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Original Research

Effect of foliar application with kinetin and urea on some growth characteristics of Cleopatra mandarin (*Citrus reshni* Hort. ex Tan.) rootstock

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ABSTRACT:

The effect of foliar spraying with the growth regulator (kinetin) and urea the in vegetative growth of Cleopatra mandarin seedlings as well as the success percentage of local sweet orange scions in the spring budding date was investigated for a period from September 2015 to July 2016 in the lath house belonging to the Department of Horticulture and Landscape Gardening, College of Agriculture, University of Baghdad, Abou-Ghraib, Iraq (the alternative location of Anbar University). A factorial experiment was conducted according to the Randomized Complete Block Design (RCBD), with three replicates for each treatment. The kinetin was sprayed with four concentrations (0, 50, 100 and 150 mg.L^{-1}) and spraying with three levels of urea (0, 0.4 and 0.8%). The results showed the significant effect for both study factors in all studied traits where the spraying with kinetin at a concentration of 100 mg.L^{-1} and the spraying with urea at a concentration of 0.8% showed significant changes in all the studied parameters.

Keywords:

Cytokinins, Urea, Foliar application, Citrus, Vegetative growth, Budding.

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INTRODUCTION

Cleopatra mandarin (*Citrus reshni* Hort ex Tan) is considered one of the important species of citrus root-stocks, which studies have begun on it as a substitute for the sour orange rootstock in Iraq in the case of the spread of the quick decline disease (Tristeza), where the most important traits of this rootstock is its resistance to the tristeza, gummosis, exocortis and more cold tolerant than sour orange, this rootstock grows well in sandy and heavy soils, the trees budded on it are slowly grown until they reach the fruiting stage (Sauls, 2008; Lacey, 2012).

The process of rootstock preparing properly and with good growth is considered one of the most important requirements to be utilized as a rootstock which reflects positively on the success of budding process of it (Lewis and Alexander, 2008). But the slow growth of different citrus rootstocks and the relatively long period (1-2 years) to reach appropriate size for budding (stem diameter 5.4 mm or more) Hartmann *et al*. (2002) is one of the main problems that leads to an increase in the production costs, which calls for using other methods to accelerate their access to the suitable stage for budding in the shortest possible time, such as foliar spraying with plant growth regulators, which have a main role in different physiological processes necessary for the growth and development of the plants (Davies, 2010).

Kinetin is considered the most known cytokinin, where its physiological efficacy is represented by stimulating cell division and expansion, uptake, transport and assimilation of nutrients, increasing the effectiveness and activity of apical meristem, promoting chloroplast development, delaying leaf senescence, hormonal regulation of plant morphogenesis and other influences (Mok, 1994; Taiz and Zeiger, 2006).

Many researchers indicated the importance of treatment with cytokinins because of their important role in enhancing plant growth traits, such as Al-Zebari (2007) when spraying kinetin on apple seedlings. Abou *et al.* (2011) when spraying benzyl adenine (BA) on olive trees, El-Badawy and Abd El-Aal (2013) when spraying kinetin on mango seedlings, Muralidhara *et al*. (2014) when spraying benzyl adenine on mango seedlings, Al-Shabani (2017) when spraying cytokinin on sour orange seedlings.

Nitrogen fertilization is one of the important agricultural processes that is conducted in nurseries. Nitrogen is the most essential element required after carbon, and it plays a central role in plant metabolism as a constituent of many cell component including nucleic acids, amino acids, proteins, co-enzymes, nucleotides, secondary metabolites, and it also forms an essential part in the formation of chlorophyll molecule and cell protoplasm (Marschner, 2012). Urea is considered one of the most suitable forms of nitrogen for foliar application due to its rapid absorption, translocation and metabolism, non-polarity, low toxicity, high solubility as well as its high content of nitrogen (Bondada *et al*., 2001; El-Otmani *et al*., 2002).

Several studies have indicated the importance of foliar spraying with urea in improving the plant's nutritional status as well as vegetative growth, such as Govind and Singh (1999) on the seedlings of sour orange and Cleopatra mandarin. Similarly, Kannan *et al*. (2002) on rough lemon seedlings, Mustafa *et al*. (2011) on olive seedlings, Alben *et al*. (1932) on rooted olive cuttings, Badshah and Ayub (2013) on pecan seedlings and Rattanpal and Singh (2014) on rough lemon seedlings.

