The Effect of Chemical Fertilizers NPK and Cytokinin on Growth Characteristics and Chemical Composition of *Ficus Nitida* Plants

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Abstract:

The research was conducted in a greenhouse at the Department of Horticulture and Garden Engineering, College of Agriculture, University of Anbar, Ramadi City, to study the impact of NPK supplementation and (CPPU) cytokinin spraying on *Ficus nitida* L.'s vegetative and root growth properties. The study encompassed two primary factors. The first factor comprises the NPK chemical fertilizer in four distinct concentrations: F0 (no addition), F1 (1g urea, 3g DAB, 2g potassium sulfate), F2 (2g urea, 6g DAB, 4g potassium sulfate), and F3 (3g urea, 9g DAB, 4g potassium sulfate). The second factor involves the cytokine CPPU at three concentrations: C0 (no addition), C1 (3 mg/ liters), and C2 (6 mg/ liter). The study was structured using a randomized complete block design (RCBD) comprising three blocks, with three pots allocated per experimental unit. Each block consisted of 36 coefficients, resulting in a total of 108 experimental units across all blocks. Increasing the quantity of secondary branches to sum up the outcomes, plant cover area, average diameter of secondary branches, dry matter percentage of leaves, total chlorophyll content in leaves, phosphorus, nitrogen, and potassium ratios in the leaves, with ratios of 47.333 cm, 0.644 cm, 7.160 mm, 23.964%, 1.443 mg g-1, 0.390%, 2.860%, and 1.923% respectively.

Keywords: foliar spray, *Ficus nitida*, Chemical Fertilizers, Cytokinin, CPPU

تأثير السماد الكيميائي NPK والسايتوكاينين (CPPU) في صفات النمو والمحتوى الكيميائي لنبات المطاط نتدا

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المستخلص:

نفذت هذه التجربة في احد البيوت الزجاجية التابعة لكلية الزراعة - جامعة الانبار ،لدراسة تأثير إضافة ال NPK والرش بالسايتوكانينCPPU في النمو الخضري والجذري لنبات المطاط البراق Ficus nitida L ، تضمنت التجربة عاملين ،العامل الأول هو السماد الكيميائي NPK بأربع تراكيز وهي F0 بدون إضافة ،والتركيز الثاني F1 مزيج من الأسمدة ١غم من اليوريا +٣ غم داب +٢ غم كبريتات البوتاسيوم ، التركيز الثالث F2 ٢غم يوريا +٦ غم داب +٤ كبريتات البوتاسيوم ،التركيز الرابع F3 مزيج من الأسمدة ٣غم يوريا +٩ غم داب +8 غم كبريتات البوتاسيوم اما العامل الثاني وهو السايتوكانين CPPU بثلاث تراكيز التركيز الأول C0 بدون إضافة ،والتركيز الثاني C1 بلغ ٣ملغم لتر-١ ،والتركيز الثالث C2 وكان ٦ملغم لتر-١ ،صممت التجربة باستخدام تصميم القطاعات العشوائية الكاملة (RCBD) بثلاث قطاعات وثلاث اصص للوحدة التجريبية الواحدة وبلغ كل قطاع ٣٦ معاملة وبعدد ١٠٨ وحدة تجريبية لكافة القطاعات وتلخصت النتائج بالزيادة في عدد الافرع الثانوية ومساحة الافتراش النبات ومعدل قطر الافرع الثانوية ونسبة المادة الجافة للأوراق والمحتوى النسب للأوراق من مادة الكلوروفيل الكلي ونسب النيتروجين والبوتاسيوم في الأوراق وكانت النسب ٤٧,٣٣٣ سم و٠,٦٤٤ سم و٧,١٦٠ ملم و٢٣,٩٦٤ %و١,٤٤٣ ملغم غم -١ و٢,٨٦٠ % و١,٩٢٣ %.

الكلمات المفتاحية: رش الأوراق، المطاط نتدا، الأسمدة الكيماوية، سايتوكاينين، CPPU.

Introduction

Ficus plant (*Ficus nitida* L.), a member of the Moraceae family, is characterized by its evergreen Treesn, dense branching pattern, and a maximum height reaching 30 meters, with a minimum height not less than 3 meters. This species, commonly known as the Folige Potted Plant, are Planted cultivated in public and residential gardens for ornamental purposes and internal coordination (EI-Khatib and Samir, 2020; Ahmed et al., 2020). The native countries of Ficus nitida L. include South Australia, India, and Malaysia. Due to the dense vegetative growth and small leaf area of the plant, it is suitable for use in various landscaping and aesthetic applications, such as plant fences or as individual plant models or in plant groups, the plant tolerates Severe Pruning This is considered one of the processes of environmental stress that negatively affects plant growth but the plant does not tolerate frost (Ahmed et al, 2020).

