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Effect Of Two Citrus Rootstocks And Foliar Spraying With Certain Treatments On Some Chemical Traits Of Dancan Grapefruit Scions

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Abstract:
The experiment was conducted in one of the nurseries in Babil Governorate during the period from 10/10/2024 to 1/6/2025 to study the effect of two citrus rootstocks and foliar spraying with certain treatments on some chemical traits of Dancan grapefruit scions. Grafted seedlings were obtained from the horticultural station in Al-Hindiya District. The experiment included two factors with three replications: the first factor was two rootstock types, coded as A (A1: Volkameriana, A2: Rangpur), and the second factor, coded as T, included the following treatments: control (T0), nano-fertilizer NPK (T1) at 1 g·L⁻¹, tryptophan acid (T2) at 200 mg·L⁻¹, humic acid (T3) at 2 mL·L⁻¹, and vitamin C (T4) at 250 mg·L⁻¹.
The results indicated that foliar spraying significantly affected some studied traits. Foliar application of vitamin C recorded the highest leaf iron content (97.33%), while spraying with nano-fertilizer NPK resulted in the highest chlorophyll content in leaves (66.9 SPAD units).
The interaction between rootstocks and treatments significantly affected most studied traits. The combination A2 T4 achieved the highest leaf iron content (106.64%), the highest leaf carbohydrate content (22.02%), and the highest leaf nitrogen content (1.913%). In contrast, A1 T3 recorded the highest leaf potassium content (1.547%), while A2 T1 achieved the highest leaf chlorophyll content (73.5 SPAD) and the highest leaf phosphorus content (0.216%).
Keywords: *Citrus, Volkameriana, Rangpur*

INTRODUCTION:

Citrus trees are evergreen fruit trees characterized by their aromatic scent due to the presence of oil glands in most plant tissues. Their fruits are a type of berry known as Hesperidium (Ibrahim & Khalif, 1995). Citrus grows in tropical and subtropical regions, with Southeast Asia being its native origin. In Iraq, most citrus species are cultivated in the central and southern regions. Citrus trees hold an important position among fruit trees due to their nutritional, economic, medicinal, aesthetic, and environmental values. They are rich in vitamin C, ranging between 44–55 mg per 100 cm³ of juice, as well as essential mineral elements such as potassium, calcium, iron, magnesium, sodium, sulfur, and phosphorus (Dwai & Fadila, 2010; Ibrahim, 2015).

Grapefruit (Citrus paradisi) was first introduced in western India. It resembles Shaddock (pomelo) but differs in several aspects: it is generally larger, more widely spread, has a rounded apex, dense vegetative growth, few thorns, relatively small fruit size, large pointed leaves, smaller leaflets compared to pomelo, and smaller flowers and fruits compressed laterally (Chandler, 2010).

Foliar fertilization is a complementary process to soil fertilization with major nutrients but not a replacement. It provides approximately 60% of the plant's macronutrient needs and 100% of micronutrients. Foliar application of micronutrients is a reliable and effective method, as low concentrations prevent negative effects such as leaf burn, curling, or tissue damage and overcome challenges in calcareous soils caused by adsorption, precipitation, oxidation, or formation of unavailable complexes for root uptake (Ali et al., 2014).

Nanotechnology is a modern scientific field that studies materials with sizes ranging from–100 nm, called nanomaterials, which possess unique chemical and physical properties compared to materials larger than 100 nm (Pour et al., 2019).
Nanotechnology has high potential for sustainable agriculture, particularly in developing countries. Nano-fertilizers improve crop quality and growth while increasing nutrient use efficiency, reducing fertilizer waste, and lowering agricultural costs.
Nano-fertilizers enhance metabolic activity in plants, leading to higher dry matter production and increased specific density (Qureshi et al., 2018).
In a previous experiment, foliar spraying of fig seedlings with nano NPK significantly affected .18 leaf contents of carbohydrates, chlorophyll, phosphorus, nitrogen, and potassium.
Tryptophan is an α-amino acid synthesized in plants via the phosphorylated pentose pathway or through hexose phosphorylation. It serves as the basic unit for auxin biosynthesis in plants and incorporates zinc in its structure. Tryptophan contains an amino group ($–NH_2$), a carboxylic acid group (–COOH), and a non-polar cyclic side chain, making it a non-polar cyclic amino acid. This amino acid is also essential for human nutrition (Nemoto & Mano, 2012).
Humic acid is a compound derived from humic substances produced during organic matter decomposition. It plays an active role in plant growth by affecting respiration and carbon metabolism. Humic acid consists of carbon, hydrogen, oxygen, and nitrogen in varying proportions, resulting in compounds with different molecular weights. When added to soil, it directly enhances plant nutrition by stimulating photosynthesis and respiration through activation or inhibition of certain enzymes. Additionally, it improves plant resistance to adverse environmental conditions during the growing season, increases cell membrane permeability, and stimulates various biochemical reactions in plants (Moghadam, 2014).
El-Salhy et al. (2017) reported that humic acid application on mandarin trees significantly increased leaf contents of chlorophyll, nitrogen, phosphorus, and potassium.
Vitamins are primary metabolites that plants usually synthesize in small amounts. They comprise a variety of organic molecules, mostly lacking amino groups. Water-soluble vitamins or their derivatives act as coenzymes, accelerating numerous biochemical reactions within plants. Ascorbic acid (vitamin C) is a major antioxidant in the ascorbate–glutathione pathway, protecting metalloenzymes from oxidation and damage (Ishikawa et al., 2006).

