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Article

Possibility of Improving Some Growth Traits and Chemical Content of Mandarin Saplings cv.Clementine by Foliar Application with Urea and GA_3.

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ABSTRACT
This study was conducted in the lath house affiliated with the College of Agriculture / University of Anbar, to find the effect of foliar spray of urea and GA3 on some growth characteristics and chemical contents of mandarin saplings cv. clementine during the period from April 2021 to December 2021, spraying urea(46% N) included, 0(spray with distilled water as control), 4, 8, and 12 $g.l^{-1}$, on the other hand, spraying GA3 included, 0(spray distilled water as control), 30 and 60 $mg.l^{-1}$. The obtained results revealed that the imposition of different concentrations of urea and GA3 had a significant effect in improving all vegetative traits and chemical contents viz, stem diameter, vegetative and root dry weight, mineral content (N,P,K,Fe and Zn) and branch content of carbohydrate, especially (12 $g.l^{-1}$ urea + 60 $mg.l^{-1}$ GA3) in comparison with control which sprayed water only.

Keywords: Foliar Spray, Urea, GA3, Vegetative Growth, Mineral content, Clementine.

INTRODUCTION

Mandarin (Citrus reticulata Blanco) belongs to the family Rutaceae, it is one of the evergreen fruit trees, and it can be considered the lowest species of the genus Citrus in height and size, this is due to the abundance and thinness of the branches produced by the plant, which gives it a drooping shape, Clementine is one of the common and successful species in Iraqi orchards; growth of these trees is medium to relatively large, the small leaves are elongated and pointed, devoid of thorns and atria, it has deep reddish orange color and both the rind and segments exhibit slightly more adherence than most mandarins [1]. Citrus is one of the important fruit trees for local consumption in Iraq, the number of fruit trees for mandarin reached 241,549 trees, the average productivity of one tree was estimated at18.6 kg, while the total production was estimated at 4,494 tons, Baghdad governorate occupied the first place in terms of production, which was estimated at 1,380 tons with a percentage of (30.7%), followed by Diyala governorate, whose production amounted to 1199 tons,(26.7%), while Salah al-Din governorate occupied the third place in terms of production, whose

production was estimated at 1159 tons of the total production of Iraq [2]. Taking care of seedlings from the beginning of their life and carrying out various fertilization operations, whether by adding to the soil or foliar spraying or treating them with some growth regulators will give the seedlings a good growth force, and speed up their arrival to the production stages earlier [3]. Plants need nutrients for their growth and development for its importance into the formation of one or more important compounds in the metabolic processes in the plant, these elements are available in the soil, but the availability may not correspond to the plant's needs because of their lack of movement, lack of readiness, leaching or volatilization, which leads to the failure of the roots to absorb some of these elements from the soil, foliar uptake of mineral nutrients is ranged from 8 to 20 times more efficient than soil application [4] Nitrogen fertilization process is one of the important agricultural operations carried out in nurseries to encourage the growth of seedlings and obtain good seedlings capable of growing consistently in terms of the vegetative and root system [5]. Urea is considered one of the most suitable types of nitrogen fertilizers for foliar application because of its rapid absorption, transmission, non-polarity and high solubility, in addition to its high nitrogen content [6]. Nitrogen is one of the most important major nutrients necessary for growth, and its ratio in high-end plants is 2-5% of the dry weight, its importance lies in its entry into the synthesis of amino acids, proteins, enzymes and cytochromes which is important in the process of photosynthesis, respiration and some hormones, as it forms an essential part in the formation of chlorophyll pigment [7]. As the nutritional factor has an effective effect on growth and production, many researchers have indicated the vital role of growth regulators in many important physiological activities in regulating plant growth, and among these substances is gibberellic acid (GA3), which plays a large and important role in encouraging cell division and elongation, as Stimulates elongation in the internodes in addition to stimulating plants to flower [8], [9]. This study was conducted to study the effect of spraying with urea as a source of nitrogen and GA3 and the combination between them in building a strong structure for mandarin saplings by improving the vegetative growth characteristics

MATERIALS AND METHODS

This trial was conducted in the Lath house affiliated with the Department of Horticulture and Landscape Gardening / College of Agriculture / Anbar University for the period from April 2021 to December 2021 to study the response of mandarin saplings cv. clementine to foliar spray with urea and GA3 on 2- years old mandarin (Citrus reticulata Blanco) grafted on sour orange rootstock (Citrus aurantium L.), uniform saplings were selected and transplanted into the black container, potting medium was a mixture of organic matter(cattle manure) and soil (1:2), saplings were subjected to the same cultural practices during growing season and were routinely irrigated wherever it is needed, soil and organic matter was analyzed as shown in table (1,2).

