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Impact of some biostimulant substances on growth parameters of Washington Navel orange trees

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ABSTRACT

In a field experiment, Washington navel orange trees were treated with three biostimulant substances; potassium humate, active dry yeast and amino green (amino acids mixture) to study the effect of these substances on vegetative growth parameters and leaf contents of Na and Cl. Potassium humate was applied at 10 and 20g /tree as soil application. In addition, yeast extract at 0.2 and 0.4% and amino green II at 0.25 and 0.50 % were applied as foliar application. The results showed that tree height, leaf area, leaf fresh and dry weights and volume index were positively affected by biostimulants treatments. Generally, the highest values of vegetative growth parameters were achieved with potassium humate, active dry yeast and amino green in descending order. The data also revealed that all biostimulant treatments significantly decreased leaf Na and Cl contents compared to untreated trees; it means that such substances (especially potassium humate) can be used to reduce the negative impact of salinity in soil or irrigation water. In general, biostimulant substances had a beneficial effect on growth performance and leaf contents of Na and Cl of Washington navel orange trees. In this concern, potassium humate at 20g/tree was considered the favorable treatment.

Key words: *Orange trees, biostimulant substances,vegetative growth parameters*

Introduction

Citrus is the largest horticultural crop, whereas citrus harvested areas in Egypt increased rapidly from year to year and reached 335,000 feddan in 2010 which produced an average of 9.5tons/feddan (FAO. 2012). Barakat *et al.* (2012) stated that extension of the cultivated area with citrus has attention due to its importance for local consumption, its highly economic value as a main source for exportation to the European countries and the Gulf States. Adequate supply of nutrient requirements is important for citrus tree growth (Obreza *et al.* 2008). Recently, bio-stimulant application is considered an important tool to enhance the yield and fruit quality of citrus and it becomes a positive factor to minimize utilization of inorganic and chemical fertilizers. It is safe for human and environment and using them was accompanied with reducing the great pollution occurred on our environment as well as for producing organic foods for export. Besides, bio-stimulants can serve as useful components of integrated plant nutrient supply systems which help in increasing crop productivity by increasing soil organism's activity and so increasing availability of nutrient elements and consequence their uptake, moreover these substances can stimulate plant growth through hormonal action or antibiosis.

Biostimulants such as humic acid, active dry yeast and amino acids mixture have a great impact on plant growth. Benefits described to the use of humic acid and related products involving increase nutrient uptake, tolerance to drought and temperature extremes, activate of beneficial soil microorganisms, and facilitate the availability of soil nutrients particularly in alkaline soils and those have low organic matter (Senn and Kingman, 2000 ; Russo and Berlyn, 1990). Also, humic materials may increase root growth in a similar manner to auxins (Senn and Kingman, 2000, O'Donnell, 1973 and Tatini *et al*. 1991). Active dry yeast can induce plant growth due to its content of different nutrients as N, P and K and some common amino acids (Abou-Zaid, 1984). Morover, application of active dry yeast was very effective in releasing carbon dioxide and stimulating photosynthesis which would be reflected on tree performance (Subba Rao, 1984). Ferguson *et al.* (1987) and Moor (1979) indicated that the stimulant effects of active dry yeast on tree growth and vitality could be attributed to its content of some natural growth regulators like auxin and cytokinins. Moreover, Zagzog (2009) reported that spraying mango trees with dry yeast enhanced vegetative growth.Utilization of amino acids mixtures on fruit trees have been reported by several authors. Polyamines have been associated with growth and tissue differentiation (Valero *et al*.2002). It has been suggested that polyamines reduce senescence rates in some plant tissues by antagonism with ethylene, possibly by competing for S-adenosylmethionine, a common precursor of both plant bio-regulators (Franco-Mora *et al.* 2005).

The scope of the present investigation was to study the effect of some biostimulants (Potassium humate, yeast extract and amino green II (amino acids mixture) on vegetative growth and leaf mineral contents of Na and Cl of Washington Navel orange trees

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Material and Methods

This study was carried out in (2010 and 2011) seasons on healthy and almost uniform Washington Navel orange trees 20 years old cultivated in a private farm located in Behaira governorate, Egypt. The texture of the soil is heavy loam soil and well drained with water table not less than 120 cm deep. The trees were annually fertilized with organic manure at the rate of $48m^3ha^{-1}$ in winter. In addition, each tree received 1kg calcium super phosphate (6.77% P) at mid January plus 1.5 Kg potassium sulphate (38.5% K) in two equal doses in mid February and mid April plus 2Kg ammonium nitrate (33.5% N) through three equal doses during March, May and July.

