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# UTILIZING DATE PALM (Phoenix dactylifera L.) LEAF AS SOIL SUBSTITUTE

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## ABSTRACT

**Introduction:** As agricultural impediments remained continuous in Qatar due to its environmental conditions, the main objective of this study was to create an alternative to soil made out of date palm leaves. **Methodology:** This paper used an experimental quantitative research design to create a soil alternative out of date palm leaves, an abundant resource commonly cultivated in Middle Eastern countries such as Qatar. The leaves, containing the same elements as other lignocellulosic fibers, can support plant growth. **Result:** Thus, date palm leaves were an effective substitute for soil. The results of the study proved the effectiveness of the date palm leaf as an alternative to soil for the growth of the tomato plants in terms of the plant height, stem diameter, number of leaves, number of fruits, and length of the leaves. The date palm soil was able to grow a plant of 45.66 cm height with 90 plant leaves, 3.37 cm leaf length, and 3.9 mm stem diameter and produced 2 fruits. Furthermore, an ANOVA (Analysis of Variance) test corroborated the results which derived a uniform conclusion that there was no significant difference between the use of traditional soil and the soil substitute on the effectiveness of tomato plant growth. **Discussion:** The date palm leaf as a soil substitute played a vital role in enabling agricultural productivity, supporting plant growth, and fostering sustainability in various environments. **Recommendation:** It is recommended to use a higher-powered blender, use a controlled environment, and utilize other plants.

**Keywords:** ANOVA, Date Palm, Date Palm Leaf, Soil, Soil Substitute, Tomato Plant

## 1. INTRODUCTION

Agriculture has always been a grave challenge to farmers in the State of Qatar due to the environmental conditions of the nation. Qatar lacks arable land resources and is therefore vulnerable to the impact of global warming. Qatar has been classified as Group B: Dry with BWh= hot desert (B = Arid or Dry; W = Waste or Desert; h = hot) by Köppen's standards (Qatar Development Bank, 2020). To elaborate, as a desert country, Qatar's poor soil, high humidity, and climate conditions result in non-conducive agricultural production. Most of Qatar's soil is infertile and arid and contains low nutrients (Hassen et al., 2020). The properties of the soil in Qatar reflect the arid environment; these properties include being too compact, too shallow, having high pH levels, and having low fertility (Saleem, 2021). Consequently, this challenged Qatar's food security and food system sustainability. Qatar's soil composition was a challenge to those planning to grow plants in Qatar. The soil was predominantly made out of sand and heavy clay which are not known for their ability to hold nutrients.

Soil availability in Qatar is different from other countries since the Middle East is bounded by damaged soils. The soil studied in Qatar was 58% polluted using the United States Environmental Protection Agency's (USEPA) standard methodologies (Alsafran et al., 2021). About one-third of the world's oil supply is located in the Middle East and since Qatar is the world's top gas producer, it raises many concerns regarding soil, land, and air pollution (Nakhle, 2019). Oil production and spillage have resulted in an increase in environmental pollution, specifically soil, and land contamination. The presence of excess chemicals in the soil damages the soil's quality, further delaying food productivity in Qatar. Not only does soil pollution affect the environment and food supply, but it also results in health problems.

Conserving the use of soil should be given importance, as it is a nonrenewable resource and it will take centuries for it to be consumed again. One-third of the world's soil resource is moderately to highly degraded, thus threatening global food supplies, increasing carbon emissions, foreshadowing mass migration, and a need for change in farming practices (Begum, 2021). If soil resources continue to diminish, several consequences will affect the world. Soil erosion will increase pollution and deposition in waterways, and blocking these waterways will eliminate aquatic animals. It also decreases soil fertility, thus negatively affecting crop yields and production in agriculture. These resources will take a lifetime to renew and fulfill the pace at which the world is consuming them.