				Texture Grade			Available nutrients mg.kg^{-1} soil					
				Clay Loam								
pH	EC(1:1) ds.m^{-1}	CEC C.mol.l^{-1}	O.M g.kg^{-1} soil	Sand g.kg^{-1} soil	Loam g.kg^{-1} soil	Clay g.kg^{-1} soil	N	P	K	Total CaCO3 g.kg^{-1} soil	Fe	Zn
											g.kg^{-1} soil	
7.9	5.19	25.47	13	42.90	27.80	29.17	62.95	13.7	216.7	269	2.22	1.56

Table1. Some physio-chemical characteristics of the experimental soil

		g.kg^{-1}				
pH	Ec(1:1) ds.m^{-1}	Organic carbon	N	P	K	C/N
6.7	1.7	316	23	9.8	25.3	13.73

Table2. Physical - Chemical analysis of organic matter.

Urea (46% N) was applied at 0(spray water as control), 4,8 and 12 g.l^{-1}, three levels of GA3(Gibberellic acid) viz. 0(spray water as control), 30 and60 mg.l^{-1}, all saplings received spraying solution which done early in the morning with tween 20 (1ml.l^{-1}) till run off at the second week of April, May and June. The following characteristics were measured:

Stem Diameter Increment (mm):

Stem diameters were measured by Vernier at the beginning and end of the experiment, difference between them represents an increase in diameter

Vegetative and Root Dry Weight (gm):

The dry weight of the vegetative and root system was measured at the end of the experiment and for one sapling from each replicate in December of 2021. The vegetative system was separated from the root system and washed with distilled water several times after drying it was placed in perforated bags and placed in an electric oven at a temperature of 65 °C until constant weight

Leaf Mineral Content (N, P, K, Fe and Zn):

Leaf samples were collected for chemical analysis, total nitrogen (%) was estimated using the Microkjeldahl, while phosphorous (%) was estimated using the blue ammonium molybdate method, and after the evolution of the color, the sample was read in the Spectrophotometer, while the potassium (%) was estimated using the flame photometer and according to the methods mentioned [10].

As for the iron and zinc elements in the leaves (mg.kg^{-1}dry weight), they were estimated using the atomic absorption spectrophotometer, according to [11].

Carbohydrate (%):

The percentage of total carbohydrates was calculated for the new growth by taking the sample and dried at 70°c in the electric oven until constant weight, and then it was ground, total carbohydrates were measured according to [12].

Design and Statistical Analysis

The experiment involved 12 treatments, the experiment was laid out in a randomized complete block design with replicates, each replicate consisted of 3 experimental units, results were subjected to the analysis of variance (ANOVA), and differences between treatments were made by F-test and the least significant differences at P= 5%

RESULTS AND DISCUSSION

Stem Diameter Increment (mm):

Data presented in Table 3 revealed that foliar application with N3 (12g.l^{-1}) produced a significant 9.15mm increment in sapling diameter increment compared with other foliar urea applications especially N0(spray with water) which gave 5.87mm, at the same time, foliar application with GA3 markedly increase stem diameter, especially G2 (60mg.l^{-1}) which gave 8.74mm in comparison with G0(spray with water only) which gave 6.55mm. Meanwhile, the interaction between spraying urea at 8g.l^{-1} with GA3 at 60mg.l^{-1} enhanced stem diameter 10.66 mm in comparison with other spraying interactions including N0G0(control) which gave 5.16mm

Vegetative and Root Dry Weight (gm):

As shown in Table 3, vegetative and root dry weight responded to foliar application with urea and GA3 when sprayed individually, spraying urea at 12g.l^{-1} (79.11g and 33.12g) and GA3 at 60mg.l-1 produced a high dry weight which was recorded (75.43g and 31.44g) for vegetative and root dry weight respectively compared with other foliar applications. Meanwhile, the maximum dry weight was recorded from saplings sprayed with (urea at 12g.l^{-1} and GA3 at 60mg.l^{-1}) which registered (85.68 g and 35.37g) respectively in comparison with control which gave (52.52g and 22.50g) for vegetative and root dry weight respectively.

Nitrogen (%):

Results in Table 4 indicated that the percentage of nitrogen affected by the spraying of urea, especially N3 to give the highest percentage amounted 2.55%, in comparison with N0 which recorded 1.84%, on the same context, G2 outperformed by giving the maximum rate which amounted 2.37% compared to G0 which showed the lowest percentage. As for the the interaction between studied factors, it showed a significant effect, treatments N3G2, N3G1 and N2G2 were manifested without a significant difference between them by achieving the highest values which amounted 2.58, 2.56 and 2.55%, while comparison treatment had the lowest values 1.77%

Phosphorus(%):

The application of urea at a dose 12 g.l^{-1} resulted in an increase in leaf phosphorus content as show in Table (4) which achieved the highest percentage of phosphorous and amounted 0.23%, while the lowest values for the percentage of phosphorus when the treatment N0 was 0.17%. It was noted that the foliar spraying of GA3 showed a significant effect, treatment G2 had the highest phosphorous rate 0.24%, while treatment G0 gave the lowest rate 0.17%. The

significant effect of the interaction was evident through the statistical differences between the treatments, especially N3G2, which achieved the highest value 0.27%. On the contrary, comparison treatment showed the lowest value 0.12%.

