TuJnaS

Original Article

Thamar University Journal of Natural & Applied Sciences ***9***(2) (2024) 6–9

DOI: https://doi.org/10.59167/tujnas.v9i2.2309

Studying the effect of soil factors on some anatomical and morphological properties of Olive *(Olea europaea L.)* leaves

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Received: 7 June 2024. Received (in revised form): 8 August 2024. Accepted: 12 August 2024. Published: 26 December 2024

Abstract

The current study aimed to evaluate the effect of soil factors on some characteristics of olive leaves. The beginning of the process was collecting plant and soil samples from some home gardens and public street gardens in the City of Kirkuk to conduct tests related to plants and soil. We performed Some tests on the soil to evaluate each type of soil and some properties of olive leaves from different sites. The present study showed differences in physical and chemical properties between the soil collected from home gardens and the soil collected from public street gardens. The electrical conductivity, total dissolved solids, sulfate, and dissolved potassium were higher in the soil collected from Public Street Gardens. In contrast, total nitrogen, phosphorus, calcium, magnesium, and organic matter values were higher in the soil collected from home gardens than in public street gardens. For leaf properties, the results show a significant ($P \leq 0.05$) decrease in average leaf area, Leaf dry matter, and Leaf ash in leaves collected from public street gardens compared to olive leaves collected from home gardens. For the structural characteristics of the leaf, the vascular cylinder, cuticle layer, mesophyll, and epidermis were smaller in the leaves of the group from Home Gardens than the leaves of the Public Street Gardens group. In contrast, the leaf edge and thickness were more significant in the leaves from home gardens than in public street gardens.

Keywords: *Olea europaea L.*; Soil Properties; Anatomical Properties; Morphological Properties.

1. Introduction

The olive (*Olea europaea L.*), a long-lived evergreen tree in the Oleaceae family, is one of the most extensively grown and significant fruit crops in terms of international trade. Native to every Mediterranean nation, olive trees are a vital component of the so-called Mediterranean diet [1-3]. Nineveh, Kirkuk, Baghdad, Erbil, and Duhok are among the cities in central and northern Iraq where olive trees are cultivated [4]. Olive fruit is significant because of its high nutritional value and caloric content. It is rich in minerals (K, Ca, Mg, and P) and vitamins (A, B, C, D, E, and K) [4-6]. Olive trees tolerate harsh environments and are often planted on steep hillsides with poor soil [7]. According to research by García-Orenes *et al.* [8-10], insufficient management practices are the primary cause of erosion in olive orchards aside from environmental variables. According to Espejo-Pérez *et al.* [7], eliminating naturally occurring vegetation between olive trees to lessen the competition between the weeds and the olive trees for light, water, and nutrients makes the soil more prone to erosion. Numerous variables contributing to soil degradation, including compaction, leaching, wind, and water erosion, threaten soil resources. One of the main factors contributing to land degradation globally is water erosion. Because the surface layer, typically the most fertile layer where organic matter and nutrients required for plant development are concentrated, is lost due to water erosion, soil quality is impacted. Degradation is induced [11-13]. When nutrients are supplied to leaves, they are often absorbed more quickly than when administered to soil. The characteristics of the soil strongly influence nutrient availability. For example, because clay soils tend to have high K-fixing capacities, most available K is quickly attached to the clay particles, meaning they often do not react well to K fertilizers added to the soil [14, 15]. Therefore, the current study aimed to evaluate the effect of soil factors on some characteristics of olive leaves.

2. Materials & Methods

2.1 Samples Collection

Collecting plant and soil samples from (ten locations) home gardens, and public street gardens in the city of Kirkuk began, and three samples were taken from each area to conduct tests related to plants and soil.

2.2 Physical and chemical factors measurement

2.2.1 Total Dissolved Solid (TDS)

It was measured in the field using a TDS meter, and the measurement was repeated twice for each sample in milligrams per liter (mg/L) or parts per million (ppm).

