Effect of nitrogen fertilizer, ascorbic acid, the number of additions, and their interactions on the physical traits of Paulownia plant (Paulownia tomentose L.)

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ABSTRACT

The study was conducted in the two growing seasons (2018-2017 and 2017-2016) in order to study the effect of urea fertilization, treating with ascorbic acid, and the number of times of its adding to Paulownia plant (*Paulownia tomentose* L.) and the success of its cultivation under the conditions of Basra province. The study included three factors: fertilizing with urea at a concentration of (0, 1.6, 3.2 g.plant^{-1}) and treating with ascorbic acid at concentrations of (0, 30, 60 mg.L^{-1}) in addition to the treatment of the number of adding times, which included once or twice addition in a month to the plant in the mentioned treatments. The study was conducted in the saran house, College of Agriculture, University of Basra, as a factorial experiment with the completely Random Block Design (CRBD), and the averages were compared with the least significant difference test at the probability level of 5%. The results showed that the urea treatment with a concentration of 3.2 g per plant increased significantly in plant height, the number of leaves, leaf area and percentage of dry matter in the total vegetative, where urea treatment at a concentration of (1.6 g.plant^{-1}) led to a significant increase in stem diameter and dry weight of roots. The treating of seedlings with ascorbic acid at a concentration of (60 mg.L^{-1}) caused a significant increase in the plant height, the number of leaves, and the percentage of dry matter for the total vegetative. There was no significant difference between the two concentrations of ascorbic acid (30 and 60 mg.L^{-1}) in the effect on stem diameter and The percentage of dry matter for the root system and the total vegetative. The number of adding times had a significant effect on the studied traits, where the twice adding has excelled on the once adding in most traits. The triple and bi-interactions between the main factors were significant, and the best interactions were at the urea treatment at a concentration of (3.2 g. plant^{-1}) and ascorbic acid a concentration of (60 mg.L^{-1}) and twice adding in a month. The results of the first season were similar to the second growing season.

*Research paper from Ph.D. thesis for the first author.

تأثير السماد النايتروجيني وحامض الأسكوربك وعدد مرات الأضافة وتداخلاتهما في الصفات الفيزياوية لنبات الباولونيا *Paulownia tomentose* L.

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الملخص

اجريت الدراسة في موسمي النمو 2016-2017 , 2017-2018 بهدف دراسة تأثير التسميد باليوريا و المعاملة بحامض الاسكوربك و عدد مرات اضافتهما في نبات الباولونيا (*Paulownia tomentosa*) و مدى نجاح زراعته تحت ظروف محافظة البصرة تضمنت الدراسة ثلاث عوامل هي:التسميد باليوريا بالتركيز 0 , 1.6 , 3.2 غرام /لنبات و المعاملة بحامض الاسكوربك بالتراكيز 0,30,60 ملغم/لتر بالأضافة الى معاملة عدد مرات الاضافة و التي شملت الاضافة لمرة واحدة او مرتين بالشهر للنبات في المعاملات المذكورة . نفذت الدراسة في الظلة القماشية التابعة لكلية الزراعة جامعة البصرة كتجربة عاملية بتصميم القطاعات العشوائية الكاملة و قورنت المتوسطات باختبار اقل فرق معنوي على مستوى 5%. بينت النتائج ان معاملة اليوريا بالتركيز 3.2 غرام للنبات الى زيادة معنوية في ارتفاع النبات وعدد الاوراق و مساحة الورقة و النسبة المئوبة للمادة الجافة للمجموع الخضري في حين ادت المعاملة باليوريا بتركيز 1.6 غم/نبات الى زيادة معنوية في قطر الساق و الوزن الجاف للجذور كما سببت معاملة الشتلات بحامض الاسكوربك بتركيز 60 ملغم/لتر زيادة معنوية في ارتفاع النبات و عدد الاوراق و و النسبة المئوية للمادة الجافة للمجموع الخضري, و لم يكن هناك فرق معنوي بين تركيزي حامض الاسكوربك 30 و 60 ملغم/لتر في التاثير على قطر الساق و النسبة المئوية للمادة الجافة للمجموع الجذري والمجموع الخضري وكان لعدد مرات الاضافة تاثير معنوي في الصفات المدروسة حيث تفوقت الاضافة لمرتين على الاضافة لمرة واحدة في معظم الصفات. كانت التداخلات الثنائية والثلاثيه بين العوامل الرئيسيه

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معنوية و كانت افضل التداخلات ناتجة من معاملة اليوريا بتركيز 3.2 غرام/نبات و حامض الاسكوربك تركيز 60 ملغم/لتر والاضافة لمرتين بالشهر كما كانت نتائج الموسم الاول مشابه لما تم الحصول عليه في موسم النمو اثاني.

* البحث مستل من أطروحة دكتوراة للباحثة الاولى.

