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Effect of root stimulator (Rootex) and organic nutrient (Siapton 10L) on the growth characteristics of *Cupressus arizonica seedlings.*

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Abstract

A factorial experiment was carried out in the Directorate of Sarchnar Nursery in Sulaymani / Kurdistan Region-Iraq, using a randomized complete block design (RCBD) with three replications to study the effect of using root stimulator (Rootex) at three levels were (0)mgL^{-1}, (670)mgL^{-1} and (1.34) gmL^{-1} and foliar application with organic nutrients (Siapton 10L) with three concentration on 1st October 2021 as well, which were (0, 1and 2) mlL^{-1} and there interactions on *Cupressus arizonika's* seedlings growth. The data were analyzed using XLSTAT software, and averages were compared according to Duncan Multiple Range. The results showed the superiority of Rootex treatment at the level 1.34 gmL^{-1} on the studies characteristics (plant height, percentage of N, P, K in the leaves, chlorophyll content in the leaves, Zink and Iron concentration in the leaves, root length, shoot fresh and dry weight, shoot dry matter and root fresh and dry weight). Treating seedlings' foliar with (Siapton 10L) at the concentration $2mlL^{-1}$ showed the superiority in the studies characteristics (plant height, percentage of N, P, and K in leaves, chlorophyll content in the leaves, Zink and Iron concentration in the leaves, root length, shoot fresh and dry weight, shoot dry matter, root fresh and dry weight and root dry matter). The dual interaction of 1.34 gmL^{-1} of Rootex with $2mlL^{-1}$ (Siapton 10L) showed the superiority in the studies characteristics of (plant height, percentage of N, P, and K in leaves, chlorophyll content in the leaves, Zink and Iron's concentration in leaves, root length, shoot fresh and dry weight, and root fresh and dry weight.

Keywords: Seedling, *Cupressus arizonica*, Rootex, Siapton 10L.
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Introduction

The genus Cupressus has widely distributed in many regions of Asia within the Mediterranean region as well as North America, as it includes more than twenty (20) species [1]. This tree is considered one of the evergreen trees, where its leaves are medium-sized, in colors that tend mostly to gray and green to bright green, the tree a conical to oval shape [2], and it can be considered an important economic source for the western sides of its spread areas as it is rich in essential oils. The Arizona cypress tree (*Cupressus arizonica*) is one of the types of evergreen forest trees widely spread in the mountains of Arizona towards Mexico at altitudes between 1300-2500 meters above sea level and has the ability to withstand varying temperatures, and for being a beautiful tree with a distinctive fragrant aromatic smell, it was brought to Europe in the early nineteenth century as one of the ornamental trees with a distinguishing addition to the landscape [3].

The elements N, P and K are necessary for plant growth, and each element has a physiological role in growth, as N enters the formation of amino acids, protoplasm, and chlorophyll as well as other compounds that enter into the construction of the plant cell, also enters into the formation of NAD, NADP and nitrogenous bases [4], Phosphorous is important for the plant cell, as it enters the building of cell membranes and in the formation of energy compounds ATP, GTP and UTP [5], and phosphorylated fats and affects the formation of protein compounds and enters the representation of carbohydrates and contributes to the activation of many enzymes as well as inhibits the activity of a number of enzymes [6], and P is important in the development and growth of roots, especially adventitious and fibrous roots, as it is found in height concentrations in meristematic areas where growth is active [7], and plays an important role in enzymatic reactions [8]. Also, the formation of flowers and seeds, as well as its role in stimulating seed germination and building strong stems for the plant.

Root growth stimulants that contain N and P are often used to stimulate and increase the growth of roots, as these two elements help in the growth of root hairs and improve root growth in general and maintain a balance between the growth of the root system and the vegetative system [6]. Amino acids are organic compounds, which are the structural units of protein and play an important role in constructing plant growth and development. Amino acids work to mitigate the effect of various stresses [9].

The amino acids have multiple effects on the physiological activities in the plant, including direct and indirect effects [10], as they work to increase the N content in the plant, which is reflected in the increase in the chlorophyll formation and thus increase the products of photosynthesis and increase the dry weight of the plant [11] and increase chlorophyll content in tomato [12].

