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RESEARCH ARTICLE
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Influence of Site factors and chemical fertilizers on growth of Paulownia tomentosa seedlings in Shaqlawah-Erbil.

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ABSTRACT
Across the globe, urban centers and farms are expanding, often at the cost of natural forest systems, which are also the victims of an increasing demand for timber. The loss of these systems causes severe damage to regions ecosystem: soil erosion increases while soil moisture capacity and atmospheric humidity decrease The Paulownia tree provides a unique and ideal solution to this problem. It is a fast-growing, readily sustainable hardwood requiring minimal management and very little investment. Harvesting begins within 8-10 years and can continue yearly for as long as is desired, since new shoots grow from the stumps of felled trees. This study aimed to check the comparable effect between chemical fertilizer NPK and Potassium sulphate K2SO4 in comparable with control on growth traits of Paulownia tomentosa seedlings. the experiment conducted in shaqlawah town which belong to erbil 50 km to the north in the north face of safeen mountain in permanent field. during May 2022 to April 2023. The experiment designed according to RCBD full factorial, two fertilizers used K2SO4 30g. and NPK 30g. three times per year every four months with control no fertilize treat. the biometric traits height and diameter measured three times after (4 ,8, 12) months of planting. The leaf chemical analysis was doing two times after (6, 12) months of planting for NPK determination. In leaf samples, even the soil chemical and physical analysis was caried out for the field soil before planting. The climatic factors measured by the ministry of Agriculture between May 2022 to April 2023. The results show highly significance effect of site factors conditions (temperature, light and precipitation) on biometric growth of seedlings were p value ≤0.05 during the experiment with increment 158 cm in height of seedling and increment 11 mm in diameter. the results show significance between fertilizers effect on biometric growth traits (height and diameter) of seedlings, so the data p value for the growth trait (height) of the seedlings showed significant P value ≤0.05 during the experiment duration between NPK, K2SO4 and control, the increment were 27 cm between control and K2SO4 and 89 cm between NPK and control. for the diameter of seedlings, the p value of anova table were ≥0.05 between K2SO4 and Control and ≤0.05 between Control and NPK. according to these results we recommend to to use chemical fertilizer for producing seedlings and Afforestation programmes especially NPK fertilizer which enhance the growth of seedlings significantly even because our land were mostly had a deficiency on nitrogen , It is clear to us that there are differences in the proportion of nutrients in the soil of the regions, but the main factor influencing the process of forest growth is the nitrogen element, which is considered one of the most important problems of plant nutrition in arid and semi-arid areas.

***Keywords*:** Trees Ecophysiology, minerology & fertilizers, growth traits.

INTRODUCTION
Paulownia tomentosa (Thunb.) Steud. is a fast-growing tree named Empress tree which belongs to the family Paulowniaceae. It is planted as an ornamental tree and as a source of renewable energy as well as paper pulp and furniture [1]. Paulownia wood is high quality for making musical instruments, furniture, doors and windows. [2]. In addition, Paulownia species are among the most important forestry commercial crops in the world. The tree native to China and East Asia [3]. Can assimilate of significant amounts of carbon dioxide from the atmosphere, most importantly, the ability to regenerate many times after cutting, the tree has been used in plantations for more than 40 years in different regions of America, Europe, Asia and Australia [4]. The height of trees is (10-25) m and have 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 [5] and it has been called as queen for its shape in the spring. 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 [6]. Chemical fertilization, especially NPK is known to promote the vegetative growth of tree seedlings [7]. The nitrogen component is considered one of the most important elements necessary for the plant, where the plant content of nitrogen ranges between 2-5% of the dry weight and occupies an important role in plant nutrition and physiology [8]. [9] on *Taxodium distichum*., concluded that the seedling height, stem and root diameter, number of leaves and roots, fresh and dry weight of leaves, stems and roots as well as leaf area were increased as a result

of the NPK application. [10] found that the biomass increased with a rate of 43-82% as a result of three additions of urea or neutral fertilizers. Regarding the effect of NPK fertilization on mineral contents [11] on *Ficus benjamina*., concluded that mineral contents increased as a result of NPK fertilization applications. our knowledge there is no previous study on the morphological and physiological properties of *Paulwonia tomentosa* in responses to chemical fertilizer. The objective of this study was to evaluate the site factors in shaqlawah-erbil and effect of NPK and K_2SO_4 on growth parameters and chemical composition of *Paulownia tomentosa* .

