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The effect of foliar spraying with humic acid and anti-transpiration Nautilus on the vegetative growth characteristics of local lemon trees

Shahlaa Ali Madloom , Falah Hassan Al-Mayahi

University of Dhi Qar / College of Agriculture and Marshlands / Department of Horticulture and Landscape Architecture

E-mail:: shahlaa@utq.edu.iq

E-mail:::Falah-ha@utq.edu.iq

Abstract

This study was conducted in one of the private orchards affiliated to Al-Nasr District in Dhi Qar Governorate for the year 2024-2025. To study the effect of foliar fertilization with humic acid at three levels (0, 1.5, 3) g. L^{-1} and spraying with anti-transpiration (Nautilus) at three levels (0, 1, 2) ml. L^{-1} on the vegetative growth characteristics of local lemon trees. The results obtained can be summarized as spraying with humic acid at the level of (3 g. L^{-1}) had a significant effect on the vegetative characteristics of the plant (leaf area, stem diameter, number of leaves, number of branches, plant length) compared to the comparison coefficient. Likewise, spraying with Nautilus at the level of (2 ml. L^{-1}) had a clear significant effect on the vegetative characteristics studied for local lemon trees compared to the comparison coefficient. The two-way interaction between the study treatments had a clear significant effect on the H2I2 treatment (3 g/L^{-1} x 2 ml/L^{-1}) in most of the studied traits.

Keywords: Humic acid, anti-transpiration, local lemon

I. introduction

The oldest known tree is the lemon tree, which was used by the ancients in medicine, especially to combat poisons. It was called Benzahir, a Persian word meaning antidote to poison (Bilal 2015). This tree is characterized by its large size with long branches that grow horizontally. Its new growth and flowers are sometimes pink or purple in color. The leaves are medium in size, light green in color, and have no auricles. They usually do not contain thorns at their base, although they are small if present. The edge is serrated, and its fruits are oval in shape (Al-Khafaji et al., 1990; Ibrahim and Khalif, 1995). Its fruits are also rich in nutrients necessary for the human body, especially vitamin C (Al-Alaf, 2020). Humic acid is one of the forms of organic matter resulting from the decomposition of organic materials. It appears in the form of a dark brown solution. This solution consists mainly of the elements C, O, N, and H. In addition to these basic elements, it contains other elements in varying proportions, such as iron, phosphorus, sulfur, and aluminum (Al-Balkhi et al., 2010). Humic acid is a natural biological organic substance that constitutes about 80% of humic matter (Al-Ani, 2018). Anti-transpiration is a waxy substance that is fully utilized to utilize water inside the plant. It also works to reflect the sun's rays onto the insulating rays of the plant, which works to reduce the effects of high rays. It also works to partially close the stomata through a waxy layer on the entire surface, thus reducing the effect of water through transpiration (Song et al. 2011). This thesis was conducted to demonstrate the effect of adding organic fertilizer humic acid and anti-transpiration Nautilus on some vegetative growth characteristics of local lemon trees.

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II. Materials and working methods

Study site

This study was conducted in a private orchard in Al-Nasr district, Dhi Qar Governorate, for the academic year 2024-2025 on local lemon trees, with a distance of 3 m between each tree. Service operations, including tree pruning, removing broken, crowded and dead branches, weeding, weeding, irrigation and pest control, were carried out throughout the study period.

Soil samples were taken for the purpose of analyzing some characteristics as shown in Table No. (1).

Value	Unit of measurement	Adjective	T
7.8	-	pH	1
2.5	ds| m	EC	2
45.80	%	Sand	3
21.32	%	Clay	4
32.90	%	Silt	5

The experiment was carried out according to the Randomized Complete Blocks (R.C.B.D) as a factorial experiment with two factors, the first of which is humic acid at three levels (0, 1.5, 3) $g.L^{-1.}$ The second is the anti-transpiration (Nautilus) at three levels (0, 1, 2) ml. L^{-1}, with three replicates and one tree per experimental unit, thus the number of trees in the experiment became 27 trees. The trees were sprayed in two stages, three sprays before flowering and three sprays after fruit set, with 10 days between each spray until complete wetting. The Zahi substance was used as a spreading material, for the purpose of reducing the surface tension of water molecules. At the end of the experiment Measurements were taken for the studied traits. The results were analyzed using the Genstat program and the means were compared according to the least significant difference (LSD) test at a probability level of 0.05 (Al-Mohammadi and Al-Mohammadi, 2012).

2- Characteristics studied:

1- **Leaf area**: Three fully developed leaves were taken from each tree and measured using the method used by (Al-Zaidi, 2016) and described by (Sadik et al., 2011), using a scanner and Image software installed on a computer. The total leaf area was then calculated by multiplying the average leaf area by the average number of leaves per plant.

2- Stem diameter (mm): Stem diameter was measured using a vernier caliper 4 cm above soil level.

3- Number of branches

4- Number of leaves

5- Plant height Measured using a measuring tape.

