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EFFECT OF SPRAYING ORGANIC FERTILIZER, NANO PROCESSOR WITH BORON IN THE GROWTH AND PRODUCTIVITY OF *CITRUS LIMON* L. TREES

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Abstract

The experiment was carried out in the main garden of the Horticulture Division, Al-Hindiya Station for the production of certified citrus seedlings, Karbala Governorate, Iraqi Ministry of Agriculture, during the 2018 season. The experiment included 9 treatments and three iterations to study the interaction between two factors, the Optimus plus nutrient solution in three concentrations (0, 1, 2 ml. Liters-1) which contains (5% nitrogen, 30% amino acid and 3% organic nitrogen) and the second factor Boron in the form of boric acid and with three concentrations (0, 100, 200 mg.L^{-1}), the local lemon trees inlaid with bitter orange were sprayed at a rate of three sprinkles (before the fruit contract, after the decade, a month after the last spray). The results showed that spraying with nanomagnetic fertilizer at a concentration of 2 ml.L^{-1} and boron at a concentration of 200 mg.L^{-1} resulted in the highest increase in all studied traits including the leaf area, the leaf content of total chlorophyll, the leaf content of carbohydrates, the number of fruits, Fruit weight and total yield, with significant differences compared to the treatment of spraying with distilled water

Keywords: Optimus plus, boron, growth and productivity, *Citrus limon* L

Introduction

Lemon (*Citrus limon* L.) belongs to the genus Citrus in the Rutaceae family. The northeastern regions of India and southwestern China are the original habitats of this species (Daway and Zakaria, 2009). *Citrus limon* is one of the types of citrus cultivated in Iraq widely since a long time ago due to the availability of appropriate conditions for its cultivation. And because of its fruits that it desires from consumers. Lemon fruits are rich in minerals needed for the human body such as potassium, calcium, iron, magnesium, sodium, sulfur, phosphorus, and it is an important source of vitamin C and a good amount of vitamin A, B1, B2, B12 and niacin (Laura *et al.*, 2009).

One of the varieties of sour lemon is the local variety and it is a very desirable variety in Iraq because of its excellent quality, small size, juicy and with a thin peel and contains less acidity than the rest of the international varieties (Daway and Zakaria, 2009).

The nanomaterials possess all the necessary properties for use in agriculture as they are highly efficient with high solubility and effectiveness and are used in small quantities and lead to good results without the need for repeated application and thus increase the efficiency of the use of fertilizers (Singh *et al.*, 2017).

Amino acids are the basic unit for building all proteins. They are also raw materials for generating some hormones, purines, vitamins, plant tissue formation and building chlorophyll.

Amino acids are vital stimulants that absorb and transfer quickly within plants and have a direct effect on enzymatic activity as they accelerate the absorption and transmission of nutrients inside the plant and help in the process of opening and closing stomata and providing the energy needed to manufacture protein within the plant (Abdel Hafez and Abu Al-Yazid 2006; Abo Sedera *et al.*, 2010; El-Desouky *et al.*, 2011).

Ahmed *et al.* (2012) mentioned in their study the effect of spraying amino acid tryptophan on Valencia orange trees (14 years old) with a concentration of 25, 50 and 100 ppm that led to a significant increase in the studied vegetative growth characteristics (branch length, branch diameter, number of leaves, leaf area, quotient Tree, number of fruits in the tree, weight of fruits, size of fruits) compared to the comparison treatment.

It was found (Ahmed *et al.*, 2017) that spraying tryptophan amino acid on orange trees (*Citrus sinensis* L. Osbek) (age 40 years) at a concentration of 25,50 ppm was found to improve vegetative properties (leaf area, number of leaves, branch diameter, length of branches and yield indicators including the fruit weight average and the fruit size average. It was also noted (Amin, 2019) that spraying with nanotechnology treated in the growth of seedlings of benzheir (*Citrus aurantifolia* L.) at a concentration of 1.5 ml. Liters-1 resulted in a significant improvement in all vegetative traits.