MATERIALS AND METHODS

This study was conducted in the lath house belonging to the Department of Horticulture and Landscape Gardening, College of Agriculture, University of Baghdad, Abou-Ghraib, Iraq (the alternative location of Anbar University) for the period from September 2015 to July 2016 in order to study the effect of foliar spraying with Kinetin and Urea in some growth traits of Cleopatra mandarin seedlings (*Citrus Reshni* Hort ex Tan)

Table 1. Physical and chemical soil analysis

Physical analysis ($g.kg^{-1}$ soil)				
Sand	**Loam**	**Clay**	**Texture**	
661.3	176.0	162.7	Sandy loam	
Chemical analysis				
pH	**EC (1:1) $ds.m^{-1}$**	**N ($g.kg^{-1}$ soil)**	**P ($mg.kg^{-1}$ soil)**	**K ($mg.kg^{-1}$ soil)**
7.2	2.58	78.4	16.5	246.2

as well as the success percentage of local sweet orange scions in the spring budding date. A 520 seedlings with five months age were selected, uniform in their growth as much as possible, with their stem diameters ranged between 3-4 mm on the height of 15-20 cm from the soil surface level, where they were cultivated in sandy loam soil in the plastic pots with the dimensions of 17 cm diameter x 25 cm height.

In addition, all service operations were conducted for the seedlings from irrigation and removal of all lateral branches (suckering process), weeding and control of insects when needed, also samples from the soil were taken for the purpose of conducting some chemical and physical analysis prior to the implementation of the experiment as shown in (Table 1).

A factorial experiment was conducted with two factors, the first factor included foliar spraying with the kinetin growth regulator solution at four concentrations: K_0 (spraying with distilled water), K_1 (50 $mg.L^{-1}$), K_2 (100 $mg.L^{-1}$) and K_3 (150 $mg.L^{-1}$). The plant growth regulator of kinetin produced by New Sunshine (Xiangtan) Agrochemical Co., Ltd. (I.A. 99%) is prepared by weighing the growth regulator powder according to each concentration and dissolved it in 25 mL of 95% ethanol and then complete the volume to 1 L with distilled water. The second factor included foliar spraying with urea at three concentrations: U0 (spraying with distilled water), U_1 (0.4%) and U_2 (0.8%).

The foliar spraying process was conducted in accordance with the following dates: 5/9/2015, 5/10/2015, 5/11/2015 and 5/3/2016 by using a backpack sprayer, with the capacity of 16 liters until the drip point with the addition of a wetting agent (Triton B) to the spraying solution at a concentration of 0.1%.

A factorial experiment with two factors (4 × 3) was conducted according to the Randomized Complete Block Design (RCBD), with three replicates and each replicate represented by 15 seedlings per treatment. The data were analyzed according to the statistical program GeneStat, and the arithmetic averages were compared by using the least significant difference test at a probability level of 0.05 (Al-Mohammedi and Al-Mohammedi, 2012).

Three seedlings were randomly chosen from each treatment and for each replicate for the purpose of measuring vegetative growth traits and chemical measurements in April 2016. In order to conduct the budding process the number of seedlings was standardized (7 seedlings for each treatment and for each replicate) depending on the lowest number of suitable seedlings for budding which their stem diameters amounted of 5.4 mm or more at a height 15-20 cm from the soil surface level Hartmann *et al*. (2002) which was at the control treatment. The shield budding (T-budding) was carried out with the local sweet orange scions (*Citrus sinensis* L. Osbeck) at the spring budding date at 10/4/2016, at a height of 15-20 cm from the soil surface (Ishfaq *et al*., 2012).

Studied traits

Leaves number.$seedling^{-1}$

The number of leaves was calculated in the April of 2016.

Leaves area.seedlings^{-1} (dm^2)

Ten fully expanded leaves were taken from each seedling, Leaf area was calculated by measuring the maximum length and maximum width for leaf as follows: Leaf area = 2/3 x length x width according to Chou (1966), leaves area for seedling was calculated by multiplying the total number of leaves with average of leaf area.

