Soil Properties and Influencing in citrus Agriculture in Husseinieh district

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Abstract
Soils different in the study area accordingly on its location change, as the natural ingredients lead Such In determining the characteristics of it soils and drawing their features and the possibility of using them in various agricultural activities, The search included a study and analysis of the physical and chemical characteristics of soil in Al-Husayniyah district, northeast of Karbala Governorate, by (24) samples and for (12) sites. To know the changes in its physical properties represented in soil texture, soil moisture and temperature, as for its chemical properties, it was represented by SOM, pH and EC. Results of the search showed that the physical and chemical properties of the soil of the study area are suitable for Agriculture citrus fruits, the soil was characterized by a texture that ranged from Sand Loamy and Sandy loam and sandy, which made it good and the movement of air and water was relatively more good, allowing the roots of plants to penetrate through it, In addition to soil moisture, moderate temperature and low salinity their rates are less than 4 dS.m-1 as such, it is considered a low-salinity soil, which encouraged the prosperity of cultivating citrus trees in the Al-Husseiniya district.

1. Introduction
Citrus fruits are considered one of the most important fruits for their nutritional, medicinal and economic value, as Citrus fruits are known for their refreshing aroma and provide vitamin C, in addition to ascorbic acid, it contains many phytochemicals that play a role in pharmaceutical preparations, such as carotenoids (lycopene and carotene), limonoid, avanon (naringenin and rutinoside) and vitamin B complex, it is effective in improving blood circulation and has anti-allergic, anti-cancer and anti-viral properties, and it ranked first in agricultural production in Al-Husayniyah district, accounting for about 50% of the agricultural production in it, and the physical and chemical properties of the soil are one of the important environmental variables that affect the cultivation of citrus trees, in addition to soil type, water availability, cultural practices and nutrient supply, the growth and quality of citrus fruits also depend on climatic conditions, the most important of which are temperature, relative humidity, precipitation, wind speed and sunlight.

The search adopted two different time periods, which are the period during the dry season of 2019 AD and the beginning of the rainy season for the same year. Each site has two samples for depths of (0-30) cm and (30-60) cm in a regular random manner, distributed amongst Rivers Levees Soils and Rivers Basins Soils and Mixed Gypsiferous Desert Soils (Map - 1), The research problem is represented in the following question: What is the effect of the physical and chemical properties of the soil in agriculture citrus fruits in the Husseinieh area? The research hypothesis was represented by the following answer: The physical and chemical properties have a great role in influencing the possibility of cultivation and growth of citrus fruits in the Husseinieh area as a result of different agricultural requirements and their tolerance to different soil properties, and since soil is one of the most important basic pillars on which citrus agriculture depends Therefore, the research aimed to clarify thevariance between the physical and chemical properties of the soil and the effect of these
characteristics in citrus agriculture in the Husseinieh district, which is located within the administrative boundaries of the Karbala governorate. Specifically, the northeastern part of it within the center of Karbala, and it extends from the western borders of Babel Governorate in the east to Lake Razzazah in the west, and it is bordered on the north by the lands of Al-Anbar Governorate, and from the east by the course of the Euphrates River (Shat Al-Hindiya), and from the south and southwest of the northern Badia and Lake Razzazah, as for the astronomical boundaries, it lies between longitude (24 53° 43' - 32 9° 44') east and two latitudes (54 42° 32' - 42 47° 32') north. The research came in three main paragraphs, which are as follows:

(Map -1) soil sample sites in Al-Hussainiya district

Source: Field Study using GPS.

(Map -2) The administrative boundaries of Al Hussainiah District

Source: Based on the 2018 Karbala map using Arc GIS 10.8 software.
2. Physical Characteristics of Husseinieh district soil

2.1. Soil Texture:

Soil texture refers to the range of particle size in soil, which means that these particles that make up a particular soil are large or small, or medium sized, or a range of sizes, and texture is a permanent and natural feature of soil and is most commonly used to describe its physical structure[1].