The following treatments were applied monthly (from March to October) as follows:-

1-Control
2-Yeast extract as foliar application at 0.2 %.
3-Yeast extract as foliar application at 0.4 %.
4-Amino green II as foliar application at 0.25 %.
5-Amino green II as foliar application at 0.50 %.
6-Potassium humate as soil application at 10g /tree.
7-Potassium humate as soil application at 20g / tree.

Potassium humate was added as soil application in a small hole under the periphery of the trees. Meanwhile yeast extract and amino green II were applied as foliar spray using a hand pressure sprayer, Triton B emulsifier at a rate of o.2 % as a surfactant was used with each spray solution as wetting agent.

Tree height was measured at the end of each vegetative growth cycle of the trees (1st November).

Volume index of trees was calculated using the equation for one-half of a spheroid (Turrel *et al.* 1969): $V = 0.5236\ HD^2$

Where: V= Volume index, H= Canopy height and D = Canopy diameter.

In the spring of each year, 20 non-fruiting shoots of spring cycle were tagged at constant height and at all directions of each tree. In November, leaf samples (about 50 leaves /tree) were taken from tagged shoots and washed with distilled water. Leaf area of each sample was determined using planimeter. Average leaf fresh weight was determined. Leaf samples were oven dried at 65^0 C to a constant weight and leaf dry weight was estimated. Dried leaves were ground. To determine the leaf mineral contents, 0.3 g of ground material of each sample was digested with H_2SO_4 and H_2O_2 according to Wolf (1982). In the digested material, sodium was determined by Flame photometer (Chapman and Pratt, 1978).Chloride was measured using a sliver ion titration (Cotlove, 1965).

The experiment consists of seven treatments arranged in a randomized complete block design. Five replicates were chosen for each treatment with one tree in each replicate. Least significant differences (L.S.D) at 0.05 (Steel and Torrie, 1984) were used for comparison between the control and the other experimental treatments for the following parameters; vegetative growth and leaf Na and Cl composition.

Results and Discussion

Data in Table 1 show the effect of biostimulants treatments on vegetative growth of Washington Navel orange trees. All biostimulants significantly increased tree height compared to control, except amino green II at 0.25% which caused an insignificant increase. Potassium humate at 20gm/tree markedly increased tree height compared to other biostimulants. Generally potassium humate ranked superior than other biostimulants in increasing tree height especially at 20gm/tree followed by active dry yeast at 0.4%.

Regarding leaf area and fresh weight, the data followed typical trend to that obtained with tree height. In other words, it was obvious that potassium humate at 20 gm/tree caused a significant increase in leaf area compared to control or other biostimulants. Percentage of increment of tree leaf area and leaf fresh weight due to potassium humate at 20gm/tree compared to control were 27% and 48.6% respectively.

Data of leaf dry weight as influenced by various biostimulants treatments indicated that potassium humate at 10 or 20 gm/tree and active dry yeast at 0.2 or 0.4% significantly increased leaf dry weight (without significant differences between them) compared to control and amino green II either at 0.25% or 0.5%.

Assessment of volume index as one of the most important vegetative growth parameter of citrus trees was reported in table (1). The application of potassium humate at 20gm/tree resulted in a significant increase in volume index compared to control. Although other biostimulant treatments increased volume index compared to control but the differences were not significant. Moreover, no significant differences were noticed between potassium humate at 20gm/tree and other biostimulant treatments.