Material and methods:

A factorial experiment was conducted in the Directorate of Sarchnar Nursery in Sulaymani / Kurdistan Region - Iraq, using a Randomized Complete Block Design, RCBD, with three replications to study the effect of using a root stimulator (Rootex) at three levels of (0) mg L^{-1}, (670) mg L^{-1} and (1.34) gmL^{-1} and foliar application with organic nutrients, Siapton 10 L, with three levels as well, which were (0, 1 and 2) mlL^{-1} and their interactions, thus the experiment included 27 experimental units, 6 plants for

each unit, a total of 162 plants at the age 7 months used in the experiment. Plants were transplanted in plastic bags on 24/9/2021 with a capacity of 5 kg filled with a mixture of soil and peat moss at the rate of 3:1. Six days after transferring, on 1st October 2021 the seedlings were treated with Rootex stimulant levels which were added to the water, and the process was repeated 4 times, the period between each watering with Rootex was 21 days. The plants were treated with foliar application of the organic nutrient (Siapton 10 L) 7 days after transferring the seedlings to the plastic bags, by using 6 applications, 14 days between one application and another. The nutrient was also mixed with a diffuser (Sodium Hypochlorite) to reduce the surface tension of the spray solution. Data were analyzed according to the XLSTAT program [13] and averages were compared with Duncan multiple ranges test.

The study parameters were:

Plant height (cm), Stem diameter (mm), N, P, and K percent in the leaves, the leaves content of, Zn and Fe and the leaves content o chlorophyll, Root length (cm), shoot fresh weight (gm), shoot dry weight (gm), root fresh weight (gm), root dry weight (gm), shoot dry matter, root dry matter.

Three plants were taken from each experimental unit randomly on 1.10.2022 for the purpose of measuring the study's parameters by cleaning the leaves and placing them in perforated bags, then the leaves were dried after placing them in an electric oven with a vacuum at a temperature of 70 C^0 until the stability of the weight, then the plants were milled according to [14]. The following components were estimated:

Nitrogen (N) using micro Kjeldahl according to [15]

Phosphorous (P) was estimated according to [16].

Potassium (K) was estimated by Flame [17].

Chlorophyll content in the leaves was estimated using Spectrophotometer.

Treatments:

R0= 0 mgL^{-1} of Rootex was added to the water irrigation.

R1= 670 mgL^{-1} of Rootex was added to the water irrigation.

R2= 1.34 gmL^{-1} of Rootex was added to the water irrigation.

S0= foliar application with 0mlL^{-1} of Siapton 10L

S1= foliar application with 1mlL^{-1} of Siapton 10L

S2= foliar application with 2mlL^{-1} of Siapton10L

Table 1: Some of chemical and physical characteristics of the soil

field soil characteristics		Value
EC		1.4 dsm^{-1}
pH		7.03
N		43.7 mg Kg^{-1}
P		8.63 mg Kg^{-1}
K		417 mg Kg^{-1}
S		3.86 mg Kg^{-1}
Mg		1.63 mg Kg^{-1}
Texture	Sand	510 g Kg^{-1}
	Silt	280 g Kg^{-1}
	Clay	210 g Kg^{-1}

The soil samples were analyzed at the central Laboratory in the College of Agriculture Engineering Science / University of Bagdad according to [18].

Table 2: Chemical compounds of Rootex and Siapton 10 L

Rootex		Siapton 10 L	
Compound	Amount (%)	Compound	Amount (%)
Nitrogen (N)	7	Organic matter	54 wt.%
P_2O_5	47	Total nitrogen	9.4 wt
K_2O	6		
Free amino acid	3		
Organic matter	15		

Results:1-plant Height (cm):

