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EFFECT OF FOLIAR SPRAY WITH NANO-OPTIMUS PLUS AND POTASSIUM CHELATED WITH AMINO ACIDS IN SOME GROWTH CHARACTERS OF *CITRUS AURANTIFOLIA* L. SAPLINGS

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Abstract

This experiment was conducted in March 1st, 2018 on in 3 months old *Citrus aurantifolia* L. seedlings to study the effect foliar spraying with Nano-fertilizer Optimus Plus and Potassium chelate and their interaction in some vegetative growth and plant content of chlorophyll and carbohydrates. The experiment was randomized complete block design (R.C.B.D) with three replicates and two factors, the Nano Fertilizer at four concentration levels (0, 0.5, 1 and 1.5 ml.L^{-1} and potassium chelate (0, 2, 3 and 4 ml.L^{-1}). Means were compared among treatments using the least significant difference test (L.S.D) at 0.05 probability level. Results showed that all the tested plant growth indicators were significantly affected by treatment of Optimus Plus at 1.5 ml.L^{-1} which resulted in the highest values in seedlings height, number of branches, stem diameter, number of leaves, leaf area, leaf content of total chlorophyll and dissolved carbohydrates. Similar results were recorded in case of potassium chelate at the highest concentration (4 ml.L^{-1}) which significantly differed from all the other potassium concentrations. However, interaction treatment of 1.5 ml.L^{-1} Optimus Plus and 4 ml.L^{-1} potassium chelate was the most effective treatment among all treatments and interactions and resulted in the highest values of all tested parameters. Over the untreated control, seedlings height, number of branches, stem diameter, number of leaves, leaf area, leaf content of total chlorophyll and dissolved carbohydrates were increased by 66.9%, 146.8%, 64.24%, 129.71%, 37.52%, 143.41% and 91.31%, respectively.

Key Words: Nano-Fertilizer, Lime, plant growth, saplings, Optimus Plus, Potassium

Introduction

Citrus medica var. limon are grown in more than 100 countries and are evergreen trees that ranks first in the world production of fruit trees. It belongs to the *Rutaceae* family which includes many genera, namely the genus *Citrus*, which includes more than 162 species and is one of the most important species economically. *Citrus* is considered one of the important fruits commercially and of high nutritional value (Ladaniya, 2008). However, the production of citrus in Iraq, compared to high production of other countries, is considerably low and does not meet the needs of the local market only for a few periods. The Iraqi production average of one tree is about 14.1 Kg with a total production about 101543 tons produced from estimated number of citrus trees of 7263240 for the year 2010 (Central Organization of Statistics, 2010). Citrus fruits are highly nutritional contain high amounts of vitamins C, B1, B2 and they're a great source of fiber as well as containing carotenoids and folic acid, free of cholesterol and sodium, containing good amount of phosphorus, potassium, magnesium and copper, which protect against heart diseases (Nasr, 2003).

Citrus aurantifolia L. are evergreen trees belonging to the *Rutaceae* family that grow in a number of countries around the world such as Mexico, Italy, India and America, so these countries are considered as original countries of this plant, from which the plants were spread to different regions of the world (Murata, 1997).

The traditional fertilization is usually depends on the method of absorption of nutrients through roots, so fertilizers are added to the soil extensively and although the plant is adequately equipped with nutrients and additives in this way, there are excessive losses in the amount of fertilizer added, especially in case of fertilization large agricultural areas. Therefore, researchers in the

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last few decades were focusing on efficient methods to alternate soil fertilization. Foliar spray with fertilizers is one of these effective alternatives, which is believed to be efficient, effective and rapid nutrient absorption, especially in case of unsuitable soil conditions for soil application, such as drought, extreme rise and drop in temperatures, washing loss and other factors affecting nutritional elements available to plant roots (Dang *et al*., 2005).

Nano-processed fertilizers are in fact important because they are environmentally friendly and critical to promote sustainable agricultural development. This technology has enabled the exploitation of small Nano-materials molecules that carry fertilizer to build the "smart fertilizer", which is able to enhance the efficiency of nutrients use and reduce the cost of environment protection. Studies indicate that the use of Nano-fertilizers causes an increase in plant nutritional efficiency, reduces their toxicity to soil organisms, as well as reduces the effects of potential stress due to over application of fertilization and reduces amounts of fertilizers used. Nanotechnology has high potential for sustainable agriculture improvement, particularly in developing countries (Naderi and Danesh-Shahraki, 2013).