2.2.2 Electrical Conductivity (EC)

The electrical conductivity was measured in the field with an EC-meter in Siemens per meter (S/m) or mho and is usually represented by the Greek letter sigma, σ, after regulating the device using distilled water and adjusting the temperature to 25 °C.

2.2.3 pH

The acid function was measured using a pH meter after regulating it with buffer solutions.

2.2.4 Total nitrogen

The Kjeldahl method was used, according to the method described in [16], to estimate the percentage of total nitrogen in the samples.

2.2.5 Determination of phosphorus

This method is based on the reaction of phosphorus with vanadate and molybdate, which forms a yellow complex compound in acidic environments and is measured in the nm [17].

2.2.6 Potassium and calcium

Concentrations of potassium and calcium in soil samples were estimated using a FLAM device [18].

2.2.7 Sulphate Ion Concentration

Sulfate ions were estimated for the samples using the turbidimetric method, which included taking a known volume of the filtered sample measured in the mg/L [19].

2.2.8 Organic matter

The organic content values of soil samples were estimated according to what was stated in [20].

2.2.9 Soil texture

The soil texture measurement method is used to estimate the following proportions (clay, silt, and sand) using the pipette method measured in mm [20].

2.2.10 Leaf Properties

Average leaf area (cm^2) for the fifth leaf from the apex of twenty-one-year-old, non-fruiting shoots (selected randomly) in all directions of each tree. The leaves were obliterated and collected in polyethylene bags; then, their areas were measured using a leaf area meter (Model AM100, ADC Bioscientific Ltd.). Leaf Dry matter % (Total solids) calculated as (Determined Dm.% = 100 – moisture %). The ash % of leaves was determined by a muffle furnace at 450 °C for 4 hours, according to [21].

2.2.11 Anatomical Study

The epidermis was studied from the leaves of fresh specimens collected from the field immediately after they were fixed with a Formalin-Acetic Acid-Alcohol (F.A.A) solution, and a mixture of formalin-acetic acid-alcohol prepared by the method was measured in the µm [22].

2.2.12 Statistical Analysis

Statistical analysis of the data was conducted using the Special Program for Statistical Systems (SPSS, 2011). The statistical analysis was performed by applying the Linear Regression test, which is used to clarify the relationships between some of the studied variables (physical characteristics and chemical) and predict the value of one of the variables (The dependent variable) through the values of the other variable (the independent variable). This analysis model estimates the coefficients of the linear equation that includes one or more independent variables that best predict the value of the dependent variable. Also, the Pearson correlation coefficient was applied to some of the studied variables, a test to measure the relationship between Statistics or the correlation between two continuous variables.

3. Results & Discussion

3.1 Soil

The current study showed differences in physical and chemical properties between the soil collected from home gardens and the soil collected from public gardens. It was found that the electrical conductivity, total dissolved solids, sulfate, and dissolved potassium were higher in the soil collected from public street gardens. In contrast, total nitrogen, phosphorus, calcium, magnesium, and organic matter values were higher in the soil collected from home gardens compared to public garden soil in the streets, as shown in Tables 1 and 2.

Table 1: Some physical and chemical properties of soil collected from home gardens.

Tests \ Location	1	2	3	4	5
Electrical conductivity (EC)	0.126	0.165	0.134	0.159	0.171
pH	6.4	6.1	6.2	6.7	6.5
Total dissolved solid (TDS)	60	76	58	63	81
Total nitrogen	0.084	0.056	0.059	0.082	0.067
Phosphorus	18.818	19.8	13.014	12.18	17.31
Dissolved potassium	105.957	101.678	96.241	112.786	89.679
Sulphate	48.337	54.389	61.045	39.782	34.976
Calcium	28.399	31.525	37.818	40.977	33.656
Magnesium	9.450	8.786	10.831	12.324	14.306
organic matter	3.277	3.221	3.301	3.345	2.876
Texture	Sand loam	Sand loam	Sand loam	Sand loam	Sand loam
Clay	12	14	9	7	15
Silt	10	7	11	11	9
Sand	78	74	60	80	65

Table 2: Some physical and chemical properties of soil collected from public street gardens.