Gibberellin (G)	**Urea (N)**				Mean
	N0 = control	N1 = 4 $g.l^{-1}$	N2 = 8 $g.l^{-1}$	N3 =12 $g.l^{-1}$	
stem diameter increment(mm)					
G0= control	5.16	5.76	7.16	8.10	**6.55**
G1= 30 $mg.l^{-1}$	5.83	7.40	9.13	9.46	**7.95**
G2 = 60 $mg.l^{-1}$	6.63	7.76	10.66	9.90	**8.74**
Mean	5.87	6.97	8.98	9.15	
	N	G	N × G		
L.S.D 0.05	0.41	0.35	0.71		
vegetative dry weight(gm)					
G0= control	52.52	64.30	71.41	71.29	**64.88**
G1= 30 $mg.l^{-1}$	53.46	70.70	73.24	80.36	**69.44**
G2 = 60 $mg.l^{-1}$	59.39	74.43	82.21	85.68	**75.43**
Mean	55.12	69.81	75.62	79.11	
	N	G	N × G		
L.S.D 0.05	1.03	0.90	1.80		
root dry weight(gm)					
G0= control	22.50	25.81	28.60	31.40	**27.08**
G1= 30 $mg.l^{-1}$	25.81	29.42	32.20	32.61	**30.01**
G2 = 60 $mg.l^{-1}$	27.23	31.73	31.43	35.37	**31.44**
Mean	25.18	28.99	30.74	33.12	
	N	G	N × G		
L.S.D 0.05	1.18	1.02	2.04		

Table 3 Effect of foliar application with urea, GA3, and their combination on stem diameter increment, vegetative and root dry weight. LSD = Least significant difference at 5% probability

Potassium (%):

The results of the statistical analysis in Table 4 showed that potassium content was significantly affected as a result of spraying urea, N3 achieved the highest percentage amounting to 1.36%, which significantly outperformed the rest of the treatments, especially N0 with the lowest value of 1.22%. On the other hand, foliar application with GA3 resulted in the maximum rate of potassium especially G2, which was 1.34%, superior to the rest of the treatments, followed by treatment G1 by 1.29%, which outperformed treatment G0, which showed potassium with the lowest rate 1.26%. The interaction showed its significant effect especially the N3G2, which potassium percentage reached 1.43%, in comparison with the control which gave 1.18%

Gibberellin (G)	Urea (N)				Mean
	N0 = control	N1 = 4 g.l^{-1}	N2 = 8 g.l^{-1}	N3 =12 g.l^{-1}	
N (%)					
G0= control	1.77	2.26	2.49	2.51	**2.25**
G1= 30 mg.l^{-1}	1.87	2.41	2.52	2.56	**2.34**
G2 = 60 mg.l^{-1}	1.89	2.45	2.55	2.58	**2.37**
Mean	1.84	2.37	2.52	2.55	
L.S.D 0.05	N	G	N × G		
	0.03	0.02	0.05		
P (%)					
G0= control	0.12	0.17	0.19	0.19	**0.17**
G1= 30 mg.l^{-1}	0.14	0.19	0.21	0.23	**0.19**
G2 = 60 mg.l^{-1}	0.24	0.24	0.23	0.27	**0.24**
Mean	0.17	0.20	0.21	0.23	
L.S.D 0.05	N	G	N × G		
	0.02	0.01	0.03		
K (%)					
G0= control	1.18	1.26	1.29	1.32	**1.26**
G1= 30 mg.l^{-1}	1.23	1.29	1.31	1.34	**1.29**
G2 = 60 mg.l^{-1}	1.26	1.32	1.35	1.43	**1.34**
Mean	1.22	1.29	1.31	1.36	
L.S.D 0.05	N	G	N × G		
	0.02	0.01	0.03		

Table 4 Effect of foliar application with urea, GA3, and their combination on leaves N, P and K content. LSD = Least significant difference at 5% probability

Fe (mg.kg^{-1} dry weight):

Results in Table 5 revealed that Fe content was significantly affected by foliar spraying with urea, which was significantly increased especially N3 which achieved the highest value of 60.90 mg.kg^{-1}, in comparison with the lowest value in N0, which amounted to 42.71 mg.kg^{-1}.At the same time, spraying with GA3, achieved the highest value especially G2 which reached 56.64 mg.kg^{-1} while G0 gave the lowest value 45.72 mg.kg^{-1}. The results clearly showed the synergistic effect of spraying with urea and spraying with GA3, especially N3G2, which recorded 67.25 mg.kg^{-1}, unlike the control, which gave the lowest content of 39.67 mg.kg^{-1}