1. INTRODUCTION

Paulownia tree (Paulownia tomentose L.) is also called the Princess Princess tree, it is a deciduous tree belonging to the Pawlownaceae family. It grows naturally in central and western China and it is considered one of the fastest-growing trees. Its height reaches (10-25 m) and has large leaves with width (15-40 cm) with heart form and arranged in reversely on the stem. It produces aromatic flowers before the leaves appear in the spring and the color of the flowers are purple. The length of the petals is between 4-6 cm (Mcintosh et al., 1983) and it has been called as queen for its shape in the spring that covered with a Flowers and a pleasant scent resemble vanilla. The Paulownia tree in environmental science is called the "Empress" for its environmental benefits and made the Japanese as a state distinction. Paulownia has nine species, all of which are fast-growing plants with solid wood and they are among the fastest and most beautiful and most commercially developed trees in the world for wood production and as a source of wind and for the establishment of forests and farms (Bergman et al., 2003). Many species of paulownia are widely cultivated in China and New Zealand as well as in the United States of America, which is characterized by fast growth and high wood specifications (Wang and Shogren, 1992). Paulownia is a quadruple carbon plant in terms of the method of fixing carbon dioxide, thus it is highly efficient in various photosynthesis products (Woods, 2008; Lawrence, 2011). Paulownia leaves are also a good source of carbohydrates and protein and it can be compared to legume family crops in terms of the nutritional value of the leaves. Therefore, it is used as feed for livestock, green fertilizer, or peat moss manufacturing (Yadav et al., 2013; Woods, 2008). Paulownia wood is used in the manufacture of furniture, shipbuilding, and musical instruments (Mcintoch, 1983). It is also grown as an ornamental tree in public garages and streets. The nitrogen component is considered one of the most important elements necessary for the plant, where the plant content of nitrogen ranges between 5-2% of the dry weight and occupies an important role in plant nutrition and physiology, where it is involved in building the amino acids that are formed in building proteins, enzymes and cellular membranes, as well as It is involved in building chlorophyll, nucleic acids and vitamins (Wang et al.; 2014). Golman et al., (2006) found that the biomass increased with a rate of 43-82% as a result of three addition of urea or neutral fertilizers and they found no difference between the types of used fertilizers, where they indicated that nitrogen is the main nutrient and the determining factor in the effect of fertilization, and the addition of compound fertilizers is considered essential to stimulate the rapid growth of trees (Chen, 2006; Lyons, 1993). Ascorbic acid is considered one of the water-soluble vitamins, it is a reducing agent, an anti-oxidant, and a metabolic plant material. There is a lot of evidence that indicates that ascorbic acid has an important role in protecting plants from many environmental stresses such as salinity, temperatures, and heavy metals, and others (Shalat and Neuman, 2001; Vwioko et al., 2008). Spraying with ascorbic acid also leads to the activation of photosynthesis reactions by stimulating some of the enzymes of bio-reactions (Kefei, 1981). Since there are no studies on this plant in Iraq, The study aims to:

2. MATERIALS AND METHODS

The study was conducted at the Agricultural Research Station, College of Agriculture, University of Basra in saran house on seedlings of Paulownia trees (Paulownia tomentosa) and for two sequential seasons from 10/20/2016 until 1/9/2018. The seedlings were imported from the Arab Republic of Egypt by an agricultural nursery in Baghdad, with 15 cm height, in plastic bags. The seedlings were transported into

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large pots with a diameter of 35 cm, well washed with water and sterilized with formalin and then filled with a sterile growth media consisting of peat moss and Sandyness with a ratio of 1: 3. The plants were then converted to them on 10/22/2016 at the rate of one plant per pot. The pruning for all seedlings was done symmetrically to a height of approximately 10 cm from the soil surface. The green shoots began to open on 15/2/2017. The plants continued to grow until the ninth month, where their leaves began to fall as a result of the beginning of their entry into the Dormancy stage. A random sample was taken from the growth media and analyzed laboratory, as shown in Tables (1 and 2). All soil analyzes were performed in the central laboratory of the College of Agriculture, University of Basra, according to what was reported in (Black, 1965; Page et al., 1982).

Table 1: Some physical and chemical traits of used peat moss in the agricultural media.

Traits	Values
Degree of reaction pH	4.5-3.5
Organic matter %	97
Ash content %	5-3
Total nitrates %	1
Moisture content	50
Density ($g.cm^{-3}$)	90-70

Table 2: Some physical and chemical traits of the used loam soil in the agricultural media.

Traits	Value
Phosphorus ($mg.kg^{-1}$)	0.161
Potassium ($mol.L^{-1}$)	5.57
Total nitrogen ($mg.kg^{-1}$)	1.87
Organic matter %	2.01
Electrical conductivity (EC)	4.5
PH	7.13
Soil separates	
Clay %	14.82
Silt	5.31
Sand %	79.87
Soil texture	Sand

Experimental treatments

The study includes 18 factorial treatments with the Randomized Complete Block Design (RCBD), which are:

1- Nitrogen fertilization with urea at three levels: (0, 120 $kg.dunum^{-1}$, 1.6 g $urea.pot^{-1}$, 240 kg $N.pot^{-1}$, 3.2 g $urea.pot^{-1}$).
2- The number of adding times of nitrogen fertilizers every two to four weeks for four months.
3- Spraying with ascorbic acid at three concentrations of (0, 30, 60 $mg.L^{-1}$).