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https://10.36531/ijds.2024.148854.1072
Received 2024-04-15; Received in revised form 2024-04-15; Accepted 2024-08-19

Patil and Jeevitha (2023) explained in a study conducted on the shrub seal plant Althae rose L to find out the effect of nitrogen and phosphate fertilizer on seedlings at a concentration of 0, 120 and 140 kg ha^{-1} and four levels of phosphate fertilizer 0, 120, 140 and 160 kg ha^{-1}, The results confirmed that using 160 kg of phosphate fertilizer and 140 kg of nitrogen fertilizer resulted in the highest increase in plant height, flower production, dry matter weight, number of branches, stem weight, and chlorophyll content in the leaves. As for root characteristics, a clear increase was observed in both dry and wet root weights.

Mustafa and others (2018) confirmed in a study on ficus plant that nitrogen fertilization at a concentration of 400 mg L^{-1} gave the highest percentage of chlorophyll, carbohydrates, leaf content of nitrogen, phosphorus, potassium, zinc and iron and gave the highest values of leaf area, number of branches, number of leaves and stem diameter. Al-Zebari and others (2023) clarified in a study on the Damask rose plant that treating the plant with NPK fertilizer at concentrations of 5 and 10 g for two seasons, autumn and spring, The researcher confirmed that he obtained the best results at a concentration of 10 g and a significant increase in the characteristics of the number of branches for the autumn season, the average number of leaves and leaf area for the autumn and spring seasons, the average number of flowers on the plant increased in the spring, an increase in the chlorophyll content in the leaves, plant length and plant spreading.

The study confirmed that the concentration of 100 mg L^{-1} showed significant differences in plant height, flower stem length, increased number and diameter of flowers. Additionally, the addition of potassium silicate showed significant differences in plant height, phosphorus content in leaves, number of flowers, nitrogen content in leaves, and length of flower stem (Al-Jabouri ,2020).

Abdullakasi and others (2015) confirmed that the treatment of shrub rose hybrid with CPPU at a concentration of 0, 30 and 60 mg L^{-1} led to an increase in aesthetic and coordination value and an increase in Plant Growth. Treatment with CPPU at a concentration of 60 mg L^{-1} led to control the flowering time of plants, the flowering age of plants, dry and wet weight, the number of leaves and the content of anthocyanins in petals.

Al-Jabouri (2020) mentioned in a study on the Gladiolus plant when spraying the plant with two levels of CPPU 0,10 mg L^{-1}, it led to the appearance of many differences in most of the studied qualities, as it led to giving the largest rate of the number of lateral shoots, a significant increase in the content of chlorophyll leaves and an increase in the number of corms and cormels and their diameter.

Due to the importance of the above factors and the lack of research conducted in Iraq on the shining rubber plant and its productive, coordination, and economic importance, as well as the physiological role of fertilization with NPK and cytokine, this study was conducted to demonstrate the effect of:

1. Adding NPK in the traits of development and chemical composition of the *Ficus nitida* L.
2. Spraying with different levels of CPPU growth regulator in the traits of development and chemical composition of the Ficus nitida L.
3. The interaction between the studied factors and their effect on the traits of development and chemical composition of the *Ficus nitida* L.

Materials and Methods:

The Experiment Location:

The experiment was implemented in the greenhouse of the College of Agriculture at the University of Anbar from 1/10/2023 to 1/4/2024. It aimed to study the effect of NPK addition and foliar spraying with CPPU on improving the vegetative and root growth characteristics of *Ficus nitida* L.

Seedling preparation:

The one-year-old seedlings of the *Ficus nitida* L were obtained from a private nursery in the Al-Krayat area (Al-Tasahil nursery) and transported to the experimental site. All seedlings are as homogeneous in size as possible and free of insect and fungal infections. They were transferred on 7/10/2023 in plastic pots with Diameter of 28 cm, and the weight of one pot is 15 kg of sandy soil and peat moss.

Soil Analysis:

Samples were taken from the Growth media in which the seedlings involved in the experiment were planted before cultivation, analyzed, and the results are shown in the table below.

Table 1. The experimental Soil's Chemical and Physical Characteristics Prior to Planting

Attribute	Value	Unit
EC	1.67	dS m^{-1}
pH	7.34	
Organic Matter O.M	5.42	g kg^{-1} soil
Sand	690	g kg^{-1} soil
Silt	118	g kg^{-1} soil
Clay	192	g kg^{-1} soil
Soil texture	Sandy loam	
Available Nitrogen	112.00	mg kg^{-1}
Available Phosphorus	11.30	mg kg^{-1}
Available Potassium	118.5	mg kg^{-1}
Sulfates	7.42	mol charge kg^{-1}

Field Preparation and Agricultural Service Operations:

The greenhouse land to be studied was prepared by cleaning and washing the glass and structure. A preventive program was applied to eliminate fungal and insect pathogens. Then, a group of microelements were added to plants to compensate for the shortage of plants from these elements. The bush growth and weeding were also treated whenever needed. Taking the average of the minimum and maximum temperatures and the humidity percentage from the meteorological network / Ministry of Agriculture / Republic of Iraq (Table 2).