Potassium is one of the macro-elements that play an important role in the regulation of the osmosis voltage of plant cells as it controls the stomata movements. Studies also showed that potassium has direct and indirect effect in the activation of more than 120 enzymes, including those responsible for the use of energy, nitrogen metabolism and respiration. As absence of potassium causes the aggregation of toxic amines such as Agmatine and Putrescine, as well as leads to weakness of root system, general low plant growth and eventually decrease in the number of tubers and fruits (Abodahi, 1989) and (Havlin *et al*., 2005).

Materials and Methods

The research was carried out in the citrus production nursery belonging to the Iraqi Ministry of Agriculture/ Directorate General of Horticulture and Forestry in Karbala/Al-Hindia city for the period from 1/3/2018 to 1/ 12/2019 to study the effect of spraying with Nano-Optimus Plus at four concentration levels (0, 0.5, 1 and 1.5 ml.L^{-1} and potassium chelate (0, 2, 3 and 4 ml.L^{-1}) in the growth of *Citrus aurantifolia* L. seedlings and their tissues contents of nutrients in order to produce seedlings with high quality and marketable values as young trees or rootstocks in an appropriate period of time.

The seedlings were selected at 3 months old and as homogeneous as possible from seedlings planted in 5 Kg plastic bags. Seedlings were transplanted in 10 Kg plastic pots 30 days before starting the experiment. All the seedlings (144 pots in total) were arranged in RCBD with three replicates and three plants per replicate under shade house conditions. Soil samples were taken from pots and subjected for analysis of soil physical and chemical properties (Page *et al.*, 1982; Black *et al.*, 1965) in the soil laboratory, College of Agriculture/University of Kufa (Table 1). All the maintenance and agricultural practices and services including fertilization, irrigation, weeding and pest control were carried out on seedlings throughout the experimental period.

Table 1: Some Physical and Chemical Qualities of Soil Developing Seedlings before the Experiment Begins.

Sample Kind	Soil texture	PH	%			
			N Ready	P Ready	N Total	P Total
Soil	Sandy Loam	7.3	0.39	0.29	0.69	0.36

Measurements and data analysis

Nine months post the transplanting, the experiment was ended and data for plant growth parameters were recorded based on amount increase of the final value (at the end of the experiment) over the starting value (at the beginning of the experiment). The growth parameters included seedlings height (cm), number of branches (branch $seedling^{-1}$), stem diameter (cm), number of leaves (leaf $seedling^{-1}$), leaf area (cm^2 $seedling^{-1}$), leaf content of total chlorophyll (mg $100g^{-1}$ FW) (Ranganna, 1977) and dissolved carbohydrates (mg g^{-1} DW) (Herbert *et al*., 1971). Data were statistically analyzed and analysis of variance was performed using the GenStat (12^{th} Edition) statistical computing system. Differences among means were calculated according to the least significant LSD test at a 5% probability level.

Results and Discussion

The results in (Table 3) showed that the Nano-fertilization had a significant increase in seedlings height, stem diameter, number of branches and leaves per plant, leaf area, leaf content of total chlorophyll and carbohydrates. Spraying with Optimus plus at a concentration of 1.5 ml. L^{-1} significantly acceded the other concentration levels giving the highest increase in the mentioned characteristics. The results (Table 3) also indicated that potassium fertilization has a significant

Table 2: The Components of Optimus plus and Chelated Potassium.

Optimus plus		Potassium	
Amino Acids	30%	K2O	20%
Nitrogen (N)	5%	Amino Acids	5%
Organic nitrogen	3%		

Table 3: The Effect of the Optimus plus and Chelated Potassium in some Vegetative and Chemical Characteristics of *Citrus Aurantifolia* L. saplings