Results of Table (3) show the significant effect of the using root stimulator Rootex on this trait, which increased plant height with increasing the root stimulator's level, as the treatment of adding 1.34gmL^{-1} (R2) by recording 66.11 cm, recording its significant superiority effects above 670mgL^{-1} R1 and 0mgL^{-1} R0 which there were significant differences between them by recording 57.78cm and 51.07 cm respectively. On the other hand, foliar application with two different concentrations of nutrient solution (Siapton 10L) 1mlL^{-1}, and 2mlL^{-1}, S1 and S2, have more significant superiority than S0 which recorded (60.83 and 61.52) cm of plant height respectively, while S0 came with (52.60) cm for the same application. The interactions between the study factors showed the significant superiority of the treatments R2S2 for adding 1.34gmL^{-1} and foliar application with 2mlL^{-1} of Siapton 10L, which recorded the value 69.06 cm compared to the R0S0 which recorded 41.93 cm. The increase in plant height may be attributed to the effect of the growth stimulator (Rootex), which contains Phosphorus element, which is known for its important role in improving root growth, as well as the organic nutrient (Siapton10L) contains Nitrogen, which is entering into the composition of the Chlorophyll molecule and has a role in increasing the growth of roots, which was reflected in the improvement of plant activity. Adsorption of nutrients increased plant metabolism, which appeared in the increase in the activity of the apical meristem, and reflected in the increase in the plant height [19].

Table 3: Effect of Root stimulator (Rootex) and organic nutrient (Siapton 10L), and their interaction on *Cupressus arizonica* seedlings' height (cm)

R	R×S			Rootex
	S0	S1	S2	
R0	41.93 c	55.07 b	56.20 b	51.07 c
R1	55.33 b	58.70 b	59.30 b	57.78 b
R2	60.53 b	68.73 a	69.06 a	66.11 a
Siapton 10L	52.60 b	60.83 a	61.52 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

2- Stem diameter (mm):

Result of the table (4) shows no significant effect of adding the nutrient solution Rootex into the soil on the stem diameter. While the treatment of foliar application with organic nutrients (Siapton 10 L) at the concentration of $2mlL^{-1}$ and $1mlL^{-1}$ gave 4.66 and 4.95 mm respectively compared to S0 which recorded 3.78mm. The stem diameter increased by 98.57% in the interaction between the R0S1 which is recorded 5.56mm. While R0S0 recorded 2.80mm.

The increase in stem diameter in the treatment of using organic nutrients may be attributed to the role of Nitrogen in increasing the formation of Chlorophyll and perhaps increasing the speed of cell division, which was evident in the increase in stem diameter. [20]

Table 4: Effect of Root stimulator (Rootex) and organic nutrient (Siapton 10L), and their interaction on *Cupressus arizonica* seedlings' stem diameter (mm).

R	R×S			Rootex
	S0	S1	S2	
R0	2.80 c	5.56 a	4.63 ab	4.33 a
R1	4.42 ab	4.63 ab	4.58 ab	4.54 a
R2	4.13 b	4.64 ab	4.76 ab	4.51 a
Siapton 10L	3.78 b	4.95 a	4.66 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

3- Nitrogen content (%):

Results of Table (5) indicate the significant superiority of the study factors, as using root stimulator Rootex at the level $1.34Gl^{-1}$ (R2) recorded values of 1.73% for its superiority over the control treatment R0, which gave 1.18%. And the treatment of nutrient solution (Siapton 10L) at the concentration $2mlL^{-1}$, (S2) recorded 1.63% significantly outperforming the treatment S0, which recorded 1.18%. The interactions between the study factors showed the superiority of the R2S2, which the leaves content of N% increased by 89.42% for the treatment R2S2 which recorded 1.97% compared to the control treatment R0S0 which gave 1.04%. Perhaps the increase in the Nitrogen content of the leaves is due to the (Siapton 10L) containing of high quantities of it, and its absorption and synthesis helped to increase the leaves' content of it, and the root stimulator (Rootex) contains height amount of Organic matter, of which Nitrogen forms the basis. In addition, amino acids enter into the formation of protein which Nitrogen forms the basis of it which appeared in its increase in the leaves.

