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Evaluation of the Efficiency of Foliar Nutrient with the Chemical Fertilizer of Super Swing and Whey in some Growth Parameters and Concentration of Certain Nutrients of Transplants of Sour Orange *Citrus aurantium* L.

Nada A. El-Qatrani

Department of Horticulture and Landscape Design, College of Agriculture, University of Basrah, Iraq

*Corresponding author e-mail drnadaalmahdy@gmail.com

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Abstract: This study was carried out in the nursery of Department of Horticulture and Landscape Design, College of Agriculture, University of Basrah during 2018 growing season. Completely randomized blocks design (C.R.B.D.) was used to investigate the effect of different concentrations of super swing (0, 0.5 and 1) g.l⁻¹ and whey (0, 50 and 75) % and their interactions to enhance the growth parameters and chemical characteristics of Sour orange transplants. The results showed a significant increase in most of the measured growth parameters of transplants treated with high concentration of foliar spraying to both fertilizers. Application of super swing at 1 g.l⁻¹ with whey at 75% together significantly increased the height of plant, the number of leaves, leaf area, the diameter of stem, number of flowers, the leaves content of both nitrogen and potassium, percentage of dry matter, and content of chlorophyll. Whereas, control treatment was significantly increased the water content compared to other treatments. Addition of growth-enhancing compounds such as super swing and whey extract to the plant can improve the metabolic performance and enhances the plant's ability to absorb nutrients from the soil.

Keywords: whey extract, super swing, sour orange transplants.

Introduction

Citrus plants are belonging to the Rutaceae family, which are economically important for aromatic leaves with oil glands in most parts of the plant, essential oil and perfume. Sour orange *Citrus aurantium* L. used as a Rootstocks commonly in the citrus growing areas of Iraq. It has ability to develop a resistance to several microbial diseases and tolerance the high salinity

of the soil compared to other types of citrus. In addition, it has the excellent compatibility as Rootstocks in most commercial species because of its resistant to plant gum disease that affects the citrus farms in Iraq. This is an easy way to multiply the seeds and their spread. Also, deep roots give transplants the ability to resist drought which this is essential point in Iraqi environment

as a result of low levels of groundwater (Shams Allah, 2007).

Foliar fertilization has a significant role in producing adapted transplants to ensure their quick nutrients access and avoid the most important disadvantages of soil fertilization methods are volatilization especially nitrogen, decrease the level of fertilizers readiness due to the lack of suitable cultivated soil and/or, changing the pH of the soil (Prism *et al.*, 2011). Thus, foliar nutrition is complementary to ground fertilization. Foliar nutrition is more economical compared to ground fertilization method, especially with micro-elements that less from the soil with inappropriate environmental factors such as alkaline soil, calcium carbonate, salinity and drought (Romhidand & El-fauly, 2000).

Al_Dujaili & Neamah (2014) reported that spraying of nutritious solution Agro leaf at concentrations of 0, 7.5, 15 and 22.5 g.l⁻¹ on the Turkish fig transplants had a significant effect on the improvement of vegetative growth Parameters. Where concentration of 15 g.l⁻¹ gave the highest rate of vegetative qualities. Moreover, Hassan (2017) pointed out that the spraying of olive transplants Ashrssy cultivar with the More cumin solution at three levels 0, 2, 4 g.l⁻¹ had a significant effect on the improvement of vegetative growth such as plant height, a number of leaves, leaf area, dry weight and Increase in leaf content of chlorophyll. Al-Karam & Al-Biaty (2016) studied the effect of spraying of organic fertilizer and growth promoter Biozym on the growth of Wolly peach "Red June," Biozym. They found that a concentration of 4 ml L⁻¹ gave the highest values in the number of leaves and the content of chlorophyll. Wahdan *et al.* (2011) indicated that

the spraying of foliar with urea and calcium chloride in "Succary Abiad" mango cultivar grown in Egypt. They reported that urea and calcium chloride have a significant effect on the improvement of vegetative growth parameters of the trees, including increasing of stem length, the number of leaves, leaf area as well as increasing the level nitrogen, potassium, and calcium in the leaves.