Material and methods

1- Experiment set up

This The experiment took place in Shaqlawah erbil in the north face of Safeen mountain in the field between may2022to April 2023, four months-old, bag container-rooted seedlings of similar height (0.15–0.18) m, stem diameter and crown characteristics were obtained in early April 2022 from a local nursery. four-months-old seedlings were chosen because the early developmental stage is crucial for seedling establishment. One species used *Paulownia tomentosa* broad-leaved, Chinese tree species of economic importance were studied, associated with ectomycorrhizal (ECM) fungi [12] *the* experiment designed as RCBD one factor to check the effect of two chemical fertilizer Potassium sulphate K_2SO_4 (31O+51K+18S) and compound NPK (20-20-20) in comparable with control on growth traits.

2- Seedling planting

The seedlings planted in permanent field in shaqlawah, ten replications used per treatment, the total number of seedlings were 30. the seedlings irrigated and rested for one week with ought treatment to acclimate with the field situation, the seedlings stayed in the field 12 months treated with silvicultural treat watering in summer months May to October (5 ltr./week) till the harvest in April.

3- Fertilizer treatment

Two types of fertilizers used to fertilize the seedlings in comparable with control treatment, NPK (20-20-20) and Potassium Sulphate K_2SO_4 (31O-51K+18S) 30 g. three times / year every 4 months, each seedling irrigated (5) Ltr./ week.

4- Biometric measuring

The height of seedling measured with Haga Altimeter measure in dimension (0- 30) m according to [13]. the diameter measured with caliper Haglof Sweden SS 88200-dimension (0- 150) mm, the height measured from the base of seedling to the highest tip and the diameter measured in the middle of seedling DBH to get the real value. The measuring of biometric data done three times, after (4,8,12) months,D1 dated1/9/2022,D2 1/1/2023, D3 1/5/2023of planting.

5- Leaf chemical analysis

The leaf chemical analysis of leaf samples measured in the lab two times, after 6 and 12 months of planting, the leaf of seedlings cutted and putted in cartoon bags and labeled, the samples putted in oven in 60 °C for 48 hours to drying the samples, For determination of leaf nitrogen N,P,K concentrations, dried until constant mass, fine leafs were ground to powder (Pulverisette 5; Fritsch, Idar-Oberstein, Germany) the biomass measured as dry matter in (gm ±0.1). The samples were weighted and the data recorded. The total percentage of nitrogen was estimated using the Macro Kjeldahl device, potassium were measured according to [14], The amount of phosphorus was estimated calorimetrically using the method [15].

6- Soil Sampling and chemical Analysis

Soil sample levels were collected from four different locations in the field spaced around the tree seedlings [16]. soil samples were collected from topsoil to a depth of 50 cm and placed in nylon bags and closed tightly to prevent moisture leakage. For determination of leaf nitrogen % N, P, K concentrations, dried until constant mass, fine leafs were ground to powder (Pulverisette 5; Fritsch, Idar-Oberstein, Germany) the biomass measured as dry matter in (gm ±0.1). the samples weighted and the data recorded. The total percentage of nitrogen was estimated using the Macro Kjeldahl device, potassium were measured, The amount of phosphorus was estimated calorimetrically using the method [17]. The percentage of organic matter was determined by the dry ignition method [18]. pH measurement Using an oxygen meter (pH – Meter Pye unicam Pw – 9420) [18]. Measurement of electrical conductivity Ec (Digital connector Pw – 9526).