Increasing vegetative growth parameters as a result of biostimulants application could be attributed to that such substances can affect most vital processes in plant growth. In this respect, humic acid acts as conditioners for soil, so it improves soil structure and increases root development which will be reflected on improving vegetative growth. Moreover, potassium humate increases water holding capacity, enhances aeration of soil,

chelates nutrients and, possesses high ion-exchange capacity and increases percentage of total N in soil so increases the nutrient availability (Stevenson, 1982). In addition, in a study on Chemlali olive seedlings Aml *et al*. (2011,a) indicated that treatment of humic acid +amino acids+ macro elements+ trace elements was very effective concerning plant height, brunch numbers, leaf numbers, also it increased plant diameter and leaves area comparing with control. Moreover, Alva and Obreza (1998) reported that humic materials significantly increased orange and grapefruit trees growth and fruit production

General positive effects of applying active dry yeast to plant growth were attributed to its content of different nutrients as N, P and K and some common amino acids (Abou-Zaid, 1984). Also, yeast contains some natural growth regulators; i.e., auxin (Kihlbery, 1972, Wareing and Philips, 1973 and Moor, 1979) and Cytokinins (Ferguson *et al.* 1987). In addition, application of active dry yeast is very effective in releasing CO_2 which improves net photosynthesis (Larson *et al*. 1962, Hegab *et al.* 1997, Mansour, 1998; Attala *et al*. 2000 and Abd El-Moniem *et al*. 2002). Yeast extract contains higher values of proteins and large amount of vitamin B which plays a key role in improving growth and controlling the incidence of fungi diseases (FAO, 1971 and Idso *et al*. 1995).

The involvement of amino acids in protein synthesis and enzymatic activities could interpretate the enhancement of vegetative growth parameters. Several hypotheses have been proposed to explain the role of amino acids in plant growth. Available evidence suggests several alternative routes of IAA synthesis in plants starting from amino acids (Hashimoto and Yamada, 1944). In this respect, Waller and Nowaki (1978) suggested that the regulatory effect of certain amino acids like phenylalanine and ornithine on plant development is through their influence on gibberellins. In this concern Aml *et al* (2011,b) sprayed Kronaki olive seedlings with Pepton (the commercial form of amino acids mixture) at 0.5 and 1% and reported that the treatment increased height and diameter of the plant, branches number, leaves number and leaves area comparing with the control.

The effect of organic stimulants on leaf Na and Cl contents was reported in Table 1. The data proved that leaf Na content tented to be significantly reduced by active dry yeast at 0.4%, and potassium humate at 10 or 20 gm/tree compared to control. Moreover other biostimulants caused a slight decrease in such trait. Regarding leaf Cl content as influenced by biostimulants, data listed in table 1 showed that active dry yeast either at 0.2 or 0.4 and potassium humate at 10 or 20gm/tree resulted in a significant decrease in leaf Cl content, meanwhile amino green II treatments caused a slight decrease compared to control. Generally, potassium humate at 20 gm/tree ranked superior in decreasing leaf Na and Cl content compared to other biostimulant treatments. Decreasing Leaf Na and Cl content due to biostimulants application could be a promising approach to elevate salinity problem in citrus orchards. Similar results were obtained by Eissa *et al*. (2007a, b & c). They revealed that humic acid application (especially soil treatment with 20 ml/tree, every week from July 1st to October 15th) markedly minimized the harmful effect of salinity and enhanced apple, pear, peach and apricot salt tolerance.

Table 1: Vegetative growth parameters and leaf Na and Cl contents of Washington Navel orange trees as influenced by some biostimulants. (average of two seasons).

Treatments	Tree height (m)	Leaf area (cm^2)	Leaf fresh weight (g)	Leaf dry weight (g)	Volume index (m^3)	Na (%)	Cl (%)
Control	2.727	7.193	0.543	0.320	13.420	0.237	0.370
Yeast extract (0.2%)	3.110	7.983	0.660	0.447	20.937	0.203	0.330
Yeast extract (0.4%)	3.407	8.397	0.747	0.480	26.080	0.19	0.307
Amino green II (0.25%)	2.783	7.573	0.557	0.333	15.447	0.217	0.343
Amino green II (0.5%)	2.977	7.873	0.557	0.337	17.473	0.223	0.347
potassium Humate (10gm)	3.370	8.10	0.707	0.447	22.670	0.187	0.280
potassium Humate (20gm)	3.810	9.180	0.807	0.497	27.960	0.17	.267
LSD 0.05	0.243	0.4616	0.0601	0.0512	12.949	0.035	0.034

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