Tests \ Location	1	2	3	4	5
Electrical conductivity (EC)	0.273	0.352	0.910	0.751	0.734
pH	6.4	6.5	6.7	6.3	6.4
Total dissolved solid (TDS)	130	111	98	126	134
Total nitrogen	0.056	0.073	0.085	0.088	0.060
Phosphorus	2.963	4.5	2.1	5.3	3.7
Dissolved potassium	79.468	85.986	83.312	76.429	78.111
Sulphate	86.119	97.041	101.233	84.265	87.632
Calcium	69.680	70.871	55.936	67.453	71.519
Magnesium	21.401	23.864	15.631	19.549	24.773
organic matter	1.276	1.324	1.289	0.983	1.212
Texture	Sand loam	Sand loam	Sand loam	Sand loam	Sand loam
Clay	2	5	5	3	4
Silt	38	41	43	35	30
Sand	60	58	71	69	66

As per Abad *et al.* [23], the soil obtained from the street showed higher EC values than the soil from the dwellings, indicating a difference in EC values between the two soil types in the current investigation. The soil and the garbage were factors in the changes in the soil EC measured in this study. Garbage may be a reason for the elevated rise in the EC values of the soil. The concentrations of ions and salts in the liquid and solid phases are equal within the soil system. Therefore, the parameters controlling the sorption, solubilization, and mineralization/immobilization processes in soil significantly impact the ion concentrations determining the EC of the soil. The average pH values did not show significant changes ($p \le 0.05$) from the sample collection sites throughout the study period. This indicates that most readings were consistent due to the same environmental conditions influencing them during sample collection. During the study period, there were significant differences ($p \le 0.05$) in the average values of total dissolved solids compared to the sample collection sites. It indicates that street soil's total dissolved solids were higher than house soil's. The soil is primarily impacted by variations in the total dissolved solids values, which also influence the soil's qualities and attributes. The average values of the two sites showed a significant difference ($p \le 0.05$) between them, evident from the total nitrogen values range, which recorded a massive variance in their values during the study period. The source of the irrigation water, which is primarily influenced by weather patterns, increases in ion concentrations from soil washing, and increased ion dissolution from increased rainfall, relative humidity, and soil moisture, is most likely the cause of the variation in average values between the two sites [23]. The current study's results also demonstrated notable calcium, magnesium, potassium, and Phosphorus variations at the site level. Street soil, on the other hand, has the lowest levels of these elements when compared to house soil, which is reflected in plant growth for potential Phosphorus has indirect impacts on soil because its availability influences the development of roots and branches, which enhances vegetation cover, the amount of organic matter in plants, and the outcomes of primary and secondary metabolism [24]. The current study's findings also demonstrated notable variations in sulfate levels, with house soil having the lowest sulfate content compared to soil obtained from the streets. The present study's findings also demonstrated notable variations in the amounts of organic matter, demonstrating that the group of streets' soil has the lowest quantity of organic matter compared to the soil of residences. Because the organic matter is sufficiently rich in nitrogen, it will break down and produce nitrates and ammonium nitrogen through a process known as mineralization. However, when organic matter decomposes at low nitrogen levels, nitrogen, and ammonium are consumed or immobilized because degrading microbes take available nitrogen out of the soil system, known as immobilization [25].

3.2 Vegetative growth

Table 3 shows some of the leaf measurements that were studied, and the results show a significant ($P \le 0.05$) decrease in average leaf area in leaves collected from public street gardens (4.366 ± 0.203) compared to olive leaves collected from home gardens (4.95 ± 0.254). Leaf dry matter in leaves collected from public street gardens (39.456 ± 3.28) showed a significant ($P \le 0.05$) decrease compared to olive leaves collected from home gardens (56.942 ± 4.87). Leaf ash also showed a significant ($P \le 0.05$) decrease in average leaf area in leaves collected from public street gardens (8.12 ± 0.378) compared to olive leaves collected from home gardens (7.114 ± 0.137).