7- Data management and statistical analysis

The statistic caried out with spss program, data imported to excel file.the data analyzed with GLM linear model (Anova two way) full factorial multi variable . first the data checked with Shapiro to check the normality of data, then descriptive statistic calculated to get the means of variable with standard error value. even the graphs made with SPSS.

Results

1- Influence of Site factors and time on biometric data

According to statistical analysis results, the data p value for the growth traits (Height and Diameter) for the seedlings showed significant P value ≤ 0.05 during the experiment duration between D1 which is the date four month after starting the experiment and D2 which is eight months from planting and D3 after twelve month for the growth traits height and Diameter of seedlings fig. (3,4), so the means of height of *Paulownia tomentosa* seedlings in D1 were 70 cm were the mean of D2 were 141cm and mean height for D3 were 228cm with increment yield 71 cm between D1 and D2 during eight months and the p value of anova table were ≤ 0.05. and increment yield 158 cm between D1 and D3 during twelve months and the p value of anova table were ≤ 0.05. for the diameter traits the D1 mean were 10 mm and for D2 were 15 mm and 21 mm for D3, the p value was ≤ 0.05 which means significantly of growth traits per time duration first to end of experiment.

2- Influence of fertilizers type on biometric data

According to statistical analysis results, the data value for the growth trait (Height) for the *Paulownia tomentosa* seedlings showed significant P value ≤ 0.05 during the experiment periods between control and NPK and K_2SO_4. so the means of height of seedlings in control treatment were 95 cm and in KS were 122cm and in NPK were 184 cm. So the difference in height of seedling between control and K_2SO_4 were 27cm and between K_2SO_4 and NPK were 62cm with highest differences between control and NPK were 89cm. and the p value of anova table were ≤0.05 which means significantly of growth height of seedlings traits per fertilizer type duration first to end of experiment. Which means the differences of fertilizer type for availability of macro nutrients which is very important for the growth of seedlings physiologically and producing of biomass [19]. for the diameter traits significant p value found between control and NPK and K_2SO_4 continuously mean≤0.05 if the mean diameter for control were12 mm and 17 mm for NPK and (14) for K_2SO_4. No significant found between NPK and K_2SO_4 if P value were ≥0.05 fig. (1,2).

3- Influence of fertilizers type on leaf chemical content of nutrients

According to statistical analysis results, the data p value for the leaf chemical trait content of nutrients for the seedlings showed significant P value ≤0.001 in D1 and D2 between control, K_2SO_4 and NPK for % total nitrogen content, % phosphors and % Potassium between fertilizer treatment if the N% content in 30/4/2022 were 4.95% in NPK and 0.20% in control and 0.19%in K_2SO_4. The phosphor content was 2.40% in NPK, 0.24% in control and 0.20% in K_2SO_4. Potassium content in leaf samples were 1.63% in NPK with significant p value≤0.001 with control content 0.62% while no significant difference between NPK1.63% and K_2SO_4 1.245% if P value were ≥0.05 table(1). the date two D2 after 12 months of planting the experiment 30/4/2023 the results show the same effect of fertilizer treatment on leaf chemical content of nutrients N,P,K so the p value were significant ≤0.001 between control and NPK and between K_2SO_4 and NPK for (N)% were 4.97% in NPK and 0.28% in K_2SO_4 and 0.19% in control. For the phosphors (P)% were 2.58% in NPK, 0.23% in K_2SO_4 and 0.21% in control. Potassium content in leaf samples significant were found between control and K_2SO_4 and NPK p value≤0.001 , (K)% in control were 0.41% and in NPK (K)% were 1.76% and in K_2SO_4 (K)%were1.34% with no significant found between K_2SO_4 and NPK in (K)% content if P value were ≥0.05, table (1).