Average increase in stem diameter (mm)

Preliminary readings for the stem diameter at a height of 15-20 cm from soil surface level by using vernier caliper were taken before conducting the treatments in September of 2015, the readings were taken again in April 2016. The average increase in stem diameter was calculated by taking the difference between the two readings.

Percentage of suitable seedlings for budding

It was calculated according to the number of seedlings whose stem diameters amounted of 5.4 mm or more at a height of 15-20 cm from the level of soil surface in April 2016 according to the following equation:

$$\text{Percentage of suitable seedlings for budding} = \frac{\text{Number of the seedlings whose stem diameters amounted of 5.4 mm or more}}{\text{Total number of seedlings}} \times 100$$

Dry weight of vegetative parts (g)

It was measured in April of 2016 for three seedlings from each treatment per replicate, total vegetative system were separated from the root system, carefully washed with tap water several times and dried in the electric oven at 65ºC until the stability of weight.

Percentage of total carbohydrates in stem

It was estimated according to Dubois *et al.* (1956).

Nitrogen content in leaves (%)

The fully expanded leaves (6 - 10th) were taken from the apex of the plant (Smith, 1966) in April of 2016. The leaves samples were washed with distilled water several times and dried at 70ºC until constant weight (Pipper, 1950). Nitrogen was estimated by using micro Kjeldahl according to the method mentioned by Bahargava and Raghupathi (1999).

Total chlorophyll of the leaves (mg.g^{-1} fresh weight)

The fully expanded leaves (6 - 10th) were taken from the apex of the plant, for extracting chlorophyll a and b, a 0.5 g fresh weight of leaves were taken and placed in tubes, a 20 mL of acetone (98%) was added to it and left for 72 h until the chlorophyll pigment was totally extracted, light absorption of the solution was determined at wavelengths (663 and 645 nm) using a spectrophotometer, the leaves content of the total chlorophyll was calculated according to the method mentioned by Bajracharya (1999).

Percentage of budding success

It was calculated in July of 2016 on the basis of the scions growth and emergence of vegetative shoot, according to the following equation:

$$\text{The percentage of budding success} = \frac{\text{Number of successful scions}}{\text{Total number of budded seedlings}} \times 100$$

RESULTS AND DISCUSSION

Number of leaves (leaf.seedling^{-1}) and leaves area (dm^2)

Table 2 shows that the number of leaves and leaves area increased as a result of treatment with kinetin, especially the K_2 concentration, which was significantly excelled over the rest of the concentrations by giving the highest values which amounted of 60.81 leaf.seedling^{-1} and 10.82 dm^2, while the lowest values were 41.63 leaf.seedling^{-1} and 8.27 dm^2 at K_0 concentration. The spraying of urea showed a significant increase in these two traits, especially the U_2 treatment which achieved the highest values amounted of 56.19 leaf.seedling^{-1} and 9.96 dm^2 while the U_0 treatment recorded the lowest values which amounted of 43.78 leaf.seedling^{-1} and 8.46 dm^2. The interaction between

Table 2. Effect of foliar application with kinetin and urea and their interaction in leaves number and leaves area of Cleopatra mandarin seedlings

	Leaves number . seedling^{-1}					Leaves area . seedling^{-1}			
S. No	Kinetin mg L^{-1} (K)	(U) Urea %			Means (K)	Urea % (U)			Means (K)
		U_0	U_1	U_2		U_0	U_1	U_2	
1	K_0	34.22	44.00	46.67	41.63	7.53	8.56	8.71	8.27
2	K_1	43.33	52.44	55.11	50.30	8.32	9.25	9.58	9.05
3	K_2	52.44	65.67	64.33	60.81	9.55	11.31	11.59	10.82
4	K_3	45.11	56.67	58.67	53.48	8.44	9.74	9.97	9.38
5	Means (U)	43.78	54.69	56.19	Means (U)	8.46	9.72	9.96	
6	LSD 0.05	K	U	KXU		K	U	KXU	
7		2.80	2.43	4.85		0.72	0.62	1.25	

the growth regulator and urea had a significant effect in these two traits, the K_2 X U_1 treatment achieved the highest value for number of leaves which reached to 65.67 leaf.seedling^{-1}, while the highest value for leaves area amounted of 11.59 dm^2 at the interaction treatment K_2 X U_2.