Table 5: Effect of Root stimulator (Rootex) and organic nutrient (Siapton 10L), and their interaction on *Cupressus arizonica seedlings' leaves content of Nitrogen (%)*

R	R×S			Rootex
	S0	S1	S2	
R0	1.04 e	1.22 cde	1.30 cd	1.18 c
R1	1.11 de	1.25 cde	1.64 b	1.33 b
R2	1.40 c	1.82 ab	1.97 a	1.73 a
Siapton 10L	1.18 c	1.43 b	1.63 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels

4- Phosphorus content (%):

Results of Table (6) show the significant superiority of the study factors, as using root stimulator Rootex at the level 1.34gmL^{-1} (R2) recorded the superiority value of 0.40% over the control treatment R0, which gave 0.24%. And the treatment (Siapton 10L) S2 recorded 0.34%, significantly outperforming treatment S0, which recorded 0.27%. The dual interactions showed the superiority of the treatment R2S2, which recorded 0.48% compared to the control treatment R0S0 which gave 0.22%. Root stimulator (Rootex) and organic nutrient (Siapton) containment of organic matter may have an effect on the solubility of the adsorbed Phosphorus due to the formation of chelating compounds with the Ca, Mg, Fe, and Al ions to prevent their association with the Phosphorus ions ready for absorption and reduce its precipitation, which increased the absorption, and appeared in the leaves content of it.

Table 6: Effect of Root stimulator (Rootex) and organic nutrient (Siapton 10L), and their interaction on C*upressus arizonica seedlings'* leaves content of Phosphorus (%)

R	R×S			Rootex
	S0	S1	S2	
R0	0.22 f	0.24 f	0.25 ef	0.24 c
R1	0.26 def	0.28 de	0.30 cd	0.28 b
R2	0.33 c	0.38 b	0.48 a	0.40 a
Siapton 10L	0.27 c	0.30 b	0.34 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

5- Potassium contents (%):

Adding root stimulator Rootex to the soil at the level 1.34gmL^{-1} gave significant superiority over other levels by recording 1.78%, while the treatment R0 at the level 0mgL^{-1} recorded 1.29%. Increasing the concentration of (Siapton 10L) increased leaves content of Potassium, 2mlL^{-1} of Siapton 10L (S2) recorded a value of 1.66% significantly outperforming the concentration (0 and 1) mlL^{-1} which

recorded (1.43 and 1.54) respectively. The dual interaction between 1.34gmL^{-1} (R2) of Rootex and 2mlL^{-1} (S2) of (Siapton 10L) increased 66.33% of Potassium contents in the leaves which recorded 1.96% compared to R0S0 which recorded 1.20%. The increase the Potassium in the leaves may be due to the fact that the two compounds which are used, contain organic matter, which leads to the liberation of humic acids,known for their role in improving the absorption of nutrients such as Zn, Fe, and Potassium, as reflected in the increase in Potassium content in the leaves [21], [22], and [23] it also agrees with what was obtained by [24] on the addition of Organic fertilizer to Jatropha plants

Table 7: Effect of Root stimulator (Rootex) and organic nutrient (Siapton 10L), and their interaction on *Cupressus arizonica seedlings'* leaves content of Potassium (%)

R	R×S			Rootex
	S0	S1	S2	
R0	1.20 g	1.35 ef	1.32 fg	1.29 c
R1	1.45 de	1.52 cd	1.69 b	1.56 b
R2	1.63 bc	1.76 b	1.96 a	1.78 a
Siapton 10L	1.43 c	1.54 b	1.66 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

6- Iron concentration (mgKg^{-1} dry matter):

Results of Table (8) show the significant effect of adding root stimulator to the soil, increasing the level of Rootex led to a significant increase of Iron concentration in the leaves, which adding 1.34gmL^{-1} and 670mgL^{-1} respectively recorded (273.26 and 195.42) mgKg $^{-1}$ dry matter outperforming the treatment R0 which gave (164.61) mgKg^{-1} dry matter. But this trait was not affected by the individual study treatments of foliar application with (1 and 2) mlL^{-1}. While the dual interaction showed the significant superiority of the treatments R2S2 and R2S1 which recorded values of (296.92 and 283.85) mgKg^{-1} dry matter, respectively. The presence of Humic acids in the composition of the organic matter contained in the (Rootex) and (Siapton 10L) may have led to the chelation of nutrients in the organic matter and thus increase their concentration in the leaves. [25].