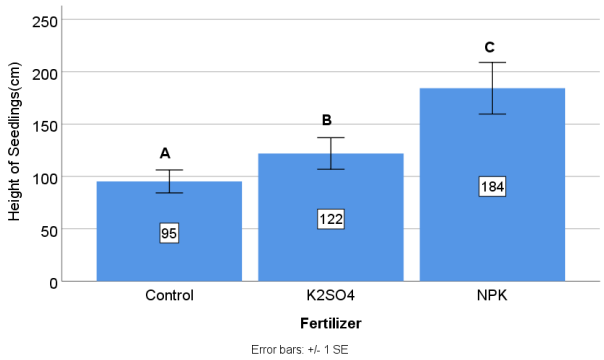

figure 1 mean height of seedling of Paulownia tomentosa under three different fertilization treatments in soil spots. Significant differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10).

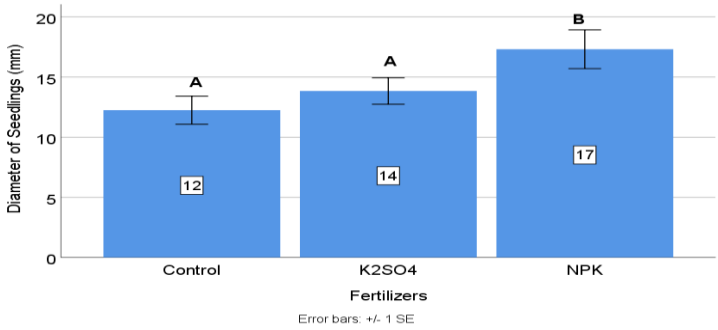

figure 2 mean height of seedling of Paulownia tomentosa under three different fertilization treatments in soil spots. Significant differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10).

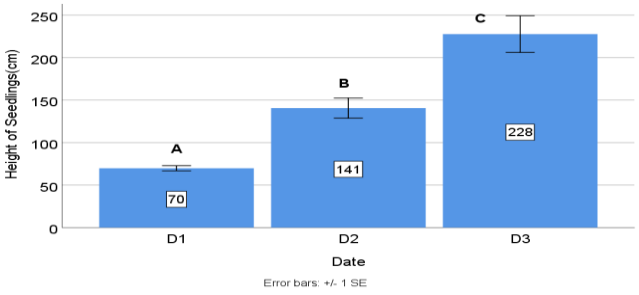

figure 3 mean height of seedling of Paulownia tomentosa under three different date , Significant treatments in. differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10).

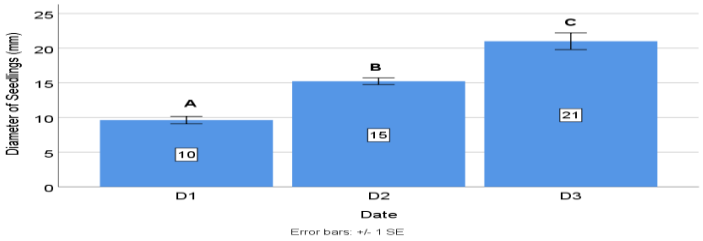

figure 4 mean diameter of seedling of Paulownia tomentosa under three different date treatments in soil spots. Significant differences between treatments are indicated by different

letters (t-test, p<0.05, mean+SE, n=10).

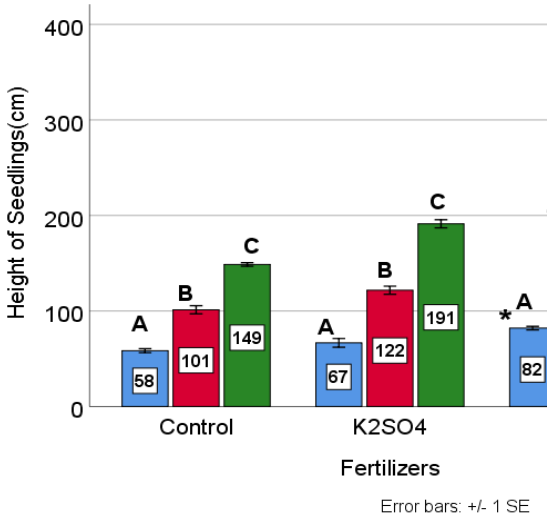

figure 5 mean height of seedling of Paulownia tomentosa under three different fertilization treatments and date in soil spots. Significant differences differences between dates marked by capital letter and stars between fertilizer treatments(t-test, p<0.05, mean+SE, n=10).