Varies of soil separations in the search area vary spatially. It was found from (see table 1) the decrease in the values of the clay separators and the increase in the values of silt and sand separations in the general soils of the study area for the studied sites as the overall rate of separations of sand, silt and clay in the summer season for depth (0-30) cm (862, 96.2, 41.8) g. Kg$^{-1}$ respectively, while the values of soil separations in depth reached (30-60) cm (845.2, 114.2, 40.5) g. Kg$^{-1}$ respectively. As for the winter season the values of separations of sand, silt and clay for depth (0-30) (858.5, 101.9, 39.6) g. kg$^{-1}$ respectively, and the depth reached (30-60) (855.8, 115.1, 29.1) g. Kg$^{-1}$ respectively.

(Table -1 )Physical Characteristics of Husseinieh district soil

The height of the sand and silt separations in the soil of River Levees Soils and river basins has the effect of making the movement of air and water relatively more good, allowing the roots of plants to penetrate easily through them and the process of good ventilation provides an appropriate opportunity for microorganisms to practice their activity which helps to speed up the decomposition of materials Organic in these soils, as for the mixed gypsum desert soils, it is characterized by the rapid movement of air and water, which leads to increased water losses as a result of its seepage into the soil, or its evaporation, which is reflected in the lack of vegetation cover and the lack of organic matter, unlike the river levees soils and river basins Which is characterized by the presence of good vegetation cover as well as the cultivation of different crops.

According to the USDA triangle classification system, soil texture is considered to be textured sand loamy in river levees soil River and in basins soils sandy loam texture While the mixed gypsum desert soil has a sandy texture, as the reason for the discrepancies in soil separations, the high percentage of sand, and the low percentage of clay and silt in the soils of the Husseinieh district is due to the nature of the factors that helped in the formation of these soils, as the sedimentation process (water) and the nature of the sediment and transported...
materials play an important role in forming the soil of the study area in addition to the quality of Parent rocks From which this soil is derived.

2.2. Soil Moisture:

Soil moisture is defined as the water present in the unsaturated soil area or the (unsaturated) vaduz area\(^2\). It was found from (see table -1) that the general average of soil moisture values for the studied depths in the soils of the studied area varies in time and place as the average rate in the summer season for depth (0-30) cm(9.74)\%, as for the average for depth (30-60) cm was (11.77)\%, while the general average was in the winter season in for both depths (respectively) (14.49, 15.23)\% and the reason for the variation in soil moisture values is due to the variation in organic matter and the presence of total porosity, as each affects the properties of fluid transport and retention in the soil column, in addition to the role of climate elements such as temperature and precipitation Which plays a direct role in the variation in soil moisture. All these factors led to a decrease in humidity in the summer season and an increase in the winter season.

2.3. Soil Temperature:

Temperature is an important factor in influencing most biological processes, and therefore it is necessary to understand the plant’s response to changing temperatures in time and place, and it was found from (see table - 1) that the general rate of temperature values for the depths studied in the study area varied in time and place. In the summer season for the depth (0-30) cm (36.8)°C, while the average for the depth (60-30) cm reached (38)°C, while the general average in the winter season for both depths (16.5,17.8)°C respectively, was The field measurements were recorded from (8:00 am to 2: 300 pm)and the reason for the temporal variation during the two seasons is due to the high air temperature and the lack of relative humidity, which increases the volume of water losses from the soil surface through evaporation / transpiration In the summer season, unlike in the winter season, which is characterized by low air temperature, high relative humidity and the presence of clouds that reduce the percentage of soil moisture loss through evaporation / transpiration, while the spatial variation of temperature is attributed to its influence by many factors, including the nature of vegetation cover It may lead The abundance of plants prevents solar radiation on the one hand and its use in evaporation / transpiration, which leads to less radiation reaching the soil, in addition to that, the nature of the soil texture affects the temperature and this explains the higher temperatures in the mixed gypsum desert soil compared to the soils of rivers and basins In the soils of the Husseinieh district, while the reason for the decrease in temperature in the first depth and its rise in the second depth is due to the increase in the moisture content of the soil at this depth, which helped to maintain the temperature for the longest possible period.

3. Chemical Characteristics of Husseinieh district soils

3.1. Organic Matter:

The content of organic matter in the soil varies greatly in terms of chemical composition and quantity, and this depends on a variety of interacting factors such as the type of vegetation cover, the prevailing climate, the parent material, soil drainage and the activity of soil organisms, a certain combination of these factors generally leads to the formation of humus forms\(^3\).