Whey, the byproduct of cheesecake, is one of the essential nutrients in foliar fertilization because it contains an appropriate level of water, proteins, lactose sugar, fat, specific nutrients, and a small percentage of vitamins (Abed Al-Hussain & Muhammed, 2016). Studies on the use of Whey as a foliar fertilizer to improve the vegetative growth of plants reported that the improvement of plant growth may also related to its contains of sugars, proteins and some mineral elements such as K, P, Ca, Fe. Al-Obeidi (2006) reported that the transplants of the tomatoes sprayed twice of the Whey extract at concentration 100% with the nutrients during the set stage have been increased the plant height, number of leaves and leaf area.

The current study was carried out to investigate the effect of foliar spraying of super swing and, whey fertilizer and their interactions on improving of the vegetative growth and chemical characteristics of Sour orange transplants.

Materials & Methods

The experiment was carried out in the nursery of Department of Horticulture and Landscape Design - College of Agriculture, University of Basrah, during the growth season 2018. Sour orange transplants used at the age of 2 years old which were planted in plastic pots filled with a 5

kg of Sand Silt Clay soil. The experiment included nine treatments as the interaction between the first factor of spray with the chemical fertilizer super swing 0.0, 0.5, 1 g.l⁻¹, the second factor was the Whey extract at three concentrations 0.0, 50, and 75%. A small amount of the liquid soap was added as a substance spread to the spray solution. Spraying was made one time per month which started from 5/1/2018 to 3/5/2018.

Experimental measurements

1- Vegetative parameters of transplants

A- Plant height (cm): Measured from soil contact to the end of developing peaks.

B - diameter of the stem (cm): - measured using Vernier caliper from the contact of the real leaf of the stem.

C- Number of leaves: - The total number of leaves for growth calculated.

D- The number of branches formed on each plant calculated.

E- Leaf area (cm²): Measured leaf area by laser area meter.

As for the Whey solution from the cheese industry, it attended by 50.75 ml and the supplement was completed to 100% as shown in table (2).

Substance	Concentration
Nitrogen (N)	6.0%
Calcium (ca)	0.9%
Sulfer (s)	7.0%
Iron (Fe)	5.0%
Zinc (zn)	6.0%
Manganese (mn)	4.0%
Copper (cu)	1.0%
Molybdenum (Mo)	0.05%
Hamic Acid	0.08%
Amino Acid	1.0%
Fulvic Acid	0.5%

Preparation of the nutrient solution for the super swinging fertilizer indicated by its chemical composition in table (1) by concentrations 0.0, 0.5 and 1 g.l⁻¹. 0.5 or 1 g.l⁻¹ dissolved in a litre of distilled water, 0.0 g.l⁻¹ (distilled water only) was used as a control treatment.

Table (1): Chemical Composition of Super swing.

2- Chemical properties of transplants

A- The concentration of total chlorophyll pigment in the leaves: It was estimated by SPAD (ccm-200plus.opti-sciences).

B- Water content and percentage of dry matter%: it was calculated by collecting five leaves of each plant and measuring the fresh weight using sensitive balance and then they were placed in paper bags and dried for 48 h. And then dry weight was measured using sensitive balance and the water content and dry matter according to the following equation (Al-Obeidi, 2006)

$$\text{water content \%} = \frac{\text{fresh weight of the sample (g)} - \text{Dry weight (g)}}{\text{Dry weight (g)}} \times 100$$

$$\text{Dry matter \%} = \frac{\text{fresh weight of the sample (g)}}{\text{Dry weight (g)}} \times 100$$

C- Concentration of the nitrogen element in the leaves: nitrogen element in the plant specimens digested by the micro Kjeldahl using the method described by Page *et al.* (1982).

D-Potassium concentration in leaves: Potassium in plant specimens digested using a Flame photometer according to the method Page *et al.* (1982).

Statistical analysis

The study was carried out as a factorial experiment according to the Complete Random Blocks by three Replicates design. Three plants to each treatment, the number of transplants was 27. Data used in the study were statistically analyzed using the *Genestat* statistical analysis program. Mean comparisons were performed

Table (2): Chemical Composition of Whey extract

Composition of Whey	Concentration
Water	93.10
Protein	0.86
Fat	0.3
Sugar	3.56
K	0.01
Ca	0.03
Fe	0.02
Ash	0.74

using LSD test at 5% level of significance ($P < 0.05$).