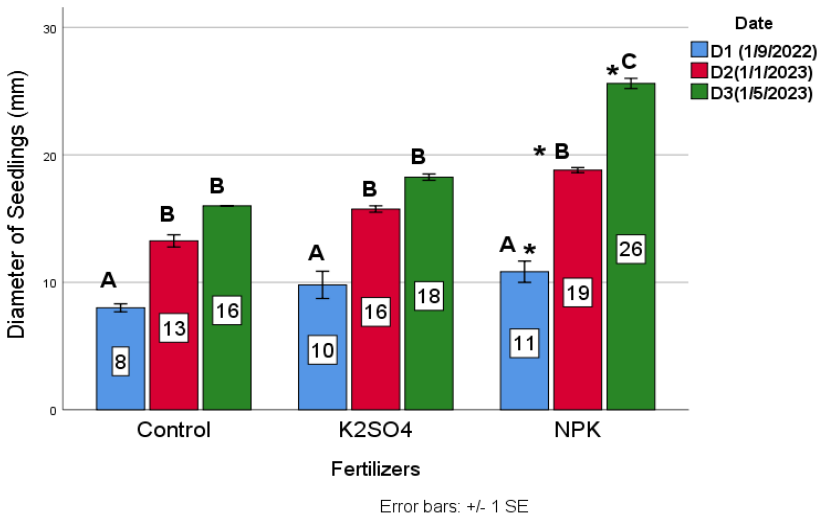

figure 6 mean diameter of seedling of Paulownia tomentosa under three different fertilization treatments in soil spots and date. Significant differences between dates marked by capital letter and stars between fertilizer treatments(t-test, p<0.05, mean+SE , n=10.

Table 1 leaf chemical traits of the species *Paulownia tomentosa* , total nitrogen (N)% , Phosphor (P)% and Potassium (K)% concentrations. Significant are indicated by different capital letters (means); Tukey test, p<0.05 .

Species	date	Fertilizer	Total Nitrogen (N) %	Phosphor (P) %	Potassium (K)%
Paulownia tomentosa	30 /10/2022	Control	0.20 A	0.24 A	0.62 A
		K_2SO_4	0.19 A	0.20 A	1.245 B
		NPK	4.95 B	2.40 B	1.63 B
	30/4/2023	Control	0.19 A	0.21 A	0.41 A
		K_2SO_4	0.28 A	0.23 A	1.34 B
		NPK	4.97 B	2.58 B	1.76 B

Table 2 Soil chemical traits of the field, total nitrogen (N) , Phosphor (P) and Potassium (K) concentrations, pH, EC (Ds/m), organic matter % and soil texture.

sample	pH	EC (Ds/m)	% N	(P) ppm	(K) ppm	O.M %	% Sand	% Silt	% Clay	Soil texture
Soil field	7.85	0.2	0.21	8.6	78.2	2.1	65.6	10.7	23.7	Sandy clay loam

Table 3 Climatic factors of Shaqlawah -Erbil from may 2022 to April 2023

Soil temperature°C		Wind speed m/sec	Sun shine hrs/day	Precipitation (mm)	% Air moisture			Temperature °C			factors \months
100 cm	50 cm				Avg.	max	min	Avg	max	min	
15.8	17.9	1.8	8.9	31.5	52.4	58.7	46.2	21.2	26.0	16.5	May
21.1	23.6	1.2	11.4	2.0	41.2	48.8	3.7	27.5	33.4	21.6	June
24.8	27.9	1.2	11.3	5.0	42.7	50.1	35.3	31.9	39.9	23.9	July
25.3	28.5	1.0	10.4	10.1	43.1	52.4	33.9	28.5	37.8	19.2	August
23.4	25.0	0.8	9.5	9.0	36.8	47.5	26.1	24.0	34.2	13.8	September

