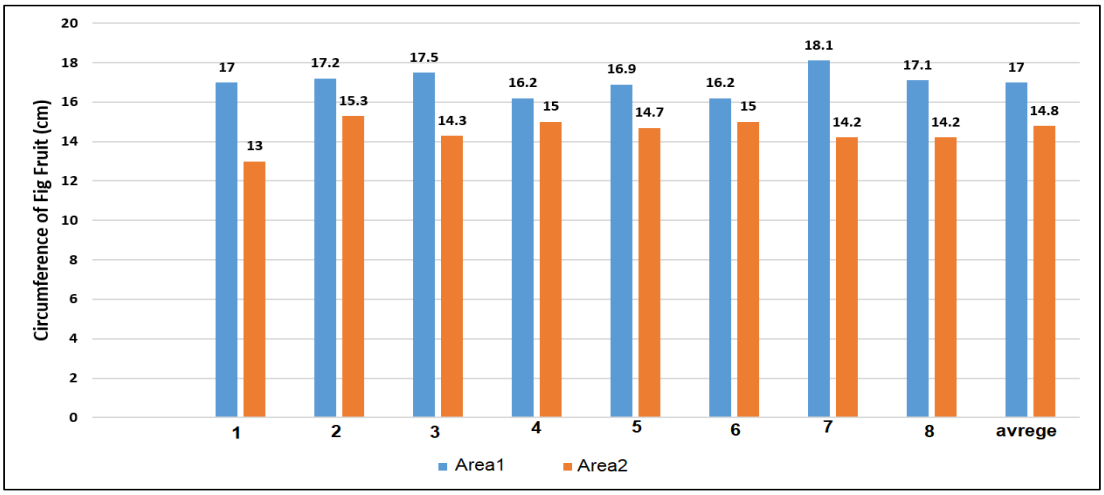


Figure (4): Comparison of the Circumference of Fig Fruit

The figure number (4) illustrates that the average circumference of fruit samples taken from area (1) is greater than those from area (2), with the average circumference of fig fruit taken from area (1) being 17 cm, while the average of samples taken from area (2) is approximately 14.8 cm. This suggests that the

conditions in area (1) may be more favorable for growth, thus resulting in better productivity of the harvest.

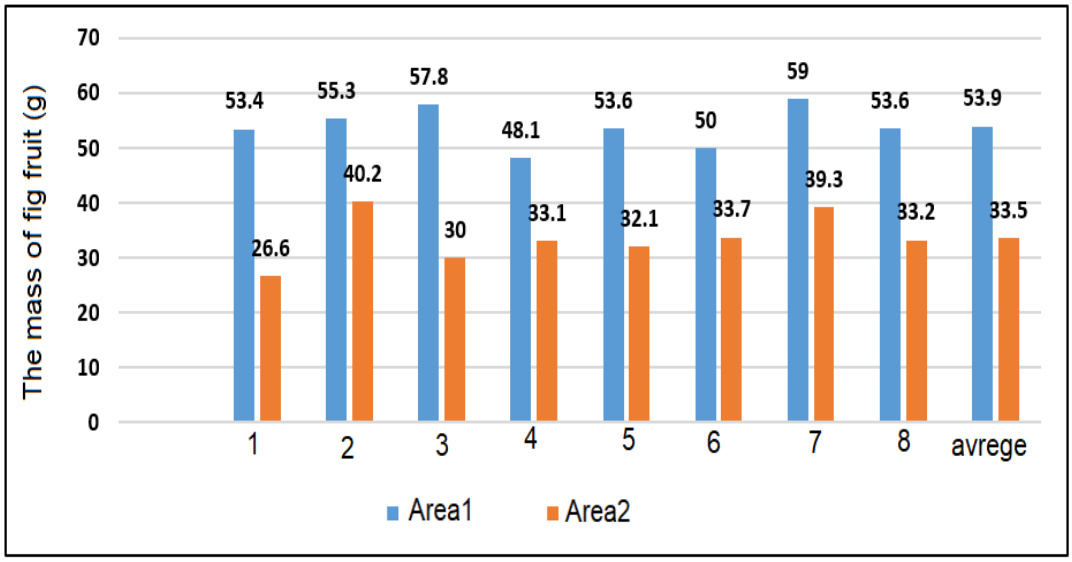


Figure (5): Comparison of the Mass of Fig Fruit Samples from the Two Areas

The figure number (5) illustrates that the average mass of fruit samples taken from area (1) is greater than those from area (2), with the average mass of fig fruit taken from area (1) being approximately 53.9 grams, while the average of samples taken from area (2) is approximately 33.5 grams. This indicates that the conditions in area (1) may be more favorable for growth, thus resulting in better quality fruits.