Chemical traits studied include:

1-Leaf chlorophyll content

Chlorophyll content was measured using a German SPAD meter. Five leaves were randomly selected from the top, middle, and bottom of each plant, with three seedlings per experimental unit, and the average value was calculated.

2-Leaf nitrogen, phosphorus, and potassium content

Sample digestion:
Leaves from each experimental unit were collected, washed, and oven-dried at 70°C until constant weight. They were then ground using an electric grinder. A 200 mg sample was digested in Pyrex flasks with 3 mL concentrated sulfuric acid for 24 hours according to the method of Cresser and Parsons (1979). Subsequently, 1 mL concentrated sulfuric acid and 1 mL perchloric acid were added, and the digestion flasks were heated until a clear solution was obtained. The solution was cooled, diluted to 50 mL, filtered, and nutrient contents were determined using standard analytical methods.
Nitrogen (N) was estimated using the Micro-Kjeldahl method (Al-Sahaf, 1989).
Phosphorus (P) was estimated using ammonium molybdate and ascorbic acid, measured with a spectrophotometer at 840 nm (Al-Sahaf, 1989).
Potassium (K) was determined using the method described by Hesse (1971) with a flame photometer.

3-Leaf iron content

Iron was measured according to Chapman & Pratt (1961) and Yash Kalar (1997) using an Atomic Absorption Spectrophotometer.

4-Total carbohydrates

Carbohydrates were estimated using Joslyn's method (1970). A 200 mg sample of dried and ground leaves was placed in test tubes, and 8 mL of 80% ethyl alcohol was added. Tubes were incubated in a water bath at 60°C for 30 minutes with continuous stirring.

RESULTS AND DISCUSSION

-1Leaf chlorophyll content (SPAD):

Table (1) showed that the two rootstocks, Volkameriana and Rangpur, did not exhibit any significant effect on this trait.

However, foliar application had a significant effect on leaf chlorophyll content, where the nano-fertilizer treatment recorded the highest average value of 66.9 SPAD, while the tryptophan treatment gave the lowest average value of 52.5 SPAD.

The interaction between the two studied factors was also significant, where treatment A2 T1 showed superiority.

A Average	Transactions T					The Origins N
	Vitamin C T4	Humic acid T3	Tryptophan T2	NPK nano T1	Compariso T0	
54.5	50.1	52.7	49.9	60.3	59.5	Volcamariana A1
59.3	58.8	58.5	55.1	73.5	50.5	Rangpur A2
	54.4	55.6	52.5	66.9	55.0	T Average
Interaction 14.73				T 10.41	A N.S	L.S.D 0.05

Table 1: Effect of two citrus rootstocks and foliar application of different treatments and their interactions on leaf chlorophyll content of Dancan grapefruit seedlings (SPAD).

2-Leaf Nitrogen Percentage (%):

Table 2 shows that the two rootstocks, Volkamaryana and Rangpur, did not have a significant effect on the leaf nitrogen percentage. Likewise, foliar treatments with water, nano NPK fertilizer, tryptophan, humic acid, and vitamin C did not result in significant differences for this trait.

However, the interaction between the studied factors was significant, where treatment A2 T4 recorded the highest average value of 1.913%, while A2 T2 had the lowest average of 1.120%.

Table 2: Effect of two citrus rootstocks and foliar application of different treatments and their interactions on leaf nitrogen percentage of Dancan grapefruit seedlings (%).

A Average	Transactions T					The Origins N
	Vitamin C T4	Humic acid T3	Tryptophan T2	NPK nano T1	Compariso T0	
1.498	1.283	1.587	1.493	1.610	1.517	Volcamariana A1
1.540	1.913	1.540	1.120	1.540	1.587	Rangpur A2
	1.598	1.563	1.307	1.575	1.552	T Average

Interaction 0.5398	T N.S	A N.S	L.S.D 0.05

	Vitamin C T4	Humic acid T3	Tryptophan T2	NPK nano T1	Compariso T0	
85.25	90.02	86.23	82.80	83.87	83.43	Volcamariana A1
82.49	106.64	83.91	74.71	80.90	78.34	Rangpur A2
	97.33	85.07	78.75	82.35	80.88	T Average
			Interaction 23.48	T 13.33	A N.S	L.S.D 0.05

3-Leaf Phosphorus Percentage (%):

Table 3 shows that the two rootstocks, Volkamaryana and Rangpur, did not have a significant effect on the leaf phosphorus percentage. Similarly, foliar treatments with water, nano NPK fertilizer, tryptophan, humic acid, and vitamin C did not result in significant differences for this trait.