It was found from (see table -2) that the general rate of the percentage of organic matter for the depths studied in the study area varies in time and place, amount in the summer season
for depth (0-30) cm (0.91%), the average for depth is (30-60) cm, and it reached (1.16%), while the general rate in the winter season and for both depths respectively was (1.26, 1.22%). The reason for the variation is due to the influence of several factors, the most important of which are climate, natural vegetation and agricultural practices by farmers represented by adding organic fertilizers as the high temperature in the summer season leads to an increase in the decomposition of organic matter, its oxidation and evaporation, or its decomposition into materials that are not useful for plants, which leads to a decrease in the values of organic matter in the summer season compared to the winter season in which the values of organic matter increased as a result of lower temperatures and high humidity. This helped to preserve the organic matter in the soil as well as add organic fertilizers to the soil by farmers.

(Table-2) Chemical Characteristics of Husseinieh district soils

| Soil Class         | Depth / cm | Summer season | Winter season |
|--------------------|------------|---------------|---------------|
|                    |            | Organic Matter | Soil Reaction | Electrical Conductivity | Organic Matter | Soil Reaction | Electrical Conductivity |
| River Levees Soil  | 0-30       | 1.40          | 8.54          | 2.14             | 1.65           | 7.11          | 2.76            |
|                    | 30-60      | 1.76          | 8.40          | 1.87             | 1.53           | 7.37          | 2.05            |
| River Basins Soil  | 30-60      | 1.15          | 8.56          | 4.86             | 1.77           | 7.18          | 5.97            |
| Mixed Gypserous    | 0-30       | 0.17          | 8.37          | 1.12             | 0.35           | 6.86          | 1.58            |
| Desert Soil        | 30-60      | 0.30          | 7.75          | 1.21             | 0.49           | 7.03          | 1.82            |
| Average (0-30)     |            | 0.91          | 8.49          | 2.71             | 1.26           | 7.05          | 3.44            |
| Average (30-60)    |            | 1.16          | 8.23          | 2.42             | 1.22           | 7.20          | 3.08            |
| General Average    |            | 1.03          | 8.36          | 2.56             | 1.24           | 7.13          | 3.26            |

3.2. Soil Reaction:

Soil reaction is one of the most important physiological properties of the soil solution, the soil may contain acid or alkaline reactions or it may be neutral, and the measurement of the chemical reaction of the soil is expressed by the value of the pH \(^4\), it was found from (see table-2) that the rate The general values of the degree of interaction (PH) for the depths studied in the study area vary in time and place. The average in the summer season for depth was (0-30) cm (8.49), while the average for depth (30-60) cm was (8.23), The overall average in the winter season and for both depths respectively is (7.05, 7.20) and according to the United States Department of Agriculture (USDA-NRCS 1998) to classify the soil on the basis of pH values (see table-3) the soil of the study area is classified within Moderately alkaline and neutral soils, and it is attributed The reason for the discrepancy in the soils of the Husseinieh district is the variation in the amount of salts in the soil between these areas on the one hand, and because of the variation in soil washing processes when irrigation operations occur on the other hand it reported an increase in PH values For the summer season compared to the winter season.

(Table 3. USDA NRCS (1998) classify soils on the basis of pH values as \(^5\):

| Categories of soil acidity – alkalinity | pH range |
|----------------------------------------|----------|
| Extremely acid                         | 3.5-4.4  |
| Very strongly acid                    | 4.5-5.0  |
### 3.3. Soil Salinity:

Soil salinity refers to the accumulation of water-soluble salts, and salinity levels are usually determined by measuring electrical conductivity (EC)\[^{[6]}\] which is a measure of the concentration of ions in a solution and the ease with which an electric current can be conducted through this solution, and often it is used as a proxy measure for total dissolved solids\[^{[7]}\]. The electrical conductivity is measured on an extract saturated in the soil in decimic per meter (m. dS\(^{-1}\)) at 25 °C. Soils affected by salinity can be classified as saline, soda, or saline soil. – Soda\[^{[8]}\]. It was found from (see table -2) that the general average of EC values for the depths studied in the studied area varies in time and place. In the summer season, the average for the depths was (0-30) cm (2.71) m. dS\(^{-1}\), while the average depth (30-60) cm was (2.42) m. dS\(^{-1}\), while the general average in the winter season and for both depths respectively was (3.44, 3.08) m. dS\(^{-1}\) and according to the classification (see table -4), the soil of the study area is of low salinity and on the basis of that, it is considered one of the good soils that can be used to grow citrus fruits and the reason for the discrepancy is that the quality of the water that is irrigated contains high quantities of salts, in addition to the rocks from which this soil was derived may vary in terms of its containment of these salts. In general, the soils of the study area are characterized by their general low electrical conductivity, due to the nature of the soil texture, which ranged between sandy and sandy texture, as well as being of high permeability, which allows washing salts after the fall of rain or irrigation operations from the surface layers and their deposition in the subsurface layers.