The reason for the increase in the number of leaves as well as leaves area of the seedlings derived from treatment with kinetin may be attributed to the role of its in stimulating the growth of leaves primordia through cell division and differentiation (Davies, 1994), kinetin also influence the allocation of nutrients and assimilates in the plant towards treated tissues (Mok, 1994; Beck, 1996) and their use in the building of vegetative parts, including the increase in number and area of leaves. These results agree with the results of El-Badawy and Abd El-Aal (2013) which showed that the foliar spraying for the mango seedlings with kinetin at a concentration of 75 mg.L^{-1} had the significant effect in increasing the number of leaves and leaves area.

These results also agree with Mahmoud *et al*. (2015) who found that the spraying of olive trees (*Olea europaea* L.) with benzyl adenine (BA) at a concentration of 60 mg.L^{-1} led to the significant increase in the leaf area for two seasons of the study. The importance of foliar spraying with urea is the increase in the number

Table 3. Effect of foliar application with kinetin and urea and their interaction in average increase in stem diameter and percentage of suitable seedlings for budding of Cleopatra mandarin seedlings

	Average increase in stem diameter (mm)					Seedlings buddable (%)			
S. No	Kinetin mg L^{-1} (K)	(U) Urea %			Means (K)	Urea % (U)			Means (K)
		U_0	U_1	U_2		U_0	U_1	U_2	
1	K_0	1.24	1.39	1.48	1.37	46.70	60.00	66.70	57.80
2	K_1	1.51	1.70	1.76	1.65	66.70	66.70	73.30	68.90
3	K_2	1.64	2.13	2.21	1.99	73.30	80.00	86.70	80.00
4	K_3	1.55	1.86	1.96	1.79	60.00	73.30	80.00	71.10
5	(U) Means	1.48	1.77	1.85	Means (U)	61.70	70.00	76.70	
6	LSD 0.05	K	U	KXU		K	U	KXU	
7		0.07	0.06	0.12		7.96	6.89	13.79	

Table 4. Effect of foliar application with kinetin and urea and their interaction in dry weight of vegetative parts and stem total carbohydrates (%) content of Cleopatra mandarin seedlings

		Dry weight of vegetative parts (g)				Stem content of carbohydrates (%)			
S. No	Kinetin mg L^{-1} (K)	(U) Urea %			Means (K)	Urea % (U)			Means (K)
		U_0	U_1	U_2		U_0	U_1	U_2	
1	K_0	8.80	10.13	10.48	9.80	7.12	7.67	8.01	7.60
2	K_1	10.07	11.08	11.79	10.98	7.64	8.12	8.52	8.09
3	K_2	11.36	12.62	12.68	12.22	8.44	8.98	8.92	8.78
4	K_3	10.10	11.16	11.94	11.06	7.69	8.16	8.71	8.18
5	Means (U)	10.08	11.24	11.72	Means (U)	7.72	8.23	8.54	
6	LSD 0.05	K	U		KXU	K	U	KXU	
		0.52	0.45		0.91	0.20	0.17	0.34	

of leaves as well as the leaves area to what it content of a high percentage of nitrogen, which enters the composition of amino acids, proteins, nucleic acids and co-enzymes, in addition to its role in the formation of the chlorophyll molecule which is the basis of photosynthesis, leading to increase its products in leaves and provide energy for the growth and construction (Marschner, 2012). These results agree with Kannan *et al*. (2002) where the number of leaves increased significantly when rough lemon seedlings were sprayed with urea at a concentration of 1.5%. It also agrees with Badshah and Ayub (2012) who indicated a significant increase in the number of leaves and leaves area for pecan nut seedlings (*Carya illinoinensis*) when spraying with urea at a concentration of 5% .