Treatments		**Plant growth characters measured by amount increase 9 months post planting**						
Optimus plus concentrations ml L^{-1}	**Potassium concentrations ml L^{-1}**	**Plant hight cm**	**Stem diameter cm**	**No. of branches. $plant^{-1}$**	**No. of leaves $plant^{-1}$**	**Leaf area cm^2 $plant^{-1}$**	**Total chlorophyll mg 100 g^{-1} FW**	**Total carbohydrates mg 100 g^{-1} DW**
0	0	29.40	1.65	2.83	52.50	816.72	28.19	3.93
	2	33.77	1.83	3.75	65.5	919.32	32.09	4.14
	3	34.74	2.05	4.10	68.33	930.30	34.56	4.58
	4	36.01	2.28	4.33	86.00	1020.12	36.36	5.03
0.5	0	32.81	1.77	3.63	56.33	886.12	34.73	4.10
	2	34.76	2.12	4.50	67.17	980.13	39.23	5.28
	3	37.10	2.20	5.17	83.00	1018.32	41.42	5.49
	4	40.78	2.49	5.57	90.20	1070.83	43.52	6.37
1	0	34.88	1.80	4.37	60.17	912.23	46.69	4.09
	2	41.13	2.13	5.47	86.50	987.80	49.11	6.02
	3	41.99	2.25	5.57	98.10	1020.73	51.8	6.22
	4	42.50	2.53	5.83	110.20	1110.36	53.85	7.16
1.5	0	38.13	1.91	5.00	75.17	990.17	56.55	5.72
	2	43.22	2.20	6.50	94.83	992.18	59.74	6.51
	3	44.80	2.30	6.83	100.10	1089.92	62.99	6.65
	4	49.07	2.71	6.97	120.60	1123.22	68.62	7.52
L.S.D. ($P \leq 0.05$)		0.92	1.549	22.86	7.203	1.278	0.28	3.20

Values are means of 3 replicates and 3 plants for each experimental unit.

effect in the rate of increase in all the studied plant growth parameters especially at the concentration of 4 ml.L^{-1} which excelled all the other concentration levels. All the plant growth characters were more affected by the interaction treatments than individual treatments. The interaction treatment of Optimus Plus at 1.5 ml.$L^{-1}$and 4 ml.L^{-1} chelated potassium recorded the highest values of increase in seedlings height, stem diameter, number of branches and leaves per plant, leaf area, leaf content of total chlorophyll and carbohydrates that of 42.09 cm, 2.71 mm, 6.97 branches $plant^{-1}$, 68.62 mg 100 g $^{-1}$FW and 7.52 mg g $^{-1}$DW, compared to 29.40 cm, 1.65 mm, 2.83 branches $plant^{-1}$, 52.50 leaf $plant^{-1}$, 816.72 cm^2 $plant^{-1}$, 28.19 mg 100 g $^{-1}$FW and 3.93 mg g^{-1}DW from the control treatment, respectively.

Foliar spraying with the Nano Optimus Plus fertilizer and chelated potassium individually or in combination led to a clear increase in vegetative growth indicators and plant nutrient content. This is due to the role of Nano-fertilizers which are characterized by having a large surface area due to the small particle size which makes their solubility high in different solvents, especially water. This feature contributes to increase the penetration of nanoparticles to contact surfaces such as roots and leaves. Nano-fertilizers provide more space for various metabolic reactions in the plant that increase the rate of photosynthesis, causing an increase in dry matter production and carbohydrates and thus increase plant vegetative growth in general (Qureshi *et al*., 2018).

Optimus plus contains amino acids, which are involved in protein building, carbohydrate formation and stimulation of photosynthesis as they contribute to the construction of chlorophyll. The amino acids Glycine and Glutamine, which are contained in Optimus Plus, are essential compounds that contribute to the construction of chlorophyll, so their sufficient availability in fertilizer increases the efficiency of photosynthesis and nutrition processing (EL-Ghamry *et al*., 2009). Moreover, those two amino acids are involved in the construction and encouragement of many plant enzymes and coenzymes (Shafeek *et al*., 2012). In addition, Optimus plus fertilizer contains nitrogen, which has a direct role in building proteins, new plant tissues and IAA which plays an important role in cell division and elongation and increases plant meristem activity (Singh, 2003).

Potassium fertilization also increases cell division (Hassan *et al*., 1990) and root proliferation and depth (Malakouti, 2006) and thus increasing roots efficiency to absorb nutrients important to plant growth (Fonts *et al*., 2000). This will lead to increased plant efficiency in photosynthesis leading to more nutrients products and thus increased cell division and elongation (Adrian, 2004). This also may be due to the role of potassium in stomata movement due to its presence in the form of organic salts in the guard cell which is the driving force of stomata opening and closing, as the mechanism of this process is linked to the plant content of potassium and sugars (Krauss, 1993).

References

Abu Dhahi, Y.M. and M.A. Younis (1988). Plant Nutrition Guide. Directorate of Books House for Printing and Publishing. Ministry of Higher Education and Scientific Research/ University of Baghdad – Iraq.

Central Statistical Organization (2000). Ministry of Planning - Republic of Iraq.