3.7. Zn (mg.kg^{-1} dry weight):

Obviously, Table 5 cleared that there was a significant increase in the zinc content of leaves when spraying with urea, treatment N3 achieved a significant superiority, giving the highest value of 56.13 mg.kg^{-1}, on the contrary, N0 showed the lowest value 36.98 mg.kg^{-1}, spraying with GA3 led to a significant increase in this trait, G2 recorded a significant superiority over the other treatments, giving the highest value 51.70 mg.kg^{-1}, compared to the lowest value in G0 which gave 8.37 13 mg.kg^{-1}. The interaction had a significant effect on this characteristic; N3G2 achieved the highest value, which recorded 61.76 mg.kg^{-1}

3.8. Shoot carbohydrate content (%):

Data in Table 5 demonstrated that there was a significant effect as a result of spraying with urea through the superiority of N3 by achieving the highest percentage of 10.37%, while treatment N0 gave the lowest percentage of 7.36%, on the same context, spraying with GA3 was clear in obtaining a significant increase carbohydrates, especially G2 which achieved the highest value 9.98%, while the lowest value at G0 which gave 8.50%. Also, this percentage increased significantly due to the effect of the interaction between studied factors, specifically the N3G2, which amounted to 10.86%, in comparison with control which gave 6.20%

Gibberellin (G)	**Urea (N)**				Mean
	N0 = control	N1 = 4 g.l^{-1}	N2 = 8 g.l^{-1}	N3 =12 g.l^{-1}	
Fe (mg.kg^{-1} dry weight)					
G0= control	39.67	44.09	46.23	52.88	**45.72**
G1= 30 mg.l^{-1}	43.70	49.65	54.71	62.57	**52.66**
G2 = 60 mg.l^{-1}	44.77	53.54	61.02	67.25	**56.64**
Mean	42.71	49.09	53.99	60.90	
	N	G	N × G		
L.S.D 0.05	1.59	1.38	2.76		
Zn (mg.kg^{-1} dry weight)					
G0= control	32.98	35.66	37.33	47.52	**38.37**
G1= 30 mg.l^{-1}	36.36	42.89	47.51	59.11	**46.47**
G2 = 60 mg.l^{-1}	41.60	47.87	55.58	61.76	**51.70**
Mean	36.98	42.14	46.81	56.13	
	N	G	N × G		
L.S.D 0.05	2.13	1.84	3.68		
Shoot carbohydrate content (%)					
G0= control	6.20	8.76	9.20	9.83	**8.50**
G1= 30 mg.l^{-1}	7.10	9.60	9.90	10.43	**9.25**
G2 = 60 mg.l^{-1}	8.80	9.83	10.43	10.86	**9.98**
Mean	7.36	9.40	9.84	10.37	
	N	G	N × G		
L.S.D 0.05	0.16	0.14	0.28		

Table 5 Effect of foliar application with urea, GA3, and their combination on leaves Fe, Zn content and shoot carbohydrate content. LSD = Least significant difference at 5% probability

DISCUSSION

It is observed from the above mentioned results in Table (3,4&5) that increase in the nutrient content of the leaves represented by N, P, K, Fe and Zn as a result of foliar spraying with urea may be attributed to the direct application of urea as a result of foliar spraying, which contains(46%) of nitrogen, and that increase in the characteristics of vegetative growth was reflected in an increase in root growth by the nature of the relationship between vegetative and root growth and thus an increase in the absorption of nutrients from the soil solution, therefore as a result of the increase in the content of leaves from nitrogen, it is expected that the content of leaves from chlorophyll would increase, as 75% of the nitrogen available in mesophyll cells is located in the chloroplast [13, 14], according of these functions and the increase of chlorophyll pigment in leaves, being the main pigment for photosynthesis and carbohydrate synthesis, on the other hand increasing the concentration of elements in leaves, improving the nutritional status of saplings which facilitating the transfer of manufactured materials from leaves to storage organs like branches and stems [15], we expect an increase in carbohydrates contents. As for the reason for the increase in the mineral content of leaves as a result of spraying with GA3, it may be attributed to the effective role that plays important role in stimulating the absorption and transfer of nutrients in the plant towards the treated tissues and increasing their concentration in the leaves [16, 14, 17].

CONCLUSION

In this study, the results of current research revealed that urea and GA3 foliar spraying on mandarin saplings cv. Clementine could be a beneficial method to increase some growth characteristics and mineral content. Therefore, urea at (12 $g.l^{-1}$) and GA3 at (60 $mg.l^{-1}$) at the same condition is recommended to produce a good vegetative system.

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