![Table 4. Salinity ratings for soil based on EC\(^{[6]}\)](image)

| Soil Rating   | EC dS.m\(^{-1}\) | Effect on plants                  |
|---------------|------------------|-----------------------------------|
| Non-saline    | < 2              | Salinity effects are mostly negligible |
| Slightly saline | 2 -  4          | Yields of sensitive crops are affected |
| Moderately saline | 4 –  8        | Yields of many crops are affected |
| Highly saline  | 8 – 16           | Only tolerant crops yield satisfactorily |
| Extremely saline | >16            | Only very tolerant crops yield satisfactorily |

### 4. The effect of soil physical and chemical characteristics in citrus cultivation.

The physical and chemical properties of the soil are affected by citrus cultivation and each feature differs from the other in terms of its effects, so we will deal with each of them separately:

#### 4.1. Requirements for agriculture citrus according to the nature of the soil texture:
Citrus fruits are selective soil and environmental plants, and can grow in a variety of soils, ranging from coarse sand to fairly heavy soils, provided that soil drainage is adequate, good drainage is necessary to supply the roots with oxygen and especially to avoid the formation of sulfides Hydrogen as a result of anaerobic microbial activity, the optimal soil structures for commercial cultivation are deep sandy or temperate clay soils.

It has been shown from a study of the texture of the soil of the Husayniyah district that the soil of river levees soils is characterized as having a coarse texture, as for the soil of the river basins, it was characterized by being soil of medium soft texture, as it is soil with a sandy loam texture, while the mixed gypsiferous desert soil was characterized by its being of coarse texture, it is a soil with a sandy texture, in terms of humidity, pore size, soil aeration, water movement and drainage processes due to the different nature of the soil texture in it, river levees soil and the river basins of the Husseinieh district were distinguished for being well ventilated, porous and able to retain water, in addition to providing the nutrients and elements necessary for plant growth, On the contrary, in the mixed gypsum desert soils that lack nutrients and cannot retain water, and this is explained by the fact that agriculture is more concentrated and better producing in the soil river levees and the river basins of the Husseinieh district compared to the mixed gypsum desert soils.

4.2. Requirements for agriculture citrus according to soil moisture:

Citrus fruits are evergreen plants and thus require water for transpiration throughout the year. During periods of rapid growth, flowering and fruit formation, citrus trees are sensitive to moisture stress, and the size of the fruits usually decreases if the lack of moisture occurs repeatedly when the fruits are grown. On trees, during the spring and summer months, the soil may be allowed to dry out somewhat, but withering should be avoided during blooming and fruit formation, and stress during the period of early fruit growth causes excessive excretion of fruit. Varying and its general average reached during the two seasons (summer and winter) respectively (10.75 and 14.86%), and thus it is considered suitable for cultivation and production of citrus fruits.

4.3. Requirements for agriculture citrus according to soil temperature:

Soil temperature plays an important role in crop growth and productivity, especially in tropical areas affected by drought and in semi-arid and arid regions, as temperature pressures affect annual and perennial crops on all stages of plant growth. Heat alone, regardless of lack of soil water, may affect citrus plants. By increasing oxidative stress and other influences on growth and vegetative development, the optimum temperature range in citrus has been estimated at 22-34 °C, if temperatures exceed 35 °C, the optimal range during the growth of citrus fruits, fruit fall may occur, and it is expected The temperature increases lead to a high loss in crop productivity, and the cold and low soil temperature (less than 13 °C) will impede plant growth and development and will reduce productivity, and damage will occur when citrus fruits are exposed to temperatures less than -2.2 °C. However, the relatively cold winters are beneficial for this; as it stimulates regular flowering and the development of good fruit color. Field study of the temperature in the soils of the Husseinieh district has been found to be variable, and its general average during the two seasons (summer and winter) respectively (37.4, 17.2 °C), which is thus It is suitable for growing and producing citrus fruits.