Nitrogen fertilization was conducted from the date of 3/15 to 6/15, as well as spraying with ascorbic acid. A neutralized compound fertilizer NPK (20-20-20) was added as a constant factor for all treatments with a rate of 1 gm per pot. The experiment was designed according to Randomized Complete Block Design (RCBD), with a factorial experiment and three factors. The results were analyzed using the statistical program and the least significant difference test was used to compare the averages below the probability level of 0.05 (Al-Rawi and Khalaf Allah, 1980).

3. RESULTS AND DISCUSSION

1- plant height (cm)

Table (3) shows that there are significant effects of the three study factors (urea fertilizer, ascorbic acid, and the number of adding times) and their interactions on the trait of plant height, where the response was significant for

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the higher concentration of nitrogen fertilizer (urea) in plant height for paulownia seedlings. The treatment (3.2 g.plant^{-1}) has excelled significantly, and for both seasons of study, which amounted to (125.1 and 159.0 cm), respectively, compared to the control treatment that gave the lowest plant height amounted to (106.0 and 134.3 cm). The high concentration of ascorbic acid (60 mg.L^{-1}) gave a significant increase in the average plant height for both seasons amounted to (124.4 and 157.9 cm), respectively compared to the lower concentration for the same treatment which amounted to (1.6 g.plant^{-1}) as well as the control treatment. As for the effect of the number of adding times was significant in this trait, where the treatment of twice adding per month was significantly excelled on the once adding treatment for both seasons, which amounted to (118.5 and 159.0 cm), respectively. Table (3) shows that the interaction between urea and ascorbic acid, as well as the interaction between urea and the number of adding times, and the effect of interaction between the number of adding times and spraying with ascorbic acid had a significant effect through the estimated increase in the plant height. As well as the interaction between the three study factors, it had a significant effect on the plant height, where the treatment with a high concentration of urea, ascorbic acid, and adding twice per the month was significantly excelled on the rest of the treatments and control which amounted to (131.2 cm).

Table 3: Effect of urea fertilizer, spraying with ascorbic acid, the number of adding times and their interactions on the plant height of the paulownia plant (cm)

Number of adding times	Urea (g.plant^{-1})	The first season (2017)				the second season (2018)			
		Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea	Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea
		0	30	60		0	30	60	
Once	0	83.4	113.5	128.2	105.9	104.3	144.1	150	129.9
	1.6	11.4	122.0	114.5	115.5	142	140.3	135.	139.4
	3.2	116.3	127.1	129.0	123.4	148.6	142.3	148.3	146.6
Twice	0	83.9	115.3	124.0	106.1	104.3	158.6	164.8	138.7
	1.6	133.8	125.7	118.5	126.8	176.8	155.7	166.3	167.3
	3.2	121.5	129.5	131.2	126.8	168.3	163.1	183.7	171.4
LSD for triple interaction		**2.124**			**1.225**	**1.986**			**1.145**
Effect of interaction between adding times and ascorbic acid	Once	101.7	120.2	124.3	Effect of adding times	128.9	142.4	145	Effect of adding times
					114.0				137.8
	Twice	110.9	122.7	124.5	118.5	145.2	159.1	170.9	157.1
L.S.D for interaction between adding times and ascorbic acid = 1.117					**LSD for Adding times = 0.702**	**LSD for interaction between adding times and ascorbic acid = =1.145**			**LSD for Adding times = 0.6566**
Effect of interaction between urea and ascorbic acid	Concentration	0	30	60	Effect of urea	0	30	60	Effect of urea
	0	84.7	114.4	126.1	106.0	104.3	159.4	158.4	134.3
	1.6	122.6	123.9	116.5	121.2	151.3	148	152.7	153.4
	2.3	118.9	123.4	130.1	125.1	157.4	150.6	166	159
L.S.D for interaction between urea and ascorbic acid = 1.502					**L.S.D=0.8663**	**L.S.D for interaction between urea and ascorbic acid =1.405**			**L.S.D=0.8102**

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The effect of the study treatments on the growth rate of the paulownia plant:

The results of the study indicated that there is increased linear growth for plant growth estimated based on the change in plant height during monthly periods and for five months under the influence of the studied treatment. Figure (1) shows an increase in plant height under the influence of urea fertilizer with a concentration of (3.2 g.plant^{-1}) from 37.83 cm to 125.10 cm after five months, and the increase was linear during the second, third and fourth months to the fifth month, as shown in Figure (1), and the percentage of increase in plant growth during the six months amounted to (230.69%) for the first season. As for the second season, the growth pattern was similar to the first season, and the effect of urea at a concentration of (3.2 g.plant^{-1}) was significant where the plant height increased from 56.54 cm to 159.00 cm during the five months of growth and with an increase of (180.22%). As for the effect of ascorbic acid on the growth rate, Table (2) shows that there is an increase in the growth rate during six months where the plant height increased significantly under the effect of spraying with ascorbic acid at a concentration of (60 mg.L^{-1}) for both seasons. The number of adding times had a significant effect on the growth rate during five months, where the twice adding per month has significantly excelled on the once adding per month. The triple and bi-interactions were significant for both seasons in the paulownia plant growth.