Middle Eastern countries are known for sweet dates from Date Palm trees that can grow amid the heat. Date Palm (Phoenix dactylifera) is one of the most abundant crops present in the Middle East and Northern Africa. The State of Qatar is the 16th largest date-producing country in the globe as of 2010, Possessing over 580,000 date palm trees, Qatar contributes 7.2% to the total date production in the world (Muhammed et al., 2015). Date palm tree fruits and leaves are regarded as waste resources and are frequently utilized to produce natural fibers as they are composed of the same elements as other lignocellulosic fibers: holo-cellulose (60–75%), lignin (20%), and ash (1.18%), making date palm a candidate in the making of an alternative to soil (Ghori et al., 2018).

With the use of date palm leaf, this study was able to provide another medium for growing crops. There are other alternatives to soil in the market including coconut husks and parboiled rice hulls. Coconut husks are an excellent alternative to soil as they allow air, water, and nutrients to enter deeper into the root zone (Malik, 2014). Parboiled rice hulls are also another alternative for soil as they have the same characteristics as coconut husks; they can absorb water and aeration (Çakırer, 2019). Although there are plenty of alternatives on the market today, they are pricey and not as accessible in a desert country such as Qatar. Since soil has been depleting rapidly around the world, alternatives may help expand the choices for gardening and farming, and the researchers believe the use of date palm leaf is perfect for a soil alternative. Tomato (Solanum lycopersicum L.) was used in the study because of its fast rate of growth which allows researchers to see significant shifts and results in a short duration. As stated by Rich (2023), tomato maturity ranges from 90 to 140 days, depending on the species and other climatic conditions. It is also easy to manage and is low maintenance. It does not require extensive care or particular conditions to grow since the researchers had limited resources.

## 2. STATEMENT OF THE PROBLEM

The objective of this study was to develop a soil substitute out of Date Palm (Phoenix dactylifera L.) leaf. Specifically, it answered the following questions:

1. How effective was the alternative soil out of date palm leaf to the growth of tomato plants in terms of the height of the tomato plant?
2. How effective was the alternative soil out of date palm leaf to the growth of tomato plants in terms of the number of leaves?
3. How effective was the alternative soil out of date palm leaf to the growth of tomato plants in terms of the length of leaves?

4. How effective was the alternative soil out of date palm leaf to the growth of tomato plants in terms of the stem diameter?
5. How effective was the alternative soil out of date palm leaf to the growth of tomato plants in terms of the number of fruits?

## 3. PURPOSES OF THE STUDY

The purpose of this study is to address the problem of scarcity of arable land in arid countries. The goal is to create a substitute for soil that makes it more accessible to local farmers that have trouble in obtaining nutrient packed soil, making it a viable option for sustainable agriculture, particularly in regions with limited resources or degraded soil quality. This study aims to evaluate the feasibility of using processed date palm leaves as a soilless growth medium for crops cultivated in arid regions. This evaluation will encompass factors in plant growth performance such as its height, leaf number, leaf length, stem diameter, and yield.

## 4. OBJECTIVES OF THE STUDY

The objective of this study is to create an alternative to soil made out of date palm leaves that is able to produce similar results as compared to commercially bought soil. This is done by observing the growth of a tomato (Solanum lycopersicum L.) in set-ups with varying ratios of commercial soil and substitute soil out of date palm leaves.

This study also addresses the agricultural and environmental needs using a sustainable and abundant alternative soil. Furthermore, the study established the insignificant difference between the two soils and the similar results of planting the tomato plant in traditional soil and in the soil out of date palm leaves. The objective of the alternative soil is to improve the agricultural procedure and cultivation developments in Qatar and to lessen the complications from financial and climate-related issues.

## 5. RESEARCH HYPOTHESIS

**H0:** There was no significant difference in plant growth between tomato plants utilizing soil and those that used date palm leaf as a soil substitute.

## 6. RESEARCH METHODOLOGY

### 6.1. Research Design

This study utilized the experimental quantitative research design of scientific research. An experimental research design concentrates on the influence of the independent variable on a dependent variable by controlling the degrees of the independent variable precisely (Gergle & Tan, 2014). It enabled the researcher to create models of variable interactions to better understand the differential influence of one variable over another. In this study, the date palm leaves were the independent variables, and the alternative to soil was the dependent variable. The quantitative method was applied to effectively design the experiment and ensure that the proper type of data is accessible to answer the research questions as precisely and efficiently as possible. This method was essential because it allowed a high level of control over the variables that determined an outcome and had the advantage of obtaining accurate results.