19.3	19.1	1.9	6.4	7.5	45.1	57.3	32.9	18.1	26.2	9.9	October
15.2	13.1	1.4	6.1	36.5	36.3	65.3	47.4	9.3	15.7	2.9	November
13.4	11.2	3.0	5.3	91.1	56.7	65	48.5	9.6	16.2	2.4	December
6.8	4.6	2.5	2.6	173.5	78.4	88.6	68.2	4.8	8.7	-0.1	January
5.2	3.6	5.8	3.1	265.2	75.7	87.5	64	6.7	10.8	1.6	February
7.1	7.0	2.2	6.1	148.3	58.1	70.1	46.1	11.8	18.5	5.1	March
6.4	7.2	2.3	6.4	147.4	73	86.9	59.2	14.7	18.9	10.2	April

Discussions

Effect of Site factors and climate on growth of *Paulownia* seedlings.

According to statistical analysis results, the data p value for the growth traits (Height and Diameter) for the seedlings showed significant P value ≤ 0.05 during the experiment duration between D1 which is the date four month after starting the experiment and D2 which is eight months from planting and D3 after twelve months for the growth traits height and Diameter of seedlings fig. (3,4). During the first stage of this study, height and diameter growth were assessed depending on the growing area and age during the first growing season, the height and survival of *Paulownia tomentosa* during the summer season were evaluated. age factor was stronger effect on growth traits with the growing space and respectively explained high percentage of the significant. The climate as a factor explained a higher percentage of the variation in height and a smaller percentage of the variation in diameter but seedlings maintained a high regenerative capacity of their root systems during the next growing season. The result of this study were compatible with [20] when they grow *paulownia tomentosa* in under site factors conditions and controlled climate. So the climate system in the area were optimum for growth of trees especially temperature avg. during the growing seasons months table(3) from May to November were between (21- 35)°C, the suitable temperature increased the activity of root and stomatal conductivity to increase the uptake of water and nutrient from the soil [21] and increase the gas exchange CO_2 and O_2 assimilation to produce glucose sugar which then convert to biomass and these compatible with [22]Taiz and for growth of plant in optimum environment in correlations with cell physiology and biology.As addressed above, temperature is a key environmental factor that shapes the distribution of plants[23]. Temperature heavily influences the metabolic activity of plant tissues and organs[24], and the ability of plants to cope with extreme temperatures is a complex process that is determined by environmental factors and by the genetic capability of a plant[25]. In particular, a moderate increase in temperature increases plant growth, photosynthesis, respiration and enzyme activity, after which these parameters tend to decline [26]. Even the precipitation amount (mm) in the area were good for growing the trees which were near (900) mm per year distributed among the months from January to December unless from July to September few (5-15) mm of rain precipitate [27]. Rain amounts and temporal patterns are a key driver of forest dynamics, because annual net primary production (NPP) generally positively correlates with the annual amount of precipitation [28]. While water uptake occurs primarily belowground, the root system has to serve several functions simultaneously. It has to provide a stable platform for the shoot so that the photosynthetic organs can intercept sunlight, and it has to provide a network that can exploit the water and nutrient resources of the soil [29].