4.4. Requirements for agriculture citrus according to organic matter:

Soil organic matter (SOM) preservation is critical to maintaining soil quality and crop productivity, and the profound effects of organic matter on nearly all soil properties make its soil management in farmland the basis for sustainable agricultural production, and in general
it is assumed that between 1% and 5% of soil organic matter, depending on the type and severity of soil cultivation \[13\], as the nature of the soil itself is a factor of fundamental importance in determining the percentage of organic matter that the soil will retain under crop conditions. Sandy soil may contain 1 percentage Only% of the organic soil, while under similar climatic conditions, clay soils may retain 5% or more of the organic matter \[14\]. The study of the organic matter for of Al-Husayniyah district revealed that it is different, amount its general average during the two seasons (summer and winter) respectively (1.03, 1.24%). In general, the percentage of organic matter is relatively low in the soils of the Husseinieh district, which encouraged farmers to add fertilizers and fertilizers to Soil, and the importance of organic matter in citrus cultivation is highlighted by the characteristics that organic matter has in helping in soil cohesion, improving its construction, and maintaining soil temperature, pH and humidity.

4.5. Requirements for agriculture citrus according to soil reaction:

The soil pH preferred by the crops varies based on the types of crops \[15\], and citrus trees can be grown in soils with a wide pH range (5.5-8.0) \[16\]. The study of (PH) of the husayniyah district soils has been shown to be different, and amount its general average during the two seasons (summer and winter) respectively (8.36 and 7.13) These values are appropriate for growing and growing citrus trees.

4.6. Requirements for agriculture citrus according to soil salinity:

Citrus trees are among the crops most sensitive to soil salinity, as high salinity harms growth, yield and fruit quality, in addition to that, the main negative effect of salinity is related to increasing the osmotic pressure on the plant, and sensitivity to salt is also affected by the choice of root bait \[10\], which is something Critical to citrus production, not only vegetative and reproductive growth, but also fruit set, growth, ripeness, skin color, internal quality, and yield are all factors affected by high salinity \[12\]. Citrus trees are susceptible to salt and cannot thrive well in saline and alkaline soils \[11\]. It was found from the (EC) study of the soils of the Husseinieh district that they are of low salinity, as it reached, respectively, (2.56, 3.26 m. dS \(^{-1}\)) and despite the presence of variation in salinity values between the studied sites in Al Husayniyah district, in time and place, may be due to the quality of irrigation water used in the irrigation of crops, its misuse, and the difference in temperature between the two seasons, and in general, the electrical conductivity has an effect on the productivity of cultivated crops as its rise leads to a decrease in productivity, especially sensitive crops such as citrus fruits.

5. Conclusions:
1- The physical characteristics have an important role in the success of cultivating citrus in the study area, as the nature of the light texture of the soil, which ranged from sand loamy to sandy loam and sandy, helped to make it good soils and in which the movement of air and water was relatively more good, allowing the roots of plants to penetrate through In addition, the process of good ventilation provides an appropriate opportunity for the microorganisms to practice their activity, which helps the speed of decomposition of organic matter and its relatively rise in it.
2- The soil of the Husseinieh district was characterized by being of adequate humidity, in addition to the appropriate temperatures for growing sensitive crops such as citrus fruits, and most of its soil was characterized by the availability of a moderate percentage of organic matter, which increased the possibility of maintaining the percentage of humidity and temperature for the longest possible period in addition to the availability of important nutrients for the growth and flowering of citrus trees.

3- Soil interaction (PH) in the soils of the study area ranged from neutral to moderate alkaline, so its value ranged between (7.13 - 8.36) and thus it falls within the appropriate limits for growing citrus fruits.

4- The soils of the study area are characterized by being low in salinity, as their general rates of electrical conductivity values on a saturated extract from the soil reached less than (4 m. dS⁻¹), which encouraged their use to grow most crops, especially crops sensitive to salinity such as citrus.

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