Table 8: Effect of Root stimulator (Rootex) and organic nutrient (Siapton 10L), and their interaction on *Cupressus arizonica seedlings'* leaves *concentration of Iron (mgKg^{-1} dry matter)*

R	R×S			Rootex
	S0	S1	S2	
R0	156.73 d	166.00 d	171.11 d	164.61 c
R1	172.12 d	204.82 c	209.32 c	195.42 b
R2	238.99 b	283.85 a	296.92 a	273.26 a
Siapton 10L	189.28 b	218.23 a	225.79 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

7- Zinc concentration: (mgKg^{-1} dry matter):

Zinc concentration in the leaves was affected by the study treatments as table (9) shows, the treatment R2 gave the superior value by recording 40.28 mgKg^{-1} dry matter, compared to the treatment R0 with 23.68 mgKg^{-1} dry weight. Zinc concentration in the leaves increased with increasing the concentration of (Sipton 10L), which applying 2mlL^{-1} showed significant superiority by recording 34.22 mgKg^{-1} dry matter outperforming the treatments 0mlL^{-1} (S0) which gave (29.03 mgKg-1 dry matter). The dual interaction R2S2 showed significant superiority by giving (45.30 mgKg-1 dry matter), compared to the interaction between 0mgL^{-1} of Rootex and 0mlL^{-1} of Siapton 10L R0S0 which gave 21.06 mgKg^{-1} dry matter. The presence of Humic acids in the composition of the organic matter contained in the (Rootex) and (Siapton 10L) may have led to chelation microelements and thus increase their concentration in the leaves. [25].

Table 9: Effect of Root stimulator (Rootex) and organic nutrient (Siapton 10L) and their interaction on Zinc concentration in *Cupressus arizonica seedlings'* leaves

R	R×S			Rootex
	S0	S1	S2	
R0	21.06 g	23.47 fg	26.51 ef	23.68 c
R1	30.23 de	31.87 cd	30.84 de	30.98 b
R2	35.78 bc	39.75 b	45.30 a	40.28 a
Siapton 10L	29.03 c	31.70 b	34.22 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

8- Chlorophyll content (mgg^{-1}**):**

Table (10) indicates the significant superiority of adding Rootex at the level 1.36gmL^{-1}(R2) recorded 26.46 mgg^{-1} in comparison to the treatment R0 which gave 17.52 mgg^{-1}, also using (Siapton 10L) had a significant effect, which the treatment S2 recorded the value 26.52 mgg^{-1}, in comparison with the treatment S0 which gave 18.28 mgg^{-1}. While in the dual interaction, R2S2 showed significant superiority by achieving 30.27 mg g^{-1}, compared to R0S0 which recorded 13.66 mg g^{-1}. The increase in the Chlorophyll content of the leaves is due to the fact that the two compounds which were used contain Nitrogen, which contributes to the composition of the chlorophyll molecule, which was reflected in the increased leaves content of it. [26]

Table 10: Effect of Root stimulator (Rootex) and organic nutrient (Siapton 10L) and their interaction on *Cupressus arizonica seedlings'* leaves content of Chlorophyll. (mgg^{-1})

R	R×S			Rootex
	S0	S1	S2	
R0	13.66 f	15.66 f	23.24 cd	17.52 c
R1	18.83 e	25.25 bcd	26.03 bc	23.37 b
R2	22.34 d	26.78 b	30.27 a	26.46 a
Siapton 10L	18.28 c	22.56 b	26.52 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels

9- Root length (cm):

The outcomes in Table (11) indicate the significant superiority of adding root stimulator Rootex at the level ($1.34 gmL^{-1}$) R2 recorded 40.54cm compared to R0 that reached 35.01cm which does not significantly differ from the treatment R1 ($670\ mgL^{-1}$) gave 37.25cm. Root length increased significantly with increasing (Siapton 10L) which (S2) $2mlL^{-1}$ showed significant superiority over other treatments and gave 42.20cm while S0 ($0mlL^{-1)}$ gave the lowest root length 31.87cm. The root length increased by 71.87% in the dual interaction R2S2 which recorded 45.03cm in comparison to the treatment R0S0 which gave 26.20cm. Potassium contribution in the formation of roots, as well as the role of Nitrogen in promoting the growth of roots and increasing the elongation of cells, which increases the ability of the roots to absorb water and nutrients, was reflected positively in increasing the length of the roots.