### 6.2 Research Locale

The research study was conducted in one of the researcher's houses in Doha, State of Qatar, specifically in the Old Airport Area (Zone 45), Al Karama Street (St. 925).

### 6.3 Data Gathering Procedure

**Procedure**

The procedure showed the step-by-step process of developing an alternative to soil out of date palm leaf and how its effectiveness was tested.

**Ensuring the equal distribution of materials for accuracy**

The controlled variables considered in this study are the amount of water which was 250 ml (time-frequency) for each watering schedule, pot size, exposure to sunlight, number and kind of seeds, and the combined weight of soil and date leaf. The only experimental variable was the different ratios of soil and date palm leaf.

**Preparing the date palm leaf**

1. Remove the dry date palm leaf by cutting off its petiole from the date palm tree;
2. Remove the date palm leaflets from its rachis;
3. Cut the date palm leaflets into smaller pieces; and
4. Gather all the separated date palm leaves in a plastic or any kind of bag.

**Making the alternative soil**

1. Carefully put the cut leaflets in a blender or any grounding machine like a food processor;
2. Grind the leaf portions until well crushed;
3. Put the grounded leaves in a separate pot;
4. Put the pot in a secure place; it must be kept at room temperature; and
5. Any extra leaves must be placed in a separate container.

**Germinating the seed**

1. Soak the tomato seeds on a damp tissue paper.
2. Put the damp tissue paper in a closed container.
3. Remove the sprouts from the tissue paper after one week.

**Plant cultivation**

**100% soil**

1. Fill the pot with 0.5 kg soil;
2. Place 10 seeds throughout the soil;
3. Put the other 0.5 kg of the soil in the pot; and
4. Water the soil with 250 ml of water.

**75% Soil and 25% Date Palm Leaves**

1. Fill a container with 0.75 kg soil and 0.25 kg date palm leaves;
2. Mix the soil with the date palm leaves;
3. Put 0.5 kg of the mixture in the pot;
4. Place 10 seeds throughout the soil mixture;
5. Place the other 0.5 kg of the mixture in the pot; and
6. Water the soil with 250 ml of water.

**50% Soil and 50% Date Palm Leaves**

1. Fill a container with both 0.50 kg soil and date palm leaves;
2. Mix the soil with the date palm leaves;
3. Put 0.5 kg of the mixture in the pot;
4. Place 10 seeds throughout the soil mixture;
5. Place the other 0.5 kg of the mixture in the pot; and
6. Water the soil with 250 ml of water.

**100% Date Palm Leaves**

1. Fill the pot with 0.5 kg date palm leaves;
2. Place 10 seeds throughout the soil;
3. Put the other 0.5 kg of the leaves in the pot; and
4. Water the soil with 250 ml of water.

**Data gathering procedure**

1. Measure the height of the plant (from base to tip) with a tape measure;
2. Count the number of leaves of each plant;
3. Measure the three longest leaves and get the average length;
4. Measure the diameter of the widest part of the stem with a tape measure; and
5. Count the number of fruits of each plant.

## 7. FINDINGS

Date palm is a common agricultural resource in Qatar that is both readily available and supplies vital nutrients like lignocellulosic fibers that plants require to grow. This study concludes that date palm leaves can be effectively utilized as a soil substitute, offering potential benefits for agricultural projects in Qatar. On plant maturation, the different plant organs were counted and measured to be able to assess the tomato plant's growth rate. The tables that follow provide the actual data collected by the researchers for each plant set-up.