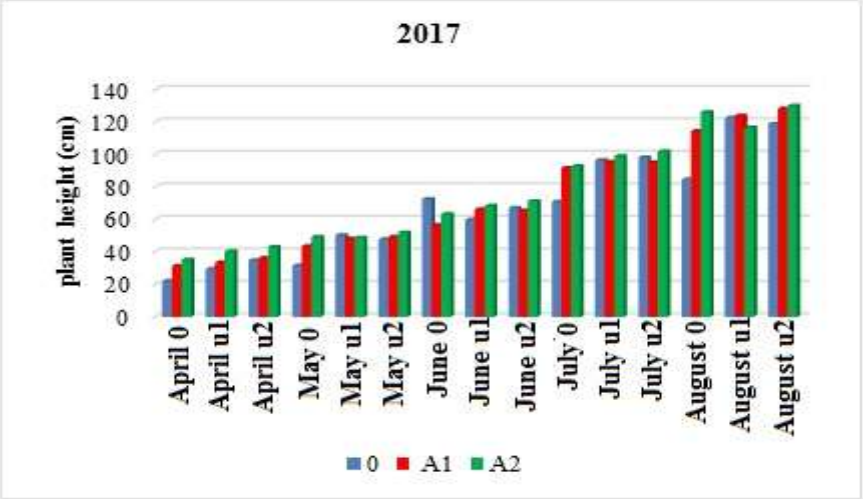

Figure 1: Effect of urea, ascorbic acid, and adding for once and twice per month on the growth rate of the paulownia plant (2017).

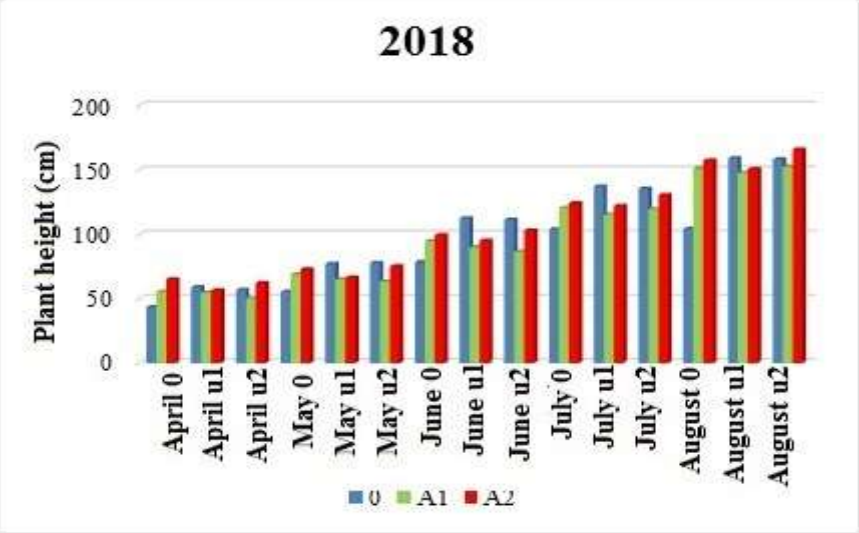

Figure 2: Effect of urea, ascorbic acid, and adding for once and twice per month on the growth rate of the paulownia plant (2018).

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2- Average stem diameter (cm)

Table (4) shows that adding urea fertilizer, spraying with ascorbic acid, and the number of adding times per month had a significant effect on the average stem diameter for the paulownia plant. where adding nitrogen fertilizer (urea) at a concentration of (1.6 g.plant^{-1}) gave a significant increase in stem diameter amounted to (18.47 and 24.96 mm) for both seasons, respectively, compared to the control plants that gave the lowest stem diameter amounted to (10.38 and 15.69 mm). As for the effect of spraying with ascorbic acid, the plants of control treatment have excelled on the plants of first and second concentrations for ascorbic acid and the lowest stem diameter resulted from the plants treated with ascorbic acid at a concentration of (30 mg.L^{-1}) for the first season. As for the second season, the plants sprayed with ascorbic acid at a concentration of (30 mg.L^{-1}) with control plants, which did not differ significantly with plants sprayed with ascorbic acid at a concentration of (60 mg.L^{-1}), which gave the least significant difference. The bi-interaction between urea fertilizer and ascorbic acid had a significant effect on the average stem diameter, as well as the interaction between urea fertilizer and the number of adding times, and the interaction between spraying with ascorbic acid and the number of adding times, it had a significant effect on the average of stem diameter. As for the effect of triple interaction for the three study factors, it had a significant effect on the average stem diameter, where plants treated with urea at a concentration of (1.6 g.plant^{-1}), ascorbic acid at a zero concentration, and adding twice per a month were characterized by a significant increase in the average stem diameter which amounted to (25.49 and 31.35 mm) for both seasons, respectively.