Table 11: Effect of Root stimulator (Rootex), organic nutrient (Siapton 10L), and their interaction on *Cupressus arizonica* seedlings' root length (cm)

R	R×S			Rootex
	S0	S1	S2	
R0	26.20 e	41.10 abc	37.73 bcd	35.01 b
R1	32.01 de	35.90 cd	43.83 ab	37.25 ab
R2	37.40 bcd	39.20 abc	45.03 a	40.54 a
Siapton 10L	31.87 c	38.73 b	42.20 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels

10-Shoot fresh weight (gm):

Applying root stimulator "Rootex" with $1.340\ gmL^{-1}$ and $670\ mgL^{-1}$ (R2 and R1) had a significant influence on the fresh weight of the shoot system which recorded (26.31 and 25.12 gm respectively, in comparison to the control treatment R0 which recorded 17.45 gm. The fresh weight of the shoot system increased with increasing the concentration of (Siapton 10L), S2 and S1, $2mlL^{-1}$ and $1mlL^{-1}$ respectively recorded 22.61 and 28.82 gm respectively compared to S0 which recorded (17.44) gm. The dual

interaction between R2S2 and R1S2 showed significant superiority over others which achieved (32.83, 32.28) gm respectively. R2S2 achieved a significant increase equal to 210.60% compared to R0S0 which gave 10.57 gm. The increase in the shoot's fresh weight may be due to the compound's high content of Nitrogen and organic matter, which is involved in the construction of Protoplasm, Proteins, Enzymes, and their complements such as NADH2, in the formation of organic acids and energy compounds ATP and GTP, which is reflected in the increase in the building activities of Chlorophyll and thus increase shoot growth. [7].

Table 12: Effect of Root stimulator (Rootex), organic nutrient (Siapton 10L), and their interaction on *Cupressus arizonica* seedlings' shoot fresh weight (g)

R	R×S			Rootex
	S0	S1	S2	
R0	10.57 d	20.37 bc	21.40 bc	17.45 b
R1	18.76 c	24.37 b	32.28 a	25.12 a
R2	23.00 bc	23.08 bc	32.83 a	26.31 a
Siapton 10L	17.44 c	22.61 b	28.82 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

11- Shoot dry weight (gm)

Table (13) indicates the significant superiority of adding Rootex at the level 1.36gmL^{-1}(R2) recorded 10.47gm in comparison to the treatment R0 which gave 6.68g also use (Siapton 10L) had a significant effect, which the treatment S1 and S2 recorded the value (9.84 and 9.46)gm respectively, in comparison with the treatment S0 which recorded 6.09gm. In the dual interaction, R2S1 and R2S2 recorded their significant superiority as they gave (11.73 and 12.65) gm respectively, compared to R0S0 which recorded 3.20gm. The increase in the chlorophyll content in the leaves may have contributed to the increase in the carbon build-up process and thus increase in the outputs of this process, which was reflected in the accumulation of carbohydrates formed as a result of this process, and contributed to the increase in the dry shoot weight

Table 13: Effect of Root stimulator (Rootex), organic nutrient (Siapton 10L), and their interaction on *Cupressus arizonica* seedlings' shoot dry weight (g)

R	R×S			Rootex
	S0	S1	S2	
R0	3.20 c	8.56 b	8.29 b	6.68 c
R1	8.05 b	9.22 b	7.45 b	8.24 b
R2	7.02 b	11.73 a	12.65 a	10.47 a
Siapton 10L	6.09 b	9.84 a	9.46 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

12- Shoot dry matter (%):

The results of Table (14) indicate the significant superiority of the study factors in the shoot dry matter, as treatment R2 recorded the highest value was 40.10% compared to R1 which gave 34.83%, and treatment S1 gave 43.81% while R0 recorded 34.47% while S2 gave 33.73%. The dual interaction showed that R2S1 was significantly superior by recording 51.15% compared to R1S2 which gave 23.54%. Perhaps the increase in the percentage of shoot dry matter is due to the fact that (Rootex) contains Phosphorus, which is involved in the production of energy compound necessary to sustain the vital activities in the plant [22] That form Ester with Hydroxide groups, associated with Alcoholic sugar to the needed place by a plant to sustain growth and vital activity. [27].