Result & Discussion

The vegetative Parameters of the sour orange transplants

The results in table (3) indicated the effect of spraying with fertilizer and whey extract on some vegetative parameters of Sour orange transplants. It was observed that spraying with super swing resulted in significant differences in most vegetative parameters. The concentration of 1 g.l^{-1} was significantly increased the plant height, the diameter of the stem, number of leaves, leaf area, number of branches compared to control treatment (75.36 cm, 0.34 mm, 60.11 leaf, 15.56 branch, 29.32 cm^2 respectively). The

increase in the vegetative growth indicators, by the spray of super swing on the leaves, maybe related to the macro and micronutrients contains of the compost such as nitrogen N, Fe, amino acids and their role in the process of cell division, which encourages the growth of meristems tissues. As well as other physiological effects plant because of its influence by fertilization and these results agree with what found by Hassan (2017).

The results of table (3) also showed that the spraying with the whey extract resulted in significant differences between treatments, where the treatment of whey at concentration of 75% was significantly increased the plant height, diameter of stem, and the number of leaves (73.27 cm, 0.34 mm, 81 branch, 59 leaf, 30.04 cm² respectively), compared to the control treatment, which recorded the lowest rate of growth parameters. The increase in studied growth parameters may be related to the availability and accumulation of organic materials and mineral elements such as P, K, Ca, and Fe. Also, whey extract contains of in right quantities and of these compounds, which are easy to absorb by plant leaves. This can increase the biological activity processes such as photosynthesis and nutrient processing and accumulation, resulting in the production of cells and increase the height of the plant and other attributes (Al-Tamimi *et al.*, 2016). These results are consistent with finding of Al-Obeidi, (2006) when using the Whey with some elements for three times at the concentration of 50% on the plants of the tomatoes, which led to a significant increase in all vegetative parameters. The results of the same table showed that the interaction

between the super swing fertilizer and whey extract was significant. The treatment of interaction (1 g.l⁻¹ + 75%) significantly increased the most studied parameters such as plant height, stem diameter, number of branches, leaf area and number of leaves (18.23 cm, 0.38 Mm, 20 branches, 32.53 cm, 62 leaves) respectively. This response may be due to the influence of single factors or combined effect of both factors.

The chemical characteristics of Sour orange transplants

Table (4) showed the effect of spraying with super swing and whey and their interaction on some chemical characteristics of Sour orange transplants. The results indicated that there were significant differences between the treatments in the water content. The control treatment was significantly higher in water content (62.76 %). Whereas, foliar spraying with 1 g L⁻¹ of super swing gave the lowest rate of water content (54.94%). The results of table (4) was also showed that spraying with the whey extract significantly increased some chemical characteristics, except for the water content, where the treatment of 75% gave the lowest water content of (56.42%) compared to the control treatment.

The interaction between the effect of factors in chemical characteristics was significant. In the control treatment, the water content increased to 64.83%. While the treatment of 1 g.l⁻¹ of super swing with 75% the whey gave the lowest rate of water content which was 52.60%. However, it was observed that the study factors of super swing and whey and their interaction have a significant effect on the percentage of the dry matter.

Table (3): Effect of spraying with super swing and whey and their interaction in some vegetative parameters of Sour orange transplants.

Super swing concentration (g.L ⁻¹)	Whey (%)	Plant height (cm)	The diameter of the stem (mm)	Number of leaves	Number of branches	Leaf area (cm ²)
0	0	60.73	0.24	51.33	10.00	24.50
	50	63.73	0.27	52.33	14.33	26.63
	75	66.50	0.30	55.67	15.33	27.23
0.5	0	65.83	0.29	55.67	9.33	27.70
	50	68.73	0.31	55.67	14.67	28.43
	75	72.10	0.34	59.33	18.67	30.35
1	0	70.13	0.30	58.00	11.00	26.00
	50	74.73	0.34	60.33	15.67	29.43
	75	81.23	0.38	62.00	20.00	32.53
LSD Interaction		0.669	0.006	2.008	2.139	1.813
Mean effect of Super swing	0	63.65	0.27	53.11	13.22	26.12
	0.5	68.88	0.31	56.89	14.22	28.83
	1	75.36	0.34	60.11	15.56	29.32
LSD		0.386	0.003	1.159	1.935	1.047
Mean effect of Whey	0	65.56	0.27	55.00	10.11	26.07
	50	69.06	0.30	56.11	14.89	28.17
	75	73.27	0.34	59.00	18.00	30.04
LSD		0.386	0.003	1.159	1.235	1.047