III. Results and Discussion

It is noted from the results of Tables (6, 5, 4, 3, 2) that spraying with humic acid has a significant effect on (leaf area, stem diameter, number of branches, number of leaves, and plant length), as the H2 treatment was superior at a level of (3 g. L^{-1}) with an average of (104.49 cm^2, 102.74 mm, 73.44 branches per $tree^{-1}$, 1250.3 leaves. $Plant^{-1}$, 3.7011 cm) respectively.

This is due to the role of humic acid in activating the physiological functions of the plant, as it works to increase the biomass of the plant by stimulating cell division, elongation and increasing its size (Wample et al., 1991). These results agree with Mahaoush (2023) in his study to determine the effect of humus fertilizer on the vegetative characteristics of orange seedlings. I also agreed with Zainal and Hussein (2017) and Rahim and Abbas (2015) in their study of the effect of humic acid on citrus fruits. As for spraying with NAUTILUS anti-transpiration, it had a significant effect on (leaf area, stem diameter, and number of branches), as the I2 treatment was superior at a level of (2 ml. L^{-1}) with an average of (63.03 cm^2, 76.89 mm, 57.00 branches per $tree^{-1}$) respectively. As for the plant height and number of leaves, the 1I treatment was at a level of (1 ml. L^{-1}) with a percentage of (1086.8 leaves. $plant^{-1}$, 3.4878 cm). Which may be attributed to its effect in reducing water stress and achieving a better water level inside the plant, as it forms a thin wax layer on the surface of the leaves that works to partially close the stomata, which reduces the water lost by transpiration, and thus maintains the fullness of the cells Song et al. (2011). The dual interaction between (humic acid and anti-transpiration

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Nautilus) also led to positive results, as the H2 I2 treatment (3 g L^{-1} x 2 ml L^{-1}) outperformed the rest of the treatments and recorded the highest average in (leaf area, stem diameter, number of branches, and plant length). As for the number of leaves, the H2 I1 treatment (3 g L^{-1} x 1 ml L^{-1}) outperformed.

Table (2) The effect of spraying with Humic Acid and Nautilus and the interaction on the leaf area ($cm^2.plant^{-1}$) of local lemon trees.

Average humic acid coefficients	Nautilus B spray parameters (ml/L^{-1})			Humic acid spraying treatments ($g.L^{-1}$)
	2	1	0	
30.76	31.40	33.40	27.49	0
44.43	46.73	44.70	41.85	1.5
104.49	110.97	107.33	95.16	3
	63.03	61.81	54.83	Average Nautilus coefficients
LSD 0.05				
H×I=1.099	I= 0.634			H= 0.634

Table (3) The effect of spraying with Humic Acid and Nautilus and the interaction between them on the stem diameter (mm) of local lemon trees.

Average humic acid coefficients	Nautilus B spray parameters (ml/L^{-1})			Humic acid spraying treatments ($g.L^{-1}$)
	2	1	0	
46.09	49.40	47.47	41.40	0
61.41	67.53	60.40	56.30	1.5
102.74	113.73	107.70	86.77	3
	76.89	71.86	61.49	Average Nautilus coefficients
LSD 0.05				
H×I=2.485	I= 1.435			H= 1.435

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Table (4) The effect of spraying with Humic Acid and Nautilus and the interaction between them on the average number of branches of local lemon trees.

Average humic acid coefficients	Nautilus B spray parameters (ml/L^{-1})			Humic acid spraying treatments (g.L^{-1})
	2	1	0	
31.33	34.00	36.00	24.00	0
56.89	59.00	58.00	53.00	1.5
73.44	77.67	76.67	66.00	3
	57.00	56.89	47.78	Average Nautilus coefficients
LSD 0.05				
H×I=3.120	I= 1.802			H= 1.802

Table (5) The effect of spraying with Humic Acid and Nautilus and the interaction between them on the number of leaves (leaf per plant-1) of local lemon trees.

Average humic acid coefficients	Nautilus B spray parameters (ml/L^{-1})			Humic acid spraying treatments (g.L^{-1})
	2	1	0	
804.4	821.3	810.7	781.3	0
1111.2	1161.3	1128.3	1044.0	1.5
1250.3	1214.0	1321.3	1214.7	3
	1065.6	1086.8	1013.7	Average Nautilus coefficients
LSD 0.05				
H×I=10.01	I= 5.78			H= 5.78

Table (6) The effect of spraying with Humic Acid and Nautilus and the interaction between them on plant height (cm) for local lemon trees.

Average humic acid coefficients	Nautilus B spray parameters (ml/L^{-1})			Humic acid spraying treatments (g.L^{-1})
	2	1	0	
2.5844	2.4500	2.9467	2.3567	0
3.3444	3.2700	3.8833	2.8800	1.5
3.7011	3.9800	3.6333	3.4900	3
	3.2333	3.4878	2.9089	Average Nautilus coefficients
LSD 0.05				
H×I=0.04992	I= 0.02882			H= 0.02882

We conclude from the study that adding foliar spraying with humic at a level of (3 g. L^{-1}) and spraying with anti-transpiration in the form of single or combined treatments between the two factors led to clear significant differences and improvement in the vegetative growth characteristics of lemon trees.

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