Table 14: Effect of Root stimulator (Rootex), Organic nutrient (Siapton 10L) and their interaction on *Cupressus arizonica* seedlings 'shoot dry matter (%)

R	R×S			Rootex
	S0	S1	S2	
R0	29.80 d	42.46 b	38.99 c	37.09 b
R1	43.12 b	37.82 c	23.54 e	34.83 c
R2	30.50 d	51.15 a	38.65 c	40.10 a
Siapton 10L	34.47 b	43.81 a	33.73 c	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

13- **Root fresh weight (gm).**

Root fresh weight was affected by the study's factors as table (15) shows that adding root stimulator at the level 1.34gmL^{-1} (R2) results in the superiority by recording 5.69 gm, compared with the control treatments R0 which achieved 3.51 gm, while S1 and S2,1 mL^{-1} and 2 mL^{-1}, of (Siapton 10 L) showed no significant difference by giving (4.73 and 4.59)gm respectively. The same table shows that there is no significant difference between the dual interactions (R2S2, R2S1 and R2S0) by recording (6.11, 5.63, and 5.31)gm respectively outperforming R0S0, which recorded 2.08gm. The root stimulator (Rootex) and organic nutrient (Siapton 10L) containing organic matter may have worked to increase the division of root cells and their elongation and growth, which was reflected in the increase in root fresh weight.

Table 15: Effect of Root stimulator (Rootex), organic nutrient (Siapton 10 L), and their interaction on *Cupressus arizonica* seedlings' root fresh weight (g)

R	R×S			Rootex
	S0	S1	S2	
R0	2.08 d	4.32 b	4.13 b	3.51 b
R1	2.76 cd	4.24 b	3.52 c	3.51 b
R2	5.31 a	5.63 a	6.11 a	5.69 a
Siapton 10L	3.38 b	4.73 a	4.59 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

14-Root dry weight (gm):

Results of table (16) show that root dry weight increased significantly by using R2 adding root stimulator at the level 1.34gmL^{-1} which recorded 1.50 gm, outperforming the treatment R0 and R1 which gave 0.79 and 0.95 gm respectively. Data show no significant difference between S1 and S2 by recording (1.36 and 1.39) gm outperforming the treatment S0, which gave 0.49 gm. The interaction between the factors showed the significant superiority of the treatments R2S1 and R2S2, by recording the values 1.67 and 1.96 gm respectively, while the treatments R0S0 and R1S0 recorded the lowest values 0.24 and 0.37 gm respectively. An increase in the chlorophyll content of the leaves may have contributed to the increase in the carbon build-up process and thus the increase in the outputs of this process, which was reflected in the accumulation of carbohydrates formed as a result of this process, which contributed to the increase in the dry shoot weight

Table 16: Effect of Root stimulator (Rootex), organic nutrient (Siapton 10L), and their interactions on *Cupressus arizonica* seedlings' root dry weight

R	R×S			Rootex
	S0	S1	S2	
R0	0.24 d	1.23 bc	0.90 c	0.79 b
R1	0.37 d	1.18 bc	1.30 b	0.95 b
R2	0.88 c	1.67 a	1.96 a	1.50 a
Siapton 10L	0.49 b	1.36 a	1.39 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

15- Root dry matter (%):

It is clear from the results of Table (17) that there is no significant difference between the treatments R1 and R2 for this trait which registered 26.30 and 26.05 respectively, compared to the treatments R0 which gave 20.50. The root dry matter was affected by (Siapton 10L) applying 2mlL^{-1} recorded the highest value which was 30.62 was superior in comparison to the treatments S0 which achieved (13.72). The dual interaction between R1S2 achieved superiority by recording (37.57) compared to R0S0 which recorded (10.75). Perhaps the increase in the percentage of root dry matter is due to the fact that (Rootex) contains Phosphorus, which is involved in the production of energy compound necessary to sustain the vital activities in the plant [22] That form Ester with Hydroxide groups, associated with Alcoholic sugar to the needed place by a plant to sustain growth and vital activity [27]

Table 17: Effect of Root stimulator (Rootex) and organic nutrient (Siapton 10L), and their interactions on *Cupressus arizonica* seedlings' root dry matter (%).