Table 4: Effect of urea fertilizer, spraying with ascorbic acid, the number of adding times and their interactions on the average stem diameter (mm) for the paulownia plant

Number of adding times	Urea (g.plant^{-1})	The first season (2017)				the second season (2018)			
		Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea	Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea
		0	30	60		0	30	60	
Once	0	6.93	10.47	12.74	9.74	10.43	16.59	18.67	14.75
	1.6	16.51	19.44	12.91	16.31	21.76	24.78	16.56	21.1
	3.2	20.41	11.03	10.7	14.68	25.62	14.98	16.87	19.8
Twice	0	6.38	13.09	15.16	11.03	11.49	18.49	21.61	16.63
	1.6	25.49	20.24	14.54	20.63	31.35	29.8	24.45	28.82
	3.2	23.5	12.38	17.52	18.37	27.97	15.7	26.28	23.78
LSD for triple interaction		**1.549**			**0.8932**	**1.760**			**1.014**
Effect of interaction between adding times and ascorbic acid	Once	13.85	13.33	12.18	Effect of adding times 13.19	18.38	18.56	17.5	Effect of adding times 18.17
	Twice	17.25	15.02	15.68	16.11	22.4	21.05	23.86	22.43
L.S.D for interaction between adding times and ascorbic acid = 1.117					**LSD for Adding times = 0.702**	**LSD for interaction between adding times and ascorbic acid = =1.145**			**LSD for Adding times = 0.6566**
Effect of interaction between urea and ascorbic acid	Concentration	0	30	60	Effect of urea	0	30	60	Effect of urea
	0	6.66	11.78	13.95	10.38	10.96	17.54	20.14	15.69
	1.6	21	19.84	13.73	18.47	26.55	27.29	20.50	24.96
	2.3	21.95	11.71	14.11	16.53	26.8	15.34	21.57	21.79
L.S.D for interaction between urea and ascorbic acid = 1.095					**L.S.D=0.6317**	**R.L.S.D for interaction between urea and ascorbic acid =1.244**			**L.S.D=0.7176**
Effect of ascorbic acid		15.55	14.18	13.93		20.39	19.81	20.68	

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3- The average number of leaves (leaves.plant^{-1})

Table (5) shows that adding urea fertilizer, spraying with ascorbic acid, and the number of adding times per month had a significant effect in increasing the average number of leaves for the paulownia plant, where adding nitrogen fertilizer (urea) at a concentration of (3.2 g.plant^{-1}) recorded the highest average number of leaves amounted to (24.5 and 29.11 leave.plant^{-1}) for both seasons, respectively, compared to the control plants that gave the lowest average number of leaves amounted to (20.14 and 22.76 leave.plant^{-1}) for both seasons, respectively. As for the effect of spraying with ascorbic acid, the plants treated with ascorbic acid at a concentration of (30 mg.L^{-1}) have significantly excelled in the average number of leaves amounted to (25.09 and 26.24 leaves.plant^{-1}) compared to the control treatment which gave the lowest average amounted to (19.97 and 23.26 leaves.plant^{-1}) for both seasons, respectively. As for the effect of the number of adding times (once and twice) per month was significant in this trait, where the plants of twice adding per month have excelled on the plants of once adding in the average number of leaves, with a significant difference between them and for two consecutive seasons. As for the bi-interactions, it was significant, where the plants sprayed with ascorbic at a concentration of (60 mg.L^{-1}) and the control treatment of urea fertilizer gave a significant increase in the average number of leaves. As for the second season, the plants treated with ascorbic acid at a concentration of (30 mg.L-1) and urea at a concentration of (1.6 g.plant^{-1}) gave the highest average number of leaves amounted to (32.23 leaves.plant^{-1}). Table (5) also shows that the interaction between the number of adding times and spraying with ascorbic acid showed a significant effect on the average number of leaves. As well as the interaction between ascorbic acid and the number of adding times per month, the treatment with a concentration of (30 mg.L^{-1}) gave a significant increase in the average number of leaves amounted to (26.75 and 27.23 leaves.plant^{-1}). As for the effect of triple interaction for the study factors, it was significant in this trait, where the plants of the control treatment for urea, which was sprayed with ascorbic acid at a concentration of (30 mg.L^{-1}), and the twice adding per a month recorded a significant difference in the average number of leaves amounted to (34.48 leaves.plant^{-1}).

1- Leaf area (cm^2)

Table (6) indicates the effect of adding urea fertilizer on the average leaf area for the paulownia plant. The treatment (3.2 g.plant^{-1}) recorded the highest average leaf area in the plant amounted to (349.8 and 435.1 cm^2) for both seasons, respectively compared to the lowest average leaf area resulted from the control treatment which amounted to (203.7 and 260.1 cm^2) for both seasons, respectively. The effect of ascorbic acid was significant in the average leaf area, where the plants of the treatment (60 mg.L^{-1}) have excelled on the rest of the treatments in the average leaf area amounted to (346.8 and 387.6 cm^2) for both seasons, respectively. As for the effect of the number of adding times (once and twice) per a month, it was significant in this trait, where the plants with the treatments of twice adding have excelled on the plants with the treatments of once adding in the average leaf area, with a significant difference between them and for both seasons. Table (6) indicates that the bi-interaction between urea fertilizer and ascorbic acid, as well as the interaction between urea and the number of adding times and interaction between spraying with ascorbic acid and the number of adding times significantly affected the leaf area of the paulownia plant for both seasons, respectively. As for the effect of triple interaction between urea fertilizer, ascorbic acid, and the number of adding times was significant, and for both seasons. The urea treatment (3.2 g.plant^{-1}), spraying with ascorbic acid at a concentration of (60 mg.L^{-1}), and adding twice per month gave the highest average leaf area amounted to (508.5 and 491.3 cm^2) for both seasons, respectively.