Spraying with boron as (boric acid 17% H_3BO_3 boron, or borax 10% $Na_2B_4O_7$ boron) was used as a fertilizer treatment on the vegetative system (Habasy *et al.*, 2016). Although boron does not enter in the synthesis of enzymes, it does affect biological processes, and it activates some enzymes, such as peroxidase catalase, Saccharides, and Amylase, as well as its role in the protein formation process. Boron deficiency leads to the accumulation of nitrates in the plant and a decrease in the formation of proteins (Naseem, *et al.*, 2019). It was also reported (Al-Abbasi *et al.*, 2008) that spraying boron with a concentration of (10, 20, 30 mg.L^{-1}) on *Citrus aurantium* seedlings (*Citrus aurantium* L.) resulted in a significant increase in all characteristics of vegetative growth. Daway and Zakaria, (2009) noted that the treatment of local orange trees (at the age of 10 years) with boron at

(75 mg. Liters-1) resulted in a significant increase in the leafy area, the percentage of the remaining fruits on the tree and the total yield, but did not affect the leaf content of chlorophyll (Al-Hamdani *et al.*, 2014). Spraying a lion burk (300 ppm) to Valencia trees, Valencia (7 years old), resulted in a significant increase in the number of fruits in the tree, tree yield, average weight of the fruit, and the percentage of juice in the fruit (Baghdady *et al.*, 2014). Therefore, this research aims to evaluate and influence different levels of nanostructured organic fertilization with different combinations with different levels of boron in the vegetative traits and nutritional contents of local lemon acid trees and their reflections on tree productivity and the natural and qualitative characteristics of the fruits produced.

Materials and Methods

This experiment was conducted in the main citrus orchard of the horticulture section in Al-Hindiya nursery for certified citrus production, Province of Karbala on 10 -12 years old local sour lemon. Before starting the experiment, random samples were taken from the field soil from different regions at a depth of 0-60 cm, then mixed homogeneously and a representative sample was taken to estimate some chemical and physical properties in the laboratory of the Department of Soil Science and Water Resources, Faculty of Agriculture, University of Kufa (Table 1). According to the station cultivation program crop program, all the crop services were performed including irrigation and insects control using insect traps and insecticides as needed. The trees were fertilized with animal manure compost at 4 kg/tree in mid of December and tree pruning was also performed by removing dead and crowded branches.

The experiment designed two operands according to Randomized Complete Block Design (R.C.B.D) with three replicates and 9 treatments. The treatments included spraying with Optimus plus (5% nitrogen, 30% amino acids and 3% organic nitrogen) with three concentrations (0, 1 and 2 ml.L^{-1}) and spraying with boron in the form of boric acid at three concentrations (0, 100, 200 mg.L^{-1}). In the early morning and until the complete wetness, the trees were sprayed three times (after flowering, after fruit formation and 30 day after the last spray) during the experiment using backpack sprayer.

Table 1 : Physical and chemical characteristics of the orchard experiment soil

pH	E.C. ds.m^{-1}	Organic matter %	N mg.kg^{-1}	P mg.kg^{-1}	K mm ch.L^{-1}	Clay	Silt	Sand	Soil texture
						g.Kg^{-1}			
7.20	1.8	1.31	130	10.9	206	82	113	805	Sandy loam

Five months after the last spray, data were recorded including leaf area (cm^2.$laef^{-1}$), leaf content of total chlorophyll mg.100g^{-1}FW (Goodwin, 1976) and carbohydrates mg.100g^{-1}DW (Joslyn, 1970), number of fruits (fruit.$tree^{-1}$), fruit weight (g.$fruit^{-1}$), total yield (Kg.$tree^{-1}$), fruit size cm^3 and fruit length cm. All the collected data were analyzed and analysis of variance ANOVA was performed using GenStat 2012 computing program. Means were compared by the least significant difference L.S.D. ($P \leq 0.05$).

Results and Discussion

Regarding the effect of different treatment on vegetative growth parameters of lemon trees, results (Table2) showed that spraying with Optimus plus at concentration of 2ml.L^{-1} led to the highest values of the tested growth and yield indicators compared to the 1ml.L^{-1} of the same fertilizer and the control. The results also show that the boron concentrations did not differ significantly ($P \leq 0.05$) in their effect on growth and obtained yield when excluding the effect of the organic fertilizers Optimus plus. In general, the values of growth and yield indicators under study were higher in the case of higher boron concentrations (2mg.L^{-1}) especially where interacted with the highest concentration of the organic Nano-fertilizer. The treatment of the interaction of boron at 2mg.L^{-1} and the Optimus plus 2ml.L^{-1} resulted in significant higher values in the fruit weight and the total yield compared to all other treatments and interactions (Table2).

Table 2 : Effect of spraying with Nano-organic fertilizer Optimus plus and boric acid on growth and yield characteristic of sour lemon trees.