Table 3: shows some of the Vegetative growth measurements that were studied.

Parameters / Locations	Home Gardens	Public street Gardens	P value
Average leaf area (cm^2) at harvest	4.95 ± 0.254	4.366 ± 0.203*	0.02
Leaf dry matter %	56.942 ± 4.87	39.456 ± 3.28*	0.0001
Leaf ash %	8.12 ± 0.378	7.114 ± 0.137*	0.0001

Table 4 also shows some structural characteristics of the leaf, as the vascular cylinder, cuticle layer, mesophyll, and epidermis were smaller in the leaves of the group from Home Gardens than the leaves of the Public Street Gardens group. In contrast, the leaf edge and thickness were more significant in the leaves of the group from home gardens than the leaves of public street gardens. Figure 1 shows the structure and layers of the leaf under an optical microscope.

Table 4: shows some of the leaf structures that were studied.

Structures (μm) / Locations	Home gardens	Public street gardens
Vascular cylinder	330	400
Leaf thickness	500	450
Cuticle	50	100
Epidermis	10	30
Mesophyll	200	220

The current study's findings demonstrated that house soil had a more significant effect on some olive leaf characteristics than olive leaves in public street gardens, as evidenced by the superior average leaf area, dry matter, ash, edge, and thickness of olive leaves grown in home gardens. The primary cause could be the high concentration of some aspects in residential soil, such as nitrogen (N), which is an essential ingredient for crop growth and development and will inhibit plant growth if not absorbed in suitable amounts [26]. The complicated growth process is impacted by the uptake of nutrients and the availability of moisture; nitrate is crucial for absorbing and transferring to developing organs [27]. Because it provides the necessary water, the presence of this element constantly promotes growth and performance. Additionally, the terminal meristem of the stem and the lateral buds of older leaves produce more leaves when soil N is present and abundant. In the end, it raises the aerial parts' yield [28]. Conversely, sufficient phosphorus feeding improves flowering, fruiting (including seed formation), maturity, and photosynthesis. In meristematic tissues, phosphorus is essential for cell division and growth. Phosphorus promotes the development of roots, especially lateral roots and fibrous rootlets. Sufficient phosphorus supplies are necessary for adequate biological nitrogen-fixing [29].

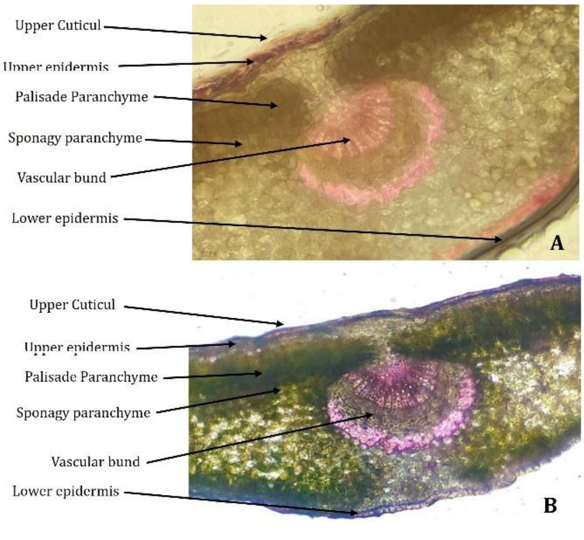

Figure 1: Cross section of olive leaves, A: Home gardens, and B: Public Street gardens.

4. Conclusions

The current study found that soil with better chemical and physical properties positively affected olive leaf growth. Among the most important elements were total nitrogen, phosphorus, and even soil organic matter, which directly affected olive leaf characteristics.

Data Availability

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare no conflict of interest.

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