Al-Zaidi, K.A.N. (2016). The Effect of Adding Wheat Peat and Spraying with its Extract on Growth and Production of Red Insulating. Master Thesis: College of Agriculture, Baghdad University- Republic of Iraq.

Hassan, N. A.Q., H.Y. Al-Dulaimi and L.A. Al-Ithawi (1990). Soil Fertility and Fertilizers. Ministry of Higher Education and Scientific Research- Republic of Iraq.

Nasr, T.A. (2003). Propagation of Fruit Trees - Scientific Rules and Modern Methods. Modern Knowledge Library. Alexandria, Egypt. 368.

Adrian, J. (2004). *Potassium Nutrition in North Great Plains*: News and views by Potash and Phosphate Institute (PPI) and potash and phosphate Institute Canada.

Black, C.A. (1965). *Methods of Soil Analysis*. Part 2. Chemical and Microbiological properties. *Am. Soc. Agron., Inc*. Madison, Wisconson, USA.

Chinnamuthu, C.R. and P.M. Boopathi (2009). Nanotechnology and Agroecosystem. *Madras. Agric. J.*, **96:**17-31.

Dang, S., L. Cheng, C.F. Scagel and Fuchigami (2005). Timing of Urea Application Affect Leaf and Root N. uptake in young Fuji\M9 apple trees. *J. Hortic. Sci. Biotech.*, **80:**116-120.

EL-Ghamry, A.M., K.M. Abd EL-Hai and K.M. Ghoneem (2009). Amino and Humic Acids Promote Growth, Yield and Disease Resistance of Faba Bean Cultivated in Clay Soil. *Australian Journal and Bacic and Applied Sciences.*, **3(2):** 731-739.

Fontes, P.R., A.S. Regynaldo and C.M. Everardo (2000). Tomato Yield and Potassium Concentration in Soil and in Plant Petioles as Affected by Potassium Fertirrigation. *Pesq. Agropec. Bras. Brasilia.*, **35(3):** 575-580.

Havlin, J.L., J.D.Beaton, S.L.Tisdale and W.L. Nelson (2005). Soil Fertility and Fertilizers, in an Introduction to Nutrient Management. 6th ed. Prentic Hall, New Jersey. 199-218.

Herbert, D., P.J. Philips and R.E. Strange (1971). Determination of Total Carbohydrates, (C.F. Methods in Microbiology. Norris J.R. and D.W. Robbins (Eds) Acad., Press, London. 5B, Chap.3) England.

Ladaniya, M. (2008). Citrus Fruit, Technology and Evaluation, *Academic Press*.

Malakouti, M.J. (2006). Increasing the Yield and Quality of Pistachio Nuts by Applying Balanced Amounts of Fertilizers. *Acta Hort., (ISHS)* **726:** 293-300.

Murata, T. (1977). Studies on the Postharvest Physiology and Storage of Citrus Fruit. *J. Jpn. Soc. Hortic. Sci.*, **46:** 283-287.

Naderi, M.R. and A. Danesh-Shahraki (2013). Nanofertilizers and their Roles in Sustainable Agriculture. *International Journal of Agriculture and Crop Sciences.*, **5-19:** 2229-2232.

Page, A.L., R.H. Miller and D.R. Keeny (1982). Methods of Soil Analysis Part (2) 2nd (ed). Agronomy 9. *Amer. Soc. Agron*. Madison Wisconsin.

Qureshi, A., D.K. Singh and S. Dwivedi (2018). Nano-Fertilizers : A Novel way for Enhancing Nutrient Use Efficiency and Crop Productivity. *International Journal of Current Microbiology and Applied Sciences.*, **7(2):** 3325-3335.

Ranganna, S. (1977). Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw-Hill publishing Company Limited. New Delhi. India. 11-12.

Sadik, K.S., Al-Taweel, N.S. Dhyeab and M.Z. Kalaf (2011). New Computer Program for Estimating Leave Area of Several Vegetable Crops. *American Eurasian Journal of Sustainable Agriculture.*, **5(2):** 304-309.

Shafeek, M.R., Y. I. Helmy, A.F. Shalaby and N.M. Omer (2012). Response of Onion Plants to Foliar Application of Sources and Levels of Some Amino Acid under Sandy Soil Conditions. *Journal of Applied Sciences Research.*, **8(11):** 5521-5527.

Singh, A. (2003). Fruit Physiology and Production 5th (ed). Kalyani Publishers New Delhi - 110002.