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Table 5: Effect of urea fertilizer, spraying with ascorbic acid, the number of adding times and their interactions on the average number of leaves (leaves.plant^{-1})for the paulownia plant

Number of adding times	Urea (g.plant^{-1})	The first season (2017)				the second season (2018)			
		Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea	Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea
		0	30	60		0	30	60	
Once	0	11.81	29.72	18.51	19.19	15.68	31.51	23.22	22.69
	1.6	19.66	21.09	18.7	19.8	24.41	25.46	21.99	24
	3.2	23.47	17.41	26.8	22.65	26.58	23.28	30.63	26.81
Twice	0	12.06	34.48	19.72	21.08	14.76	32.43	24	22.84
	1.6	28.08	20.76	20.45	23.57	29.93	19.19	25.09	25.26
	3.2	30.13	22.42	25.21	26.34	33.54	26.44	33.58	31.42
RLSD for triple interaction		**2.307**			**1.33**	**2.253**			**1.299**
Effect of interaction between adding times and ascorbic acid	Once	17.66	23.44	21.06	Effect of adding times 20.41	21.57	27.23	25.07	Effect of adding times 24.32
	Twice	22.27	26.75	21.58	23.41	24.95	26.66	27.2	26.14
R.L.S.D for interaction between adding times and ascorbic acid = 1.33					**LSD for Adding times = 0.7624**	**LSD for interaction between adding times and ascorbic acid = =1.299**			**LSD for Adding times = 1.299**
Effect of interaction between urea and ascorbic acid	Concentration	0	30	60	Effect of urea	0	30	60	Effect of urea
	0	11.93	23.85	26.8	20.14	15.22	31.97	23.61	22.76
	1.6	32.1	20.93	19.92	21.69	27.17	22.33	23.54	24.63
	2.3	19.12	19.57	26.	24.5	30.06	24.86	32.1	29.11
L.S.D for interaction between urea and ascorbic acid = 1.631					**L.S.D=0.9407**	**R.L.S.D for interaction between urea and ascorbic acid =1.593**			**L.S.D=0.9188**
Effect of ascorbic acid		19.97	25.09	21.32		23.26	26.94	26.14	

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Table 6: Effect of urea fertilizer, spraying with ascorbic acid, the number of adding times and their interactions on the average leaf area (cm^2)for the paulownia plant

Number of adding times	Urea (g.plant^{-1})	The first season (2017)				the second season (2018)			
		Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea	Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea
		0	30	60		0	30	60	
Once	0	97.1	198	338.7	199.9	172.7	281.1	303.8	244.5
	1.6	172.1	293.4	204.7	218.2	200.2	261.7	291.7	247.2
	3.2	250.3	203.8	396.9	280.3	295.5	378.2	292.8	379.6
Twice	0	99.9	206.9	351.9	207.6	172.1	297.6	392	275.7
	1.6	203.1	354	281.2	271.8	389.7	484.2	484.2	396.7
	3.2	303.8	484.1	508.5	419.3	318.6	427.1	491.3	490.6
RLSD for triple interaction		**2.737**			**1.578**	**Triple interaction**			**1.722**
Effect of interaction between adding times and ascorbic acid	Once	165.6	228.4	316	Effect of adding times	.6242	278.8	350.6	Effect of adding times
					229.5				285.8
	Twice	192	3342	377.7	290.4	313.9	411.7	424.7	376.5
R.L.S.D for interaction between adding times and ascorbic acid = 1.578					**LSD for Adding times = 0.9047**	**LSD for interaction between adding times and ascorbic acid = =1.722**			**LSD for Adding times = 1.722**
Effect of interaction between urea and ascorbic acid	Concentration	0	30	60	Effect of urea	0	30	60	Effect of urea
	0	98.5	202.5	345.3	203.7	172.4	289.4	347.9	260.1
	1.6	187.6	323.7	243	245	295	373	307	322
	2.3	277.1	344	452.7	349.8	402.7	392.1	521.2	435.1
L.S.D for interaction between urea and ascorbic acid = 1.936					**L.S.D=1.116**	**R.L.S.D for interaction between urea and ascorbic acid =2.112**			**L.S.D=1.218**
Effect of ascorbic acid		178.8	281.3	346.8		278.2	345.3	387.6	

2- The percentage of dry matter

Table (7) shows that the addition of nitrogen fertilizer (urea) to both concentrations (1.6 and 3.2 g.plant^{-1}) gave a significant increase in the percentage of dry matter for the total vegetable and without significant difference between them (34.73 and 35.13) compared to the control plants that gave the lowest percentage amounted to (32.72) in the first season. As for the second season, the urea treatment with concentration (1.6 mg.L^{-1}) gave a significant increase from those plants to which the nitrogen fertilizer was added, but with a concentration of (3.2 g.plant^{-1}) and the control plants. As for the effect of ascorbic acid, it had a significant effect on this trait, where the plants with a high concentration of ascorbic acid have excelled on the plants with low concentration and the plants of the control treatment for both seasons. As for the effect of the number of adding times, it was significant. The treatment of twice adding per month has excelled on the plants of the once adding per month. As for the effect of the interaction between urea and spraying with

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ascorbic acid, it was significant in this trait, as well as between ascorbic acid and the number of adding times per month and the interaction between urea fertilizer and the number of adding times per month, it was significant in both seasons, and the triple interaction gave a significant effect in this trait. Where the highest percentage of a dry matter for the total vegetative resulted from the urea treatment (1.6 g.plant^{-1}) and spraying with ascorbic acid at a concentration of (60 mg.L^{-1}) and twice adding per month, which amounted to (93% 39%) in the first season, while the highest percentage in the second season resulted from the control treatment of urea fertilizer and the concentration of (60 mg.L^{-1}) for ascorbic acid and for once adding per month, which amounted to (41.54%).