### 1. Effectiveness of the Alternative Soil to the Height of the Tomato Plant

**Table 1.1: Average Height in centimeters**

| | 1<br>Control Set-up<br>100% Soil | 2<br>Experimental Set-up A<br>75% Soil and 25% Date Leaves | 3<br>Experimental Set-up B<br>50% Soil and 50% Date Leaves | 4<br>Experimental Set-up C<br>100% Date Leaves |
|---|---|---|---|---|
| **Photos** |  |  |  |  |
| **Week 9** | 69 cm | 50 cm | 38 cm | 25 cm |
| **Week 10** | 82 cm | 70 cm | 53 cm | 55 cm |
| **Week 11** | 87 cm | 76 cm | 62 cm | 57 cm |
| **Average** | **79.33 cm** | **65.33 cm** | **51.00 cm** | **45.66 cm** |

Table 1.1 displays the height of the tomato plant in centimeters for the last three weeks. One control set-up and three experimental set-ups were considered for the credibility of the data. In the control set-up where 100% soil was used, the average height of the tomato plant was 79.33 cm. In the experimental set-up A where 75% soil and 25% date leaves were used, the average height of the tomato plant was 65.33 cm. In the experimental set-up B where the soil and date leaves were 50% each used, the average height of the tomato plant was 51.00 cm. In the experimental set-up C where 100% of the date leaves were used, the height of the tomato plant was 45.66 cm.

The data gathered showed that among the four set-ups, the Control Set-up of 100% soil had the highest average in terms of plant height, followed by Experimental Set-up A, Experimental Set-up B, and Experimental Set-up C, respectively. Experimental Set-up C where 100% date leaves were used, got the lowest average among the four set-ups in plant height. Tomatoes grown in the sandy soil amended with Vermicompost generally had

the greatest growth responses (plant height, leaf and flower number, and leaf chlorophyll content) compared to the clay or silt loam soils, with the silt loam soil generally providing the least response (Zucco, 2015).

**Table 1.2: Statistical Results Using Analysis of Variance for Plant Height**

| Source of Variation | F | P-value | F crit |
|---|---|---|---|
| Between Groups | 3.72 | 0.06 | 4.07 |

Table 1.2 shows the statistical relationship between the means of the results employing Analysis of Variance (ANOVA). After subjecting the data to the test, it resulted in the F statistic value of 3.72 which was lesser than the F critical value of 4.07, this signifies that the test was not significant. This holds with the P-value of 0.06 which was higher than the alpha level set at 0.05. This suggests that there was no significant difference in the recorded height of tomato plants whether they utilized soil or the date palm leaves as substitute soil as there was a similar growth rate between the use of date palm leaves and traditional soil. Plant height was an important morphological and developmental phenotype that directly indicates overall plant growth and was widely predictive of final grain yield and biomass (Wang et al., 2018). This proves that substitute soil was able to obtain a similar plant height as traditional soil as there was no significant difference between the two soils.

**2. Effectiveness of the Alternative Soil to the Number of Leaves**

**Table 2.1: The Average Number of Tomato Plant Leaves**

| | Control Set-up 100% Soil | Experimental Set-up A 75% Soil and 25% Date Leaves | Experimental Set-up B 50% Soil and 50% Date Leaves | Experimental Set-up C 100% Date Leaves |
|---|---|---|---|---|
| **Photos** |  |  |  |  |
| **Week 9** | 103 | 139 | 100 | 39 |
| **Week 10** | 186 | 114 | 198 | 67 |
| **Week 11** | 193 | 120 | 139 | 163 |
| **Average** | **161** | **124** | **146** | **90** |

Table 2.1 shows the number of leaves of the tomato plants. Once the tomato plant was mature, the number of leaves was counted. In the first set-up where 100% soil was used, the average number of leaves was 161. In the second set-up where 75% soil and 25% date leaves were used, the average number of leaves was 124. In the third set-up where the soil and date leaves were 50% each used, the average number of leaves was 146. In the fourth set-up where the date leaves were 100% used, the average number was 90.

Studying the results, it can be shown that the Control Set-up with 100% soil has the highest average number of leaves followed by Experimental Set-up B, and then followed by Experimental Set-up A. Additionally, Experimental Set-up C with 100% date leaves has the lowest average number of leaves. Vegetable leaf quantity and the size of the leaf area can reflect whether the plants are in good condition (Ci et al., 2015). This proves the effectiveness of the substitute soil as the number of leaves were similar to that of soil made from date palm leaves and the traditional soil.