Optimus plus ml.L^{-1} (Org.) X Boron mg.L^{-1} (B)		Leaf area cm^2. $Leaf^{-1}$	Total chlorophyll mg.100g^1 FW	Total carbohydrates mg.100g^1 DW	No. of fruits (fruit.tree-1)	Fruit weight g.$fruit^{-1}$	Total yield Kg.$tree^{-1}$
Org. 0	B0	24.39	48.81	3.95	120.1	76.74	9.221
	B100	25.77	50.89	3.98	124.6	77.96	9.720
	B200	25.59	48.56	4.19	138.7	79.27	10.999
Org. 1	B0	25.40	53.69	3.91	131.6	78.84	10.376
	B100	27.97	48.81	4.08	139.1	79.03	10.995
	B200	26.78	50.02	4.67	136.9	81.08	11.105
Org. 2	B0	25.81	52.17	4.20	136.3	78.23	10.669
	B100	26.70	51.23	5.30	145.5	79.69	11.600
	B200	28.23	54.11	5.47	142.8	86.34	12.331
L.S.D.($P \leq 0.05$)		1.73	0.71	0.25	3.98	1.79	1.157

The improvement of the vegetative growth characteristics of trees sprinkled with Optimus plus in both concentrations 1 and 2 ml. L^{-1} is often due to the direct or indirect effect of amino acids on the physiological processes of the trees. It is due to the role of amino acids in stimulating the vital activities that occur within plant tissues and their effects in building and stimulating enzymatic systems, enzymatic accompaniments, different bases of the Purine and Pyrimidine, and increasing the formation of nucleic acids DNA and RNA (Khalil *et al.*, 2008).

This leads to increased tree growth due to increased protein building and carbohydrate formation by stimulating photosynthesis through its contribution to increased chlorophyll building. As the amino acids Glycine and Glutamine are essential components in building chlorophyll, so their availability increases the efficiency of photosynthesis, which reflects positively in the leaf area and the leaf content of chlorophyll and increase the carbohydrate content (Amin, 2019; Ahmed *et al.*, 2012).

The Optimus plus nanoparticle contains nitrogen, which has an important role in increasing vegetative growth and is one of the components of the chlorophyll molecule, which results in increased photosynthesis. Nitrogen is involved in the synthesis of Porphyrins groups involved in the synthesis of chlorophyll, which leads to an increase in the leaf content of chlorophyll. It also participates in the formation of the amino acid Tryptophan, the first initiator in the formation of IAA that stimulates cell elongation (Ahmed *et al.*, 2017) and this reflects positively on vegetative growth indicators.

This is also the case with boron because of its importance in the movement and transmission of sugars or synthetic materials from photosynthesis to active growth regions during the cellular membrane to plant parts. Because borate is associated with the root of hydroxyl in sugars, alcohol and organic acids to form boric acid esters and the transfer of united sugars with boron is easier and faster, boron enters the metabolism of carbohydrates and indole of acetic acid and phenols and the building of DNA RNA (Naseem *et al.*, 2019)

The reason for the increase in growth indicators when treated with boron may be due to the latter's role in increasing the activity and effectiveness of growth hormones, especially cytokinin, in maintaining the chlorophyll tincture and thus increasing the growth rate of trees treated with boron (Al-Hamdani *et al.*, 2014; Al-Abbasi *et al.*, 2008).

The increase in the yield of trees treated with Optimus plus is due to the amino acids and their positive role in increasing the growth of trees and improving the nutritional status as well as increasing the trees' tolerance to environmental stresses, which reflected positively in increasing the efficiency of photosynthesis and manufacturing more quantities of carbohydrates and reduces the competition of the fruits formed on the nutrients produced in the leaves (Ahmed *et al*., 2012). Which leads to an increase in the number of fruits obtained in general (Ahmed *et al*., 2017), likewise the role of boron in increasing the yield and the number of fruits (Naseem *et al.*, 2019).

The increase of the tree's yield is due to the increase in the number of fruits in the tree and the increase in the weight of the fruit by the influence of boron. This may be due to the role of boron in the success of germination of the pollen and the pollen tube, thus increasing the probability of pollination and fertilization and then increasing the composition of the fruits that lead to increasing the yield (Habasy *et al.*, 2016; Ahmed *et al.*, 2017; Al-Hamdani *et al.*, 2014).

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