Table 7: Effect of urea fertilizer, spraying with ascorbic acid, the number of adding times and their interactions on the percentage of dry matter (%)for the paulownia plant

Number of adding times	Urea (g.plant^{-1})	The first season (2017)				the second season (2018)			
		Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea	Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea
		0	30	60		0	30	60	
Once	0	29.13	31.29	31.84	30.59	47.04	50.09	51.40	49.26
	1.6	29.71	33.43	38.17	33.36	50.04	47.40	52.18	49.89
	3.2	31.17	34.29	36.72	33.77	49.27	50.24	47.69	49.09
Twice	0	35.38	33.38	35.69	34.87	47.65	52.34	53.55	50.83
	1.6	33.75	35.40	39.93	36.10	52.46	54.46	54.39	53.55
	3.2	35.40	37.85	36.56	36.48	53.32	50.67	54.41	52.85
RLSD for triple interaction		**1.766**			**1.018**	**1.094**			**0.630**
Effect of interaction between adding times and ascorbic acid	Once	29.91	32.83	35.20	Effect of adding times	48.61	49.33	50.52	Effect of adding times
					32.38				49.40
	Twice	34.89	35.32	37.22	35.72	50.80	52.38	54.06	52.25
R.L.S.D for interaction between adding times and ascorbic acid = 1.018					**LSD for Adding times = 0.583**	**LSD for interaction between adding times and ascorbic acid = =0.630**			**LSD for Adding times = 0.361**
Effect of interaction between urea and ascorbic acid	Concentration	0	30	60	Effect of urea	0	30	60	Effect of urea
	0	32.25	32.25	33.76	32.73	47.35	51.21	52.48	50.05
	1.6	31.73	34.42	39.76	34.73	51.25	50.78	53.28	51.72
	2.3	33.28	36.07	36.64	35.13	51.29	50.46	51.05	50.97
L.S.D for interaction between urea and ascorbic acid = 1.249					**L.S.D=0.7203**				**L.S.D=0.436**
Effect of ascorbic acid		32.40	34.08	36.21		49.70	50.85	52.29	

3- The percentage of dry matter for the root system

Table (8) indicates the effect of urea fertilizer significantly on the percentage of dry matter, where the treatment (1.6 g.plant^{-1}) recorded the highest percentage amounted to (42.27 and 44.70 %) for both seasons, respectively compared to the lowest percentage that resulted from the control treatment. Ascorbic

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acid has had a significant effect on this trait, where the high and low concentration of ascorbic acid has excelled without a significant difference between them on the control plants for both seasons. As for the effect of adding times (once and twice) per month, the plants of the twice adding treatment has excelled on the plants of once adding treatment. As for the second season, treatments were recorded against the first season, with a significant difference between them in the percentage of dry matter. As for the effect of bi-interaction between spraying with ascorbic acid and adding urea fertilizer, as well as the interaction between urea and the number of adding times per month, it was significant in this trait. The triple interaction also had a significant effect, where the highest percentage of dry matter for the roots resulted from the urea treatment (1.6 g.plant^{-1}), spraying with ascorbic acid at a concentration of (30 mg.L^{-1}), and twice adding per month which amounted to (48.27%) in the first season while the highest percentage in the second season resulted from the control treatment of urea fertilizer, spraying with ascorbic acid at a concentration of (60 mg.L^{-1}), and once adding per month which amounted to (50.53%).

Table 8: Effect of urea fertilizer, spraying with ascorbic acid, the number of adding times and their interactions on the percentage of dry matter for the root system(%) for the paulownia plant