Average increase in stem diameter (mm) and percentage of suitable seedlings for budding

The study treatments affected in increasing the stem diameter and the percentage of suitable seedlings for budding. Table 3 shows that the spraying with growth regulator of kinetin with K_2 concentration has achieved a significant increase through giving it the highest values amounted of 1.99 mm and 80.00% compared to the other concentrations while the lowest values were 1.37 mm and 57.80% at K_0 concentration.

The table showed also significant differences due to urea treatment, where level of U_2 achieved the highest values of the stem diameter and the percentage of suitable seedlings for budding which amounted of 1.85 mm and 76.70% while the lowest values were 1.48 mm and 61.70% at the level U_0. The interaction between the two study factors showed its significant effect by achieving the treatment K_2 X U_2, the highest values for these two traits amounting to 2.21 mm and 86.70% respectively.

The reason for the increase in stem diameter due to spraying with kinetin may be attributed to its stimulating role in cell division and expansion (Mok, 1994). As for the effect of foliar spraying with urea in increasing stem diameter it may be because it contains a high percentage of nitrogen which is involved in building amino acids such as tryptophan Hopkins (2006) Marschner (2012), which is considered the initiator of auxin biosynthesis in the plant tissues, which in turn stimulates the division and differentiation of the vascular cambium cells into secondary xylem tissue from the inner and secondary phloem tissue to the outside, leading to increase stem thickness (Davies, 1994; Taiz and Zeiger, 2006).

The reason may also be due to the effect of spraying with kinetin and urea in increasing the number

Table 5. Effect of foliar application with kinetin and urea and their interaction in nitrogen content in leaves and total chlorophyll content in leaves of Cleopatra mandarin seedlings

		Nitrogen (%)				Chlorophyll ($mg.g^{-1}$) fresh weight			
S. No	Kinetin mg L^{-1} (K)	(U) Urea %			Means (K)	Urea % (U)			Means (K)
		U_0	U_1	U_2		U_0	U_1	U_2	
1	K_0	1.73	1.82	1.86	1.80	9.05	9.73	10.21	9.60
2	K_1	1.76	1.84	1.87	1.82	9.58	10.05	10.55	10.06
3	K_2	1.82	1.89	1.91	1.87	10.11	10.72	11.27	10.70
4	K_3	1.77	1.83	1.88	1.82	9.69	10.14	10.80	10.21
5	Means (U)	1.77	1.84	1.88	Means (U)	9.60	10.16	10.70	
6	LSD 0.05	K	U		KXU	K	U	KXU	
7		0.03	0.03		0.06	0.48	0.41	0.83	

of leaves and leaves area Table 2 as well as increasing their content of chlorophyll, which contribute to the enhancement of photosynthesis process and increase the manufacture of carbohydrates and store them in the stem which results in improved seedlings growth and increased stems diameter. As a result, the percentage of suitable seedlings for budding is expected to increase. These results agree with Muralidhara *et al*. (2014) where their results showed a significant increase in stem diameter and the percentage of suitable seedlings for budding when the mango seedlings were sprayed with Benzyl adenine.

These results are also in agreement with Al-Shabani (2017) who mentioned to a significant increase in sour orange stem diameter and percentage of suitable seedlings for budding as a result of foliar spraying with CPPU at the concentration of 12 $mg.L^{-1}$. It also agrees with Kannan *et al*. (2002), Rattanpal and Singh (2014) where their results showed a significant increase in stem diameter and percentage of suitable rough lemon seedlings for budding as a result of foliar spraying with urea at the concentration of 1.5%.

Dry weight of vegetative parts (g) and stem content of total carbohydrates (%)

Table 4 indicates a significant differences in dry weight of the vegetative parts and stem content of carbohydrates due to the spraying with kinetin where the K_2 concentration was significantly excelled on the other concentrations by giving it the highest values amounted of 12.22 g and 8.78% while K_0 concentration showed the lowest values amounted of 9.80 g and 7.60%. The same table showed significant differences as a result of spraying with urea where the dry weight of vegetative parts and the percentage of carbohydrate in the stem increased by increasing the levels of spraying, where the U_2 level achieved the highest values amounted of 11.72 g and 8.54%, while the lowest values were 10.08 g and 7.72% at the U_0 level.