**Table 2.2: Statistical Results Using Analysis of Variance for Number of Tomato Leaves**

| Source of Variation | F | P-value | F crit |
|---|---|---|---|
| Between Groups | 3.58 | 0.07 | 4.07 |

Table 2.2 depicts the statistical relationship between the means of the results after the Analysis of Variance (ANOVA) was employed. After subjecting the data to the test, it resulted in the F statistic value of 1.22 which was lesser than the F critical value of 4.07, this signifies that the test was not significant. This holds with the P-value of 0.364219 which was higher than the alpha level set at 0.05. This suggests that there was no significant difference in the recorded number of leaves of the tomato plants, whether it utilized soil or the date palm leaves as substitute soil. One of the visual key traits (phenotype) describing a plant's development and growth was its number of leaves (Dobrescu et al., 2017). This proves that the substitute soil was able to acquire an alike number of leaves as traditional soil as there was no significant difference between the two soils.

**3. Effectiveness of the Alternative Soil to the Length of Leaves**

**Table 3.1: Average Length of the Leaves in centimeters**

| | Control Set-up 100% Soil | Experimental Set-up A 75% Soil and 25% Date Leaves | Experimental Set-up B 50% Soil and 50% Date Leaves | Experimental Set-up C 100% Date Leaves |
|---|---|---|---|---|
| **Photos** |  |  |  |  |
| **Week 9** | 4.5 cm | 4.0 cm | 3.8 cm | 2.9 cm |
| **Week 10** | 4.8 cm | 4.0 cm | 4.3 cm | 3.1 cm |
| **Week 11** | 5.7 cm | 4.7 cm | 5.3 cm | 4.1 cm |
| **Average** | **5.00 cm** | **4.23 cm** | **4.47 cm** | **3.37 cm** |

Table 3.1 displays the length of leaves of the tomato plants. Once the tomato plant was fully grown, the length of leaves of the tomato plant was measured in centimeters. Four independent set-ups were considered for the credibility of the data. In the first set-up where 100% soil was used, the average length of leaves of the tomato plant was 5 cm. In the second variable where 75% soil and 25% date leaves were used, the average length of leaves of the tomato plant was 4.23 cm. In the third variable where the soil and date leaves were 50% each used, the average length of leaves of the tomato plant was 4.47 cm. In the fourth variable where the date leaves were 100% used, the length of leaves of the tomato plant was 3.37 cm.

Examining the results, it can be shown that the Control Set-up where 100% soil was used has the longest length of leaves grown. Followed by Experimental Set-up B and Experimental Set-up A respectively. Furthermore, the Experimental Set-up C where 100% date leaves were used has the shortest length of leaves grown. The size of leaves, including their surface area, dry mass, and length, has a significant impact on many biological processes, including plant growth, survival, reproduction, and ecosystem function (Koch et al., 2004). The length of the leaves reflects the condition of the plants showing good health in both the substitute soil and traditional soil.

**Table 3.2. Statistical Results Using Analysis of Variance for Length of Tomato Leaves**

| Source of Variation | F | P-value | F crit |
|---|---|---|---|
| Between Groups | 1.22 | 0.36 | 4.07 |

Table 3.2 statistically determined the relationship between the means of the results through the Analysis of Variance (ANOVA). After subjecting the data to the test, it resulted in the F statistic value of 3.58 which was lesser than the F critical value of 4.07, this signifies that the test was not significant. This holds with the P-value of 0.07 which was higher than the alpha level set at 0.05. This suggests that there was no significant difference in the recorded length of leaves of the tomato plants, whether it utilized soil or the date palm leaves as substitute soil. Leaf parameters have a profound impact on activities such as plant growth and development, so scientifically determining leaf parameters was of great significance (Wang et al., 2021). This proves that the substitute soil was able to obtain an alike length of leaves as traditional soil as there is no significant difference between the two.