1- Effect of Fertilizers nutrients on growth traits of *Paulownia* seedlings

According to statistical analysis results, the data value for the growth trait (Height) for the *Paulownia tomentosa* seedlings showed significant P value ≤ 0.05 during the experiment periods between control and NPK and K_2SO_4 fig. (1,2). and the p value of anova table were ≤0.05 which means significantly of growth height of seedlings traits per fertilizer type duration first to end of experiment. means the differences of fertilizer type for availability of macro nutrients which is very important for the growth of seedlings physiologically and producing of biomass [19]. for the diameter traits significant p value found between control and NPK mean≤0.05 fig (1,2). At the same time According to statistical analysis results, the data p value for the leaf chemical trait content of nutrients for the seedlings showed significant P value ≤0.001 in D1 and D2 between control, K_2SO_4 and NPK for % total nitrogen content,% phosphors and % Potassium between fertilizer treatment table(1). So the NPK fertilizer treatment get the higher Biometric data (height) and (diameter) then KS treatment and Control even NPK fertilizer treatment were higher leaf chemical concentration on macro nutrients (NPK) than K_2SO_4 and control table(1) this result is compatible with [30]when they fertilized *pawlownia tomentosa* seedlings with humic acid and NPK, and control, the application of NPK fertilizer caused a significant increase in the most important studied characteristics such as morphological and physiological properties of *Paulownia tomentosa* seedlings. The production of *Paulownia tomentosa* seedlings can be improved by adding the adequate levels of NPK fertilizer. And even compatible with [31] when they found that chemical fertilization with compound fertilizers (NPK) especially at a concentration of (250 mg NPK.L-1) achieved a significant increase in the percentage of nitrogen, phosphorous, and potassium in the petioles of the leaves, the concentration of chlorophyll and the percentage of protein in the leaves. And our result were compatible with the results of [32] when they fertilized *Paulownia tomentosa* and the results show 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. Nitrogen increases cytokinin production, which subsequently affects cell wall elasticity, the number of meristematic cells, and cell growth [33]. Nitrogen promotes the formation of active photosynthetic pigments by increasing the amounts of stromal and thylakoid proteins in leaves and by increasing the formation of chloroplasts during leaf growth [34]. Therefore, fertilization usually enhances root

respiration, and the root tissue nitrogen concentration increases with the addition of nitrogen fertilizer, which may be the underlying reason for the observed increase in root respiration with fertilization [35]. Phosphorus elements are essential for cell division, reproduction, genetic information and plant metabolism, acquisition, storage, and use of energy, (P) plays an important role in lateral root morphology and root branching and the availability of nutrients [36]. Potassium plays a role in a number of cellular and physiological activities, such as maintaining the intracellular osmotic balance, enzyme activation, protein synthesis and transport, photosynthesis, cell extension, stomatal regulation, semimonastic movements, phloem transport, and the cation-anion balance [37]. So, it is better to use chemical fertilizer for producing seedlings and Afforestation programmes especially NPK fertilizer which enhance the growth of seedlings significantly even because our land is mostly has a deficiency on nitrogen table (2). It is clear to us that there are differences in the proportion of nutrients in the soil of the regions, but the main factor influencing the process of forest growth is the nitrogen element, which is considered one of the most important problems of plant nutrition in arid and semi-arid areas [38]. The total nitrogen content in our field study in shaqlawah is within the limits of the proportions represented in semi-arid areas, although it is It represents the state of availability of the element nitrogen in in forest soils, and this is consistent with what was confirmed by [39].

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تأثير عوامل الموقع وألاسمدة الكيميائية في نمو شتلات باولونيا *Paulownia tomentosa* في شقلاوة– أربيل.