The interaction between the two study factors were significantly affected in both of these traits, where the treatment of K_2 X U_2 achieved the highest dry weight of the vegetative parts which amounted of 12.68 g while the treatment of K_2 X U_1 gave the highest percentage of carbohydrates in the stem which reached to 8.98%.

The increase in the dry weight of the vegetative parts and stem content of carbohydrates may be due to the strength and activity of the vegetative growth for the seedlings resulting from the treatment with kinetin and urea (Tables 2 and 3), in addition to increasing the leaves content of chlorophyll and its reflection in increasing the efficiency of photosynthesis process and increase of manufactured carbohydrates (Jordan and Ogren, 1984).

Table 6. Effect of foliar application with kinetin and urea and their interaction in the percentage of budding success of Cleopatra mandarin seedlings

Budding success (%)					
S. No	Kinetin mg L^{-1} (K)	Urea % (U)			Means (K)
		U_0	U_1	U_2	
1	K_0	42.90	57.10	71.40	57.10
2	K_1	57.10	71.40	71.40	66.70
3	K_2	71.40	71.40	85.70	76.20
4	K_3	42.90	57.10	71.40	57.20
5	Means (U)	53.60	64.30	75.00	
6	LSD 0.05	K	U	KXU	
		11.85	10.26	20.52	

These results agree with the results of Al-Zebari (2007) who found that the foliar spraying with kinetin at a concentration of 150 mg.L^{-1} has improved the traits of vegetative growth of apple seedlings (*Malus communis* L.) where it achieved a significant increase in the dry weight of the vegetative parts. These results agree with the results of Abou *et al.* (2011) on olive trees when sprayed it with benzyl adenine at a concentration of 40 mg.L^{-1}, which achieved a significant increase in dry weight and percentage of carbohydrate in leaves. These results, also agree with the results of Alben *et al*. (1932) who indicated the significant effect of weekly urea foliar applied at a concentration of 1% in increasing leaf and stem dry weight of rooted olive cuttings.

Percentage of nitrogen in leaves and their content of chlorophyll (mg.g^{-1} fresh weight)

The study treatments affected in the leaves content of nitrogen as well as its content of chlorophyll. Table 5 shows that the foliar spraying with kinetin at the K_2 concentration achieved a significant increase by giving it the highest values which amounted of 1.87% and 10.70 mg.g^{-1} fresh weight compared to the other concentrations, while the lowest values were at the K_0 concentration, which amounted of 1.80% and 9.60 mg.g^{-1} fresh weight. In addition, the foliar spraying with urea led to significant increase in these two traits by increasing levels of spraying, where the level of U_2 achieved the highest values, which amounted of 1.88% and 10.70 mg.g^{-1} fresh weight, while the lowest values were at level F_0 which amounted of 1.77% and 9.6 mg.g^{-1} fresh weight.

The interaction between the two factors showed its significant effect by achieving the treatment K_2 X U_2 and the highest leaves content of nitrogen and chlorophyll, which reached 1.91% and 11.27 mg.g^{-1}fresh weight.

The increase in the leaves content of nitrogen as a result of the treating with kinetin may be attributed to its stimulating role in the movement and transport of nutrients in the plant towards treated tissues with it (Mok, 1994; Beck, 1996). The reason for increasing the percentage of nitrogen in the leaves by increasing the spraying levels with urea may be due to its content of the nitrogen element, which is absorbed directly when spraying it on the leaves, which increased its concentration, this can be attributed to the effect of the two study factors in increasing the vegetative growth for seedlings (Tables 2, 3 and 4) which positively affects their ability to absorb the relatively available mineral elements in the soil Table 1 to achieve nutritional balance in the plant.

These results agree with El-Badawy and Abd El -Aal (2013) who showed that the leaves content of nitrogen for mango seedlings increased significantly when spraying it with kinetin at a concentration of 75 mg.L^{-1}, it also agreed with Mahmoud *et al*. (2015) where the percentage of nitrogen in the leaves increased significantly when spraying olive trees with benzyl adenine at a concentration of 60 mg.L^{-1}, these results are also agreed with Cheng *et al*. (2002) where their results showed increasing the leaves content of nitrogen when spraying apple trees with urea at the concentration of 3%, it is agreed with Rekha (2005), who indicated the increasing in the leaves content of nitrogen when spraying the rough lemon with urea at the concentration of 2%.