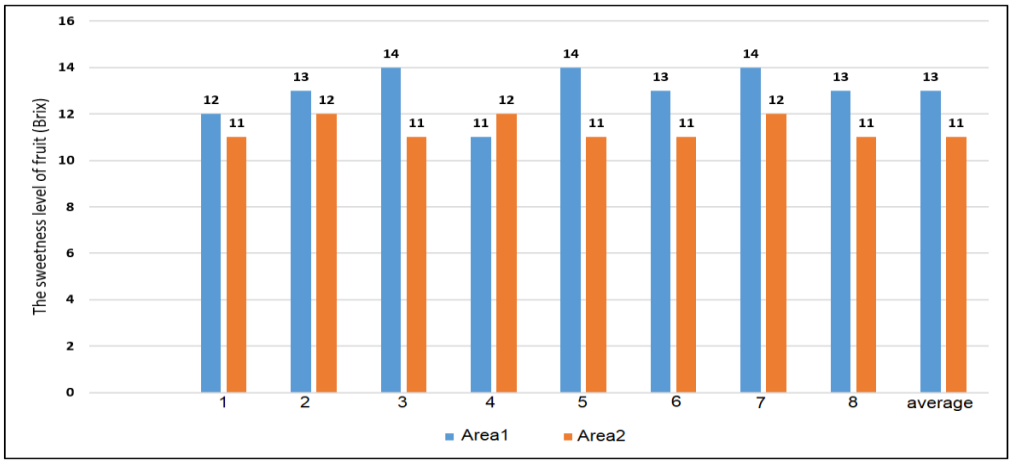


Figure (6): Comparison of the Sweetness Level of Fig

The figure number (6) indicates that the average mass of fruit samples taken from area (1) is greater than those taken from area (2), with the average mass of fig fruit taken from area (1) being approximately 53.9 grams, while the average of samples taken from area (2) is approximately 33.5 grams. This means that fruits from

area(1) may provide essential elements for plant growth and improve the quality of the harvest better compared to fruits from area(2).

Discussion of Results

To answer the first question of the research:

Based on the data shown in Table (2) and Figures (3, 2, 1), it is clear that soil properties such as salinity, acidity, and conductivity are affected by the type of organic fertilizer. The results indicate that fish emulsion fertilizer yields lower salinity and conductivity levels and more moderate acidity values compared to animal manure fertilizer. This implies that fish emulsion fertilizer can better address soil salinity and acidity than the other fertilizer.

To answer the second question of the research:

It is noticeable that the data in Table (3) and Table (4) indicate that the average number of fruits per fig tree, as well as the size, mass, and sweetness level of the fruits in area (1), which was fertilized with fish emulsion, were better than those in area (2) fertilized with cow manure. Several reasons can be deduced from this:

1) Previous studies suggest that higher salinity leads to smaller and lower-quality fruits (Al Hayani, 2009). Therefore, since salinity was higher with cow manure fertilization, we obtained smaller fruits with lower mass, whereas we obtained larger fruits with higher mass when fertilized with liquid emulsion, which reduced soil salinity.
2) The soluble organic matter content increases with increasing soil pH (Nina, 2019). This means that less acidic soil (higher pH) can absorb more organic matter, explaining the better quality of figs in area (1), where the pH value increased, resulting in higher organic matter content in the soil, thus providing better nourishment for plants.
3) Fish emulsion fertilizer is a liquid fertilizer, which accelerates plant absorption since it does not require time to decompose like cow manure.

The results of Table (3) show that fish emulsion fertilizer prevents the growth of harmful weeds, contributing to better plant nutrition and protection from agricultural pests. These weeds serve as a refuge for insects, pests, rodents, and worms that attack crops and cause fruit spoilage. Moreover, they compete with

the cultivated plants for sunlight, water, and soil nutrients. Weeds consume multiples of what trees consume in terms of nutrients and water, thereby reducing the chances of healthy plant growth and diminishing crop quality and production as well.

Conclusion

We thank God for the completion of this study, where we utilized the method of interviews and practical experimentation using the protocols of the GLOBE program. The study involved comparing two types of organic fertilizers (fish emulsion and cow manure) and their effects on soil properties and fig tree productivity. Our findings led us to conclude the superiority of using fish emulsion in fig cultivation. This implies its potential use for other crops to reduce the time needed for plants to benefit from it, increase productivity, and obtain organic farming free from pollutants while ensuring no transfer of agricultural pests or unwanted weed growth.

Thanks and Appreciation

We extend our sincere thanks and appreciation to Dr. Ali Al-Adawi, Director of the Agricultural Research Department in North Al Batinah Region, for his cooperation in the research field. We also express our gratitude to Mr. Yousif bin Mohammed Al-Maqbali, owner of Khayrat Sohar Farm, for his support and providing his farm for the study. Special thanks to Ms. Haifa Al-Kaabi for her assistance in writing the research, and to Ms. Asmaa Al-Alawi for her follow-up on project implementation and providing some necessary study equipment.

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