**4. Effectiveness of the Alternative Soil to the Stem Diameter**

**Table 4.1. Average Stem Diameter measured in millimeters**

| | 1<br>Control Set-up<br>100% Soil | 2<br>Experimental Set-up A<br>75% Soil and<br>25% Date Leaves | 3<br>Experimental Set-up B<br>50% Soil and<br>50% Date Leaves | 4<br>Experimental Set-up C<br>100% Date Leaves |
|---|---|---|---|---|
| **Documentation** |  |  |  |  |
| **Week 9** | 4.5 mm | 4.0 mm | 4.3 mm | 3.7 mm |
| **Week 10** | 4.7 mm | 4.5 mm | 5.7 mm | 3.9 mm |
| **Week 11** | 5.1 mm | 5.0 mm | 6.2 mm | 4.1 mm |
| **Average** | **4.8 mm** | **4.5 mm** | **5.4 mm** | **3.9 mm** |

Table 4.1 displays the diameter of the stem of the tomato plant in millimeters for the last three weeks. One control set-up and three experimental set-ups were considered for the credibility of the data. In the control set-up where 100% soil was used, the average stem diameter of the tomato plant was 4.8 mm. In the experimental set-up A where 75% soil and 25% date leaves were used, the average stem diameter of the tomato plant was 4.5 mm. In the experimental set-up B where the soil and date leaves were 50% each used, the average stem diameter of the tomato plant was 5.4 mm. In the experimental set-up C where the date leaves were 100% used, the average stem diameter of the tomato plant was 3.9 mm.

Analyzing the results, Experimental Set-up B has the largest stem diameter of the tomato plants. Followed by the Control Set-up and Experimental Set-up A respectively which were close in diameter with only a 0.3 cm difference. Additionally, Experimental Set-up C has the smallest stem diameter. The quantity and quality of tomato fruit are significantly influenced by the water status, a thicker stem allows the plant to retain water more effectively which increases its growth span and yield (De Swaef, 2010).

**Table 4.2. Statistical Results Using Analysis of Variance for Diameter of Tomato Stem**

| Source of Variation | F | P-value | F crit |
|---|---|---|---|
| Between Groups | 1.22 | 0.36 | 4.07 |

Table 4.2 shows the statistical relationship between the means of the results using the Analysis of Variance (ANOVA). After subjecting the data to the test, it resulted in the F statistic value of 3.43 which was lesser than the F critical value of 4.07, this signifies that the test was not significant. This holds with the P-value of 0.07 which was higher than the alpha level set at 0.05. This suggests that there was no significant difference in the recorded diameter of stems of the tomato plants, whether it utilized soil or the date palm leaves as substitute soil. Stem diameter was one of the most common measurements made to assess the growth of woody vegetation, and the commercial and environmental benefits that it provides (e.g. wood or biomass products, carbon sequestration, landscape remediation) (Paul et al., 2017). This proves that the substitute soil was able to gain a similar stem diameter as traditional soil as there is no significant difference between the two.

## 5. Effectiveness of the Alternative Soil to the Number of Fruits

**Table 5.1. Number of Tomato fruits**

| | 1<br>Control Set-up<br>100% Soil | 2<br>Experimental Set-up A<br>75% Soil and<br>25% Date Fibers | 3<br>Experimental Set-up B<br>50% Soil and<br>50% Date Fibers | 4<br>Experimental Set-up C<br>100% Date Fibers |
|---|---|---|---|---|
| **Documentation** |  |  |  |  |
| **Week 9** | 3 | 3 | 2 | 0 |
| **Week 10** | 6 | 5 | 4 | 2 |
| **Week 11** | 8 | 6 | 4 | 3 |
| **Average** | **6** | **5** | **3** | **2** |

Table 5.1 shows the average number of tomato fruits for the last three weeks including the fruits that have ripened and fallen off the stem. In the control set-up where 100% soil was used, the average number of tomato fruits was six. In the experimental set-up A where 75% soil and 25% date leaves were used, the average number of tomato fruits was five. In the experimental set-up B where the soil and date leaves were 50% each used, the average number of tomato fruits was three. In the experimental set-up C where the date leaves were 100% used, the average number of tomato fruits was two.