The reason for the increased chlorophyll content in leaves due to treatment with the growth regulator (kinetin) may be due to its role in stimulating the biosynthesis of chlorophyll by activating the enzyme effectiveness of NADH-Protochlorophyllid reductase (Zavaleta-Mancera *et al*., 1999), and may be attributed to its role in inhibition of chlorophyllase enzyme effectiveness which is responsible for the degradation and loss of chlorophyll (Davies, 1994). These results agree with the results of Fathi *et al*. (2011) where the leaves content of chlorophyll increased when spraying the persimmon trees (*Diospyros kaki* L.) with CPPU at a concentration of 10 mg.L^{-1}.

The reason for the increasing the leaves content of chlorophyll due to foliar spraying with urea is due to the role of nitrogen, which is considered the main constituent of the basic plant pigments, including chlorophyll (Marschner, 2012) as well as its role in the construction of thylakoid membranes (Evans, 1989), where Bondada and Syvertsen (2003) mentioned that chlorophyll is embedded in the thylakoid membrane, increased chlorophyll synthesis by nitrogen fertilization would result in the expansion of thylakoid membrane assembly mediated by increasing the number of grana and thylakoids per granum.

These results agreed with Baninasab *et al.* (2007) who demonstrated that the leaves content of chlorophyll in pistachio trees (*Pistacia vera* L.) had increased linearly by increasing the concentration of nitrogen by spraying urea at the concentration of 0.6%. It is also agreed with Sayyad-Amin and Shahsavar (2012) where their results showed that the leaves content of chlorophyll has significantly increased when spraying the olives trees with urea at a concentration of 0.75%.

Percentage of budding success

Table 6 reveal a significant effect of spraying with kinetin in the percentage of budding success, the concentration of K_2 achieved the highest percentage amounted of 76.20% compared to the K_0 concentration which recorded the lowest percentage amounted of 57.10%. Urea foliar applied significantly increased the budding success percentage by increasing urea levels which recorded the values of 75.00%, 64.30% and 53.60% for U_2, U_1 and U_0 respectively. The interaction between the experimental factors revealed a significant effect, that K_2 X U_2 treatment scored the highest percentage which amounted of 85.70%.

The increase in the percentage of budding success as a result of spraying with kinetin is due to its stimulating role in cell division, callus formation, cellular differentiation and assimilates movement (Davies, 1994; Hartmann *et al*., 2002). As for the effect of foliar spraying with urea, it is due to the role that nitrogen plays in enhancing the cytokinin concentration and movement from roots to aerial parts (Wagner and Beck, 1993; Takei *et al*., 2001).

In addition, the vigor growth of Cleopatra mandarin seedlings that were treated with kinetin and urea and their positive effect on improving the physiological and nutritional status of these seedlings which was reflected positively on increasing budding success. These results agree with Al-Shabani (2017) who noted a significant increase in the budding success percentage when spraying the seedlings of sour orange with CPPU at a concentration of 12 mg.L^{-1} and then budded with local sweet orange. These results also agree with Kannan *et al.* (2002) who mentioned that the percentage of budding success has significantly increased in kinnow mandarin which budded on rough lemon when spraying with urea at a concentration of 1.5%.

CONCLUSION

The results showed the significant effect for both study factors in all studied traits where the spraying with kinetin at a concentration of 100 mg L-1 and the spraying with urea at a concentration of 0.8% achieved a significant increase in the average increase of seedling height, number of leaves, leaf area, the average increase in stem diameter, percentage of suitable seedlings for budding, stem content of carbohydrates, concentration of nitrogen in leaves, chlorophyll content in leaves and the percentage of budding success.

Foliar application with kinetin and urea has improved the growth traits of Cleopatra mandarin seedlings, with increased percentage of suitable seedlings for budding, as well as shortening the time needed to reach to this stage in less than one year. Reduction of time is important for nurserymen in order to reduce the various costs of seedlings production.

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