The treatment of super swing at 1 g.l⁻¹ gave the highest percentage of dry matter was 45.04%. Whey extract caused a significant increasing by the concentration of 75% and gave the highest percentage of dry matter, which was 56.42%. In the interaction between factors, the treatment of 1 g.l⁻¹ super swing with 75% whey significantly increased the percentage of dry matter compared to other treatments. The results in the same table indicated that the treatment of super swing increased the percentage of the dry matter more than other treatments. The concentration of 1 g.l⁻¹ gave the highest rate of chlorophyll (59.94

unit), whereas the control treatment gave 54.01 unit. This response may be due to the effect of the mineral elements of the nutritious solution which led to increasing growth as nitrogen enters the chlorophyll synthesis and iron affects the increase in the number of chloroplastids and their volumes, which led to increase the leaf content of chlorophyll. Treatment of whey extract caused significant differences between the treatments. Treatment of whey at 75% gave the highest chlorophyll content (58.80 unit) compared to the control treatment.

Table (4): Effect of spraying super swing and whey fertilizer and their interaction on some chemical characteristics of Sour orange seedling.

Super swing concentration (g L ⁻¹)	Whey (%)	Water content (%)	dry matter (%)	Chlorophyll (unit SPAD)	N (g kg ⁻¹ DM)	K (g kg ⁻¹ DM)
	0	64.83	35.10	52.63	0.36	4.83
0	50	62.60	37.33	53.30	0.40	5.09
	75	60.83	39.10	56.10	0.38	4.67
	0	60.90	38.80	54.23	0.34	5.05
0.5	50	57.90	42.05	55.63	0.21	5.88
	75	55.83	44.13	57.30	0.40	5.48
	0	57.43	42.53	56.10	0.37	5.90
1	50	54.80	45.20	60.73	0.40	5.18
	75	52.60	47.40	63.00	0.36	6.79
LSD Interaction		1.483	1.537	1.304	0.032	0.068
Mean effect of Super swing	0	62.76	37.18	54.01	0.32	4.86
	0.5	58.21	41.66	55.72	0.37	5.47
	1	54.94	45.04	59.94	0.38	5.95
LSD		0.856	0.888	0.753	0.018	0.039
Mean effect of Whey	0	61.06	38.81	54.32	0.35	5.26
	50	58.43	41.53	56.56	0.34	5.38
	75	56.42	43.54	58.80	0.38	5.65
LSD		0.856	0.888	0.753	0.018	0.039

The interaction between the super swing at 1 g.l⁻¹ and whey at 75% had a significant effect on the content of the leaves of chlorophyll. This treatment significantly increased the chlorophyll content compared to other treatments with a maximum value of 63.00. The results were consistent with Joody (2014) finding where he reported that spraying the leaves of Anna transplants with the chromium foliar fertilizer at concentrations of 0, 5 and 10 g.l⁻¹ caused a positive results in improving the vegetative growth of transplants and dry matter. The results of the same table show that the treatment of super swing fertilizer at a 1 g.l⁻¹ increased the content of the leaves of the elements and gave the highest percentage of the nitrogen and potassium 5.95 and 0.38 g kg⁻¹ of dry matter compared to the control treatment respectively. The results indicated that spraying with the whey extract resulted in increasing the content of the leaves of nitrogen and potassium 5.65 and 0.38 g.kg⁻¹ respectively. The interaction between the super swing at 1 g.l⁻¹ and whey at 75% had a significant effect on the content of nitrogen and potassium. The reason is that the nutritious fertilizer and the whey contain the macronutrients and in turn have increased the content of leaves of nitrogen and potassium. These results are consistent with the findings of Reja & Salman (2013) who reported that foliar fertilizer of local orange transplants with different potassium blends,

iron and zinc resulted in positive results of improved vegetative growth of transplants and increased leaf content of chlorophyll and nitrogen.

Conclusions

In conclusion, our results showed that the foliar nutrition in the fertilizer super swing and Whey played an important role in improving

some vegetative and chemical characteristics of Sour orange transplants. Adding of growth-enhancing compounds such as super swing and whey extract to the plant was improved the metabolic performance and enhances the plant's ability to absorb nutrients from the soil.

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