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الخلاصة

تمتلك الغابات المختلطة القدرة على تحسين خصوبة التربة ودورة المغذيات وتخزين الكربون وفي إنتاج الكتلة الحيوية، ولها فوائد أخرى، مثل تحسين إدارة المخاطر والحماية من الآفات والأمراض. بالإضافة إلى ذلك، يمكن أن تعمل كنظام زراعي حرجية لزراعة الأخشاب عالية الجودة. هدفت هذه الدراسة الى التحقق من التأثير المقارن بين الأسمدة العضوية والكيميائية والري على صفات النمو لشتلات شجرة الكستناء الصيني تحت تأثير المناخ المحلي في شقلاوة– أربيل. تم اجراء التجربة الاولى لانتاج الشتلات في كلية الزراعة قسم الغابات في البيوت البلاستيكية خلال شهر ايار الى شهر ايلول 2022 والتجربة الثانية لزراعة الشتلات في الحقل الدائم في شقلاوة اربيل خلال شهر تشرين الاول 2022 تشرين الاول 2023. تم استخدام تصميم عاملي. تم استخدام نوعين من السماد البيتموس و والطمي + 500 جزء في المليون سماد مركب و المشاهدة، في شهر أيلول تم حصاد الشتلات وتم قياس الصفات البايومترية مثل طول الشتلة وقطر الشتلة والبايوماس للنمو الخضري والجذر. تظهر النتائج دلالة عالية حول تأثير الاسمدة على ارتفاع الشتلات حيث كان طول الشتلات في معاملة المشاهدة 26 سم و54سم في السماد المركب والأكثر ارتفاعا كان

لمعاملة البيتموس العضوي 65 سم، ولصفة قطر الشتلات كانت 1.1ملم للمشاهدة و 2.3 للسماد المركب و 2.8 ملم للبيتموس العضوي. وتظهر النتائج دلالة بين تأثير الأسمدة على صفات نمو الكتلة الحيوية (البراعم والجذور) لذا فإن متوسط الكتلة الحيوية للشتلات في السماد المركب 3.9 غم و 6.7 للبيتموس العضوي و 1.5 للمشاهدة. بالنسبة للكتلة الحيوية للجذر كان 1.1 غم للمشاهدة و 3.7 غم للسماد المركب و 6.6 غم للبيتموس. لفروقات الدالّة وجدت في تركيز المغذيات الكيميائية للأوراق. وبذلك فإن متوسط محتوى النيتروجين في الشتلات في البيتموس 532.3 و(87.5) في المشاهدة و 439.5 للسماد المركب جزء في المليون. وبالنسبة للنتائج الخاصة بالتجربة الحقلية فإن قيمة البيانات لصفة النمو (الارتفاع) للشتلات أظهرت قيمة 62.3سم للمشاهدة و 69.7 سم للسماد المركب ولصفة القطر 2.1 ملم للمشاهدة و 2.8 ملم للسماد المركب. وبخصوص معاملة الري فقد أظهرت قيمة البيانات لصفة النمو (الارتفاع) للشتلات قيمة معنوية وكانت 62.3 سم للمشاهدة و 68.3 سم لمعاملة الري ولصفة قطر الشتلات كانت 2.1 للمشاهدة و 2.8 لمعاملة الري . أظهرت قيمة البيانات لصفة النمو (المحتوى الكيميائي للعناصر الغذائية) للشتلات في الحقل قيمة معنوية وكانت متوسط تركيز النتروجين في المشاهدة 132.66 جزء بالمليون و 524.25 للسماد المركب. بشكل عام يمكن زراعة شجرة الكستناء الصيني في مناطق الغابات الجبلية في شمال العراق مع استخدام السماد المركب والري خلال السنة الأولى من الزراعة حتى تنتج الشتلات كمية كبيرة من الكتلة الجذرية للاستفادة من عناصر الغذائية والرطوبة الموجودة في التربة . ولتحقيق هذا الهدف نوصي بأنشاء غابة مختلطة بدلاً من الغابة النقية، لذا من الأفضل زراعة شتلات شجرة الكستناء الصيني داخل غابات البلوط الطبيعية في جبل سفين في شقلاوة أربيل لزيادة التعاون بين الأشجار حيث ان أشجار البلوط تمثل أشجار حاضنة للكستناء الصيني تحميها من درجات الحرارة العالية والرياح.

الكلمات المفتاحية: بيئة وفسيولوجيا ألاشجار، الاسمدة العضوية والكيميائية ، صفات نمو الاشجار.