Number of adding times	Urea (g.plant^{-1})	The first season (2017)				the second season (2018)			
		Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea	Ascorbic acid (mg.L^{-1})			Effect of interaction between the number of adding times and Urea
		0	30	60		0	30	60	
Once	0	33.55	34.26	37.39	34.92	28.23	48.61	50.53	41.04
	1.6	35.68	39.37	39.84	38.04	41.83	47.83	48.51	45.66
	3.2	39.47	36.87	39.00	38.55	50.18	45.02	49.54	48.44
Twice	0	335.81	44.04	44.74	40.95	28.73	38.98	40.85	35.44
	1.6	47.87	48.27	42.93	46.51	44.77	43.82	42.30	43.74
	3.2	38.86	39.70	42.00	40.05	42.21	41.83	36.39	40.35
RLSD for triple interaction		**4.258**			**2.455**	**2.270**			**1.309**
Effect of interaction between adding times and ascorbic acid	Once	35.97	36.58	38.61	Effect of adding times	38.92	47.30	49.63	Effect of adding times
					36.94				44.65
	Twice	40.34	44.00	43.37	42.35	37.59	41.29	39.94	39.40
R.L.S.D for interaction between adding times and ascorbic acid = 2.455					**LSD for Adding times = 1.407**	**LSD for interaction between adding times and ascorbic acid = 1.309**			**LSD for Adding times = 0.7502**
Effect of interaction between urea and ascorbic acid	Concentration	0	30	60	Effect of urea	0	30	60	Effect of urea
	0	34.68	39.14	41.07	37.93	28.48	43.80	45.69	38.24
	1.6	41.78	43.82	41.38	42.27	43.33	45.82	45.41	44.70
	2.3	39.16	38.82	40.50	39.30	46.19	43.43	42.96	44.39
L.S.D for interaction between urea and ascorbic acid = 3.012					**L.S.D=1.737**	**1.605**			**L.S.D=0.925**
Effect of ascorbic acid		38.15	40.29	40.99		38.25	44.29	44.79	

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The increase in the average of plant height under the influence of urea fertilizer may be due to the role of the important nitrogen element in increasing the formation level of plant hormones through its role in the formation of amino acids, including the amino acid tryptophan, which is a starting compound for the formation of Auxin IAA, and as a result, there was an increase in cell division and its size, which reflected positively on the plant height (Al-Sahaf, 1989). This result agrees with (Micntosh et al., 1983) in their study on paulownia plants and also agree with (Abdul Jabbar 2012,) on the Damas plant, where the high concentration of nitrogen fertilizer improved many traits of vegetative growth, including plant height, number of leaves, and leaf area. it also agreed with (Farahat et al., 2014) on paulownia plants, where they found that chemical fertilizers stimulate the growth of plants through the role of nitrogen in building protein and increasing Mystic efficacy. It also includes amine derivatives such as Choline, and nitrogen also contributes to converting carbon dioxide and water into sugars with the help of light energy. Nitrogen also has an effective role in absorbing nutrients (Blumenthal and Sauder, 2002; Shams Allah, 2007). The increase in stem diameter in the second season shows that the significant effect increases with increasing concentration, and the reason may be due to the role of the highest and appropriate focus to give the increase in the stem diameter, as well as in stimulating and expanding cells and their division (Horemans et al., 2000). It also agreed with (Colman et al., 2006) in their study on Poplar seedlings who found that fertilization treatments increased the leaf area with percentage amounted to (33 and 37%) due to the effect of urea and neutral compound fertilizer. The accumulation of the percentage of dry matter as a result of urea fertilizer may be due to the role of nitrogen in increasing metabolic processes and increasing the percentages of dry matter due to the high activity of respiration, water absorption, nutrients absorption, and photosynthesis processes where it invests in the production of dry matter (Farahat et al., 2014). This result agrees with (Al-Rabei, 2004) in their study on Ziziphus spina-christi trees. It also agreed with (Farahat et al., 2014) on paulownia plant and (Gotore et al., 2014) on pine and eucalyptus trees, where they found that using nitrogen fertilizer with low concentrations and for several times is better than adding one time to lead to its dissolution with water and the use of the plant only with low quantity. As for the role of ascorbic acid, it has an influential role in the photosynthesis process, which stimulated the growth of plant stem and its height as a result of using the products of photosynthesis and growth processes (Robin 1973). This result agrees with (Mohammed et al., 2016) on the dahlia plant, where the polyphenol compounds produced by plants as byproducts show high effectiveness as antioxidants and prevent free radical formation which leads to the rapid growth of paulownia plants. (Al-Tinawi et al., 2010). The increase in stem diameter in the second season shows that the significant effect increases with increasing concentration, and the reason may be due to the role of the highest and appropriate focus to give the increase in the stem diameter, as well as in stimulating and expanding cells and their division (Horemans et al., 2000; Smirnof and Wheeler, 2000). Since ascorbic acid is included as a Coenzymatic in the enzymatic reactions for the metabolism of protein and carbohydrates, it helps to stimulate the process of active growth. As well as its entry into the processes of respiration and photosynthesis (Robinson, 1973). The reason for increasing the leaves may be due to the role of ascorbic acid in the processes of dividing and growing plant cells, which leads to encouraging protein and nucleic acid formation as well as its role in protecting the plant from environmental stresses (Wheeler and Smirnoff, 2000). The significant effect of ascorbic acid in increasing the leaf area and for both seasons may be attributed to the role of ascorbic acid in regulating the bio-processes of the plant. As for light oxidation or its resistance to environmental conditions such as drought, which leads to an increase in the leaf area (Ghklin and Barth). Guo et al., (2005) also showed that ascorbic acid is one component of the defense system for the non-enzymatic plant against many different stresses by protecting the plant from the

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damage caused by it. The reason for increasing the percentage of dry matter may be due to the role of ascorbic acid in the metabolism of living cells, where spraying with ascorbic acid leads to activation of photosynthesis reactions by stimulating some enzymes of bio-reactions (Kefei, 1981).

It can be concluded from this study that urea fertilization in several batches and spraying with ascorbic acid has an important role in improving the traits of the vegetative growth for paulownia seedlings.

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