Analyzing the results, the Control Set-up has the most number of tomato fruits. Meanwhile, Experimental Set-up A has five followed by Experimental Set-up B having three, and Experimental Set-up C has the least average number of fruits of two. The yield and quality of tomatoes are largely affected by the method of fertilization. The findings suggest that applying compost to industrial tomato plants, alone or with mineral fertilizers, improves fruit quality and promotes crop system sustainability, and the optimal strategy depends on the target crop and soil type (Cozzolino, 2023).

**Table 5.2. Statistical Results Using Analysis of Variance for the Number of Tomato Fruits**

| Source of Variation | F | P-value | F crit |
|---|---|---|---|
| Between Groups | 2.92 | 0.10 | 4.07 |

Table 5.2 shows the statistical relationship between the means of the results using the Analysis of Variance (ANOVA). After subjecting the data to the test, it resulted in the F statistic value of 2.9181 which was lesser than the F critical value of 4.0661, this signifies that the test was not significant. This holds with the P-value of 0.1003 which was higher than the alpha level set at 0.05. This suggests that there was no significant difference in the recorded number of tomato fruits, whether it utilized soil or the date palm leaves as substitute soil. This proves that substitute soil was able to acquire a similar fruit yield as traditional soil as there was no significant difference between the two soils.

## 8. DISCUSSION

Natural soil played an important role in the existence of most known plants to date. In addition to generating new deserts and decreasing agricultural productivity, regions lacking natural soil might change the way water moves across the landscape, possibly increasing the frequency of flooding. However, with Qatar lacking arable land resources and high costs of soil per pack, natural soil may not be within reach for many (Hassen et al., 2020). The soil found in Qatar reflected the nation's natural arid environment, showing properties such as being too compact, shallow, and lacking adequate fertility (Saleem, 2021). Qatar has approximately 1.5 million date palm trees which fulfill above 80% of the country's requirements (Muhammed et al., 2015). Qatar is the sixteenth-largest date-producing nation worldwide. As of 2010, there were 581,336 date palm trees spanning 2,469 hectares, producing 21,491 metric tons of dates. It is the most common fruit tree in the nation, and 7.2% of all agricultural output is produced from dates (Johnson et al., 2015). With date palm, the most abundant agricultural resource in Qatar, which contains the essential nutrients that plants need to grow (Ghori et al., 2018) and was easy to obtain, this study aimed to create an alternative to soil made out of date palm leaves, working to encourage certain lands to be productive for agriculture and more convenient and accessible for many. This research sought to assess the effectiveness of the alternative soil made out of date palm leaves to the growth of tomato plants in terms of the plant height, number of leaves, length of the leaves, the diameter of the stem, and number of fruits. Based on the results, the soil made out of date palm leaves showed no significant results regarding the growth of the tomato plant in comparison to the tomato planted in 100% soil. Utilizing the Analysis of Variance (ANOVA) test, the plant height with a p-value of 0.060958, the number of leaves with a p-value of 0.364219, the length of leaves with a p-value of 0.066066, the stem diameter with a p-value of 0.0724, and number of fruits with a p-value of 0.100322 yielded the same results of p-values greater than the alpha level set at 0.05 which lead to the acceptance of the null hypothesis. Therefore, it proved no significant difference regardless if the tomato plant was planted in the soil or the date palm leaves as the alternative medium.

## 9. CONCLUSION

This study has concluded that the utilization of date palm leaves as a soil substitute is possible but is not as effective as commercial soil. In conclusion, future researchers may utilize this study as a guide in creating other agricultural-based projects, with date palm leaf leaves as the main component.

## 10. RECOMMENDATIONS

The researchers suggest making use of a higher-powered blender to grind the date palm leaves into finer dust to maximize the distribution of the essential nutrients and minerals found in the leaves. Future researchers are also encouraged to establish the planting procedure in temperatures of 21-24 degrees Celsius and locations with direct sunlight and sun exposure of 8-10 hours each day. Additionally, future researchers may use other plants, aside from tomatoes, to further test the substitute soil's limitations. Concerning the accurate measurements of plant organs, an auxanometer is recommended. Moreover, the employment of biomass growth rate can also be one parameter to consider for future research.

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