However, the interaction between the studied factors was significant. Treatment A2 T1 recorded the highest average value of 0.216%, while A2 T4 had the lowest average of 0.108%.

Table 3: Effect of two citrus rootstocks and foliar application of different treatments and their interactions on leaf phosphorus percentage of Dancan grapefruit seedlings (%).

A Average	Transactions T					The Origins N
	Vitamin C T4	Humic acid T3	Tryptophan T2	NPK nano T1	Compariso T0	
0.180	0.172	0.184	0.188	0.195	0.158	Volcamariana A1
0.165	0.108	0.158	0.164	0.216	0.181	Rangpur A2
	0.140	0.171	0.176	0.206	0.169	T Average
			Interaction 0.1031	T N.S	A N.S	L.S.D 0.05

4-Leaf Potassium Percentage (%):

Table 4 shows that the two rootstocks, Volkamaryana and Rangpur, did not have a significant effect on the leaf potassium percentage. Similarly, foliar treatments with water, nano NPK fertilizer, tryptophan, humic acid, and vitamin C did not result in significant differences for this trait.

However, the interaction between the studied factors was significant. Treatment A1 T3 recorded the highest average value of 1.547%, while A1 T1 had the lowest average of 1.037%.

6-Total Leaf Carbohydrate Percentage (%):
Table 6 shows that the two rootstocks, Volkamaryana and Rangpur, did not have a significant effect on the leaf carbohydrate percentage.
Similarly, the foliar treatments with water, nano NPK fertilizer, tryptophan, humic acid, and vitamin C did not result in significant differences in this trait.
Likewise, the interaction between the study factors was significant. Treatment A2 T4 recorded the highest average of 22.02%, whereas A1 T1 recorded the lowest average of 13.95%.

Table 6: Effect of two citrus rootstocks and foliar application of different treatments and their interactions on total leaf carbohydrate percentage of Dancan grapefruit seedlings (%).

A Average	Transactions T					The Origins N
	Vitamin C T4	Humic acid T3	Tryptophan T2	NPK nano T1	Compariso T0	
17.05	17.40	19.64	18.06	13.95	16.19	Volcamariana A1
18.20	22.02	14.97	18.01	19.14	16.88	Rangpur A2
	19.71	17.31	18.03	16.54	16.53	T Average
Interaction 4.826				T N.S	A N.S	L.S.D 0.05

The increase in the leaf potassium percentage is attributed to foliar application of materials containing macro- and micronutrients, which enhances their content within plant tissues. This explains the observed increase in leaf nutrient content (Han et al., 2008). This aligns with Pilbeam and Barker (2007), who noted that the elements N, P, and K enhance the rate of vital metabolic processes in which these elements participate, forming the basic compounds required for carbon metabolism and respiration, thereby increasing their availability within the leaf.
The increase in leaf chlorophyll content (Table 1) is due to the role of nitrogen in chlorophyll biosynthesis. Nitrogen is incorporated into the porphyrin rings, which form the basis of chlorophyll, with about 70% of leaf nitrogen being involved in the formation of this pigment. Additionally, nitrogen is essential in the formation of cytochromes, which are necessary for photosynthesis, resulting in leaves with higher chlorophyll content and larger size (Hagagg et al., 2018; Zagzog et al., 2017; Kole et al., 2016). Moreover, the increase in chlorophyll may also be attributed to the effect of nano-nitrogen in enhancing biochemical activities and enzyme activity, stimulating chlorophyll formation and improving photosynthetic efficiency (Al-Sahaf, 1989; Havlin et al., 2005; Taiz & Zeiger, 2006). These results are consistent with Merza Al-Jilihawi (2020) and Saied (2018).
The previous results also showed a significant increase in leaf phosphorus content. This increase is due to the enhanced growth and development of seedlings following foliar application of nano-fertilizers. These fertilizers provide a larger surface area for various metabolic reactions in the plant, and their easy penetration into cell walls facilitates access to the vascular bundles (Ma et al., 2010).
Results also indicated that foliar application of ascorbic acid (vitamin C) significantly improved most traits, including leaf carbohydrate, nitrogen, and iron content. This increase is attributed to the role of ascorbic acid in stimulating cell division and the biosynthesis of organic nutrients within the plant, in addition to enhancing the plant's ability to resist various stresses.

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