R	R×S			Rootex
	S0	S1	S2	
R0	10.75 g	28.38 c	22.36 d	20.50 b
R1	13.71 f	27.63 c	37.57 a	26.30 a
R2	16.70 e	29.51 bc	31.95 b	26.05 a
Siapton 10L	13.72 c	28.51 b	30.62 a	

Means within a column, row and their interaction following with the same letter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

The increase in the leaves content of chlorophyll (table 10) helped in increasing the carbon build-up, which increased the outputs of this building (Carbohydrates), which was reflected in the increase in plant height (table 3), and the increase in the build-outs was reflected in an increase in the stem diameter (table 4) which lead to increase the fresh and dry weight of shoot system (table 12 and 13) and dry weight of root system (table 16).

Conclusion:

The use of the root stimulator (Rootex), at the level 1.34 gmL^{-1} led to the increase in the root and shoot growth characteristics, and Organic nutrient (Siapton 10L) at the concentration $2mlL^{-1}$ contributed to the increase of Chlorophyll content in the leaves, which reflected on increasing Carbon building-up, that increasing the shoot growth characteristic and some of root growth characteristics. The dual interaction led to a significant increase in most of the shoot and root growth characteristics, which resulted in vital activities of the plant.

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تأثير محفز نمو الجذور (Rootex) و المحلول المغذي (Siapton 10L) في صفات النمو لشتلات سرو الفضي *Cupressus arizonica*

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الخلاصة

اجريت تجربة عاملية وفق تصميم القطاعات العشوائية الكاملة و بثلاث مكررات في مشتل سرجنار محافظة السليمانية اقليم كردستان / العراق، لدراسة تاثير محفز نمو الجذور Rootex و رش المجموع الخضري بالمحلول العضوي (Siapton 10L)تداخلاتهما في نمو شتلات نبات السرو الفضي *Cupressus arizonica* . تم معاملة الشتلات في 2021/10/1 بثلاث مستويات من Rootex (صفر)ملغم لتر$^{-1}$و (670) ملغم لتر$^{-1}$ و(1,34) غم لتر$^{-1}$ و رش المجموع الخضري بالمحلول العضوي (Siapton 10L) بثلاث تراكيز (صفر، 1، 2) مل لتر$^{-1}$ و تداخلاتهما. حللت البيانات باستخدام برنامج XLSTAT و قرنت المتوسطات باستخدام اختبار دنكن متعدد الحدود. اظهرت النتائج التفوق المعنوي لمعاملة محفز نمو الجذور بتركيز 1,34غم لتر$^{-1}$ في صفات (ارتفاع النبات، محتوى الاوراق من N,P,K و الكلوروفيل و تركيز Fe, Zn في الاوراق، طول الجذورو الوزن الطري و الجاف للمجموع الخضري، نسبة المادة الجافة في المجموع الخضري، وزن الطري و الجاف للمجموع الجذري). و حققت معاملة رش النبات بالمحلول المغذي بتركيز (2) مل لتر$^{-1}$ في صفات (ارتفاع النبات، محتوى الاوراق من N,P,K و الكلوروفيل و تركيز Fe, Zn في الاوراق، طول الجذورو الوزن الطري و الجاف للمجموع الخضري، نسبة المادة الجافة في المجموع الخضري، وزن الطري و الجاف للمجموع الجذري). فيما حققت معاملة التداخل بين محفز نمو الجذور بتركيز 1,34غم لتر$^{-1}$ و المحلول العضوي بمستوى (2)مل لتر$^{-1}$ في صفات(ارتفاع النبات، محتوى الاوراق من N,P,K و الكلوروفيل و تركيز Fe, Zn في الاوراق، طول الجذورو الوزن الطري و الجاف للمجموع الخضري، نسبة المادة الجافة في المجموع الخضري، وزن الطري و الجاف للمجموع الجذري).

الكلمات مفتاحية: الشتلات، السرو الفضي، Rootex، Siapton 10L.