Table 2. Monthly Average of Maximum and Minimum Temperatures During the Study Period

Month	Average Temperatures (˚ C°)		Relative Humidity%
	Maximum ˚ C	Minimum ˚ C	
October	40.22	26.96	37
November	32.82	20.53	8
December	25.22	15.47	68
January	21.3	13.22	71
February	26.71	16.35	56
March	26.21	19.25	50
April	37.26	25.26	38

* Agricultural meteorological network / Ministry of Agriculture / Republic of Iraq

Experimental design and statistical analysis:

The work was implemented according to the design of the randomized complete block design R.C.B.D. by 3 blocks. Each block contained 12 treatments, and each transaction included three Pots. The total treatments in the experiment became 36 experimental units, and the total number of plants was 108. The data were analyzed using the Genstat program at a probability level of 0.5.

Experiment Factors:

Chemical Fertilizers

NPK addition:

The NPK fertilizers Chemical was uniformly incorporated into the soil in a single application at four different levels. Subsequently, Diammonium phosphate (DAP) was applied at rates of 0, 3, 6, and 9g per 15 kg, while potassium sulfate was applied at rates of 0, 2, 4, and 8 g per 15 kg of Pot weight on October 15, 2023. The urea was added at levels 0, 1, 2, and 3 g per 15 kg of anvil weight after 3 weeks of adding the two levels.

Spraying with a CPPU growth regulator:

Certain plants were treated with a cytokine growth regulator at concentrations of 6, 3, and 0 mg L^{-1} in the early morning through two spray applications. The initial spray was performed a week after the cytokine application, followed by a second spray a month later. The cytokine forchlorfenuron (CPPU) was dissolved in drops of ethanol and distilled water, adjusted to one liter in the presence of a stirrer. The plants were uniformly sprayed using a handheld sprayer until thoroughly moistened.

Studied Characteristics:

The data for the studied characteristics were taken in the autumn and spring period and include:

1. The average of raised in the number of secondary branches (plant Branch-1)
2. The area of the plant nesting (CM)
3. Average diameter of secondary branches (mm)
4. Percentage of dry matter of leave %
5. Chlorophyll (Acetone method)

The total chlorophyll content in the plant material after the second spray of treatments was determined by taking 0.2 grams of fresh weight of the plant material and treating it with 20 ml of 80% acetone alcohol solution. The sample was then placed in a dark vial for 24 hours. Subsequently, optical density readings of the sample were taken using a Spectrophotometer at wavelengths of 645 and 663 nanometers. The total chlorophyll content was then estimated according to the equation below (Goodwin, 1976). Total Chlorophyll (mg 100 g^{-1}) = (20.20) (A645nm) + (8.02) (A663nm)

6. Phosphorus Percentage in Leaves:

The quantity of phosphorus present within the Leaves was calculated using the Ammonium Molybdate and Vitamin C method, and the results were presented by reading with a Spectrophotometer device at a wavelength of 620 nanometers.

7. Nitrogen Percentage in Leaves:

The amount of nitrogen was calculated using the Kjeldahl method with a Micro-Kjelal device.

8. Potassium Percentage in Leaves:

The potassium percentage was estimated using a Flame Photometer device.

Results

The average of raise in the number of secondary branches (Plant Branch^{-1}):

The results in Table 3 showed a significant difference in the rate of secondary branches. The treatment with chemical fertilizer F_2 significantly outperformed the other treatments, recording 41.889 plant branches^{-1}, while the control treatment F_0 showed the lowest significant difference in the rate of secondary branches at 31.667 plant branches^{-1}. As for the treatment with CPPU spray, the treatment with a concentration of 3 mg L-1 significantly outperformed and recorded 40.500 plant branches^{-1}, whereas the number of branches was lower in the control treatment C_0, recording 34.500 plant branches^{-1}.

The results of the same table indicated significant differences in the coefficients of interference between chemical fertilizer and cytokine F_2C_1 treatment in the average of raise in the number of secondary branches, it recorded 47.333 plant branches^{-1} while the rate of the number of secondary branches decreased at F_0C_0 treatment and amounted to 28.666 plant branches^{-1}.

Table 3. The Effect of Chemical Fertilizer NPK and CPPU on the Average of Raise in the Number of Secondary Branches (Plant Branch-1) of the Shiny Rubber Plant

	C_0	C_1	C_2	Average F
F_0	28.666	33.333	33.000	31.667
F_1	36.000	41.333	39.667	39.000
F_2	37.667	47.333	40.667	41.889
F_3	35.667	40.000	38.333	38.000
Average c	34.500	40.500	37.917	
LSD F		1.458		
LSD C		1.263		0.05
LSD F*C		2.526		

Area of the Plant (cm^2)

The results of (Table 4) showed the presence of significant differences between the coefficients of the studied factors in the average area of the nesting, Excelled the treatment of the neutral NPK chemical fertilizer, symbolized by the symbol F_2, in the average nesting area, reaching 0.547 cm_2, While the average nesting area is reduced when treated F_0, reaching 0.446 cm^2. With regard to the CPPU treatment, the treatment was characterized by a concentration of 3 mg L^{-1}, which is denoted by the code C1 and amounted to 0.538 cm^2 in the average area of the nesting, while the area decreased during the comparison and amounted to 0.450 cm^2.

The results of the same table confirmed the presence of a significant difference in the treatment of bilateral interference between the study factors, as the interference treatment F2C1 was significantly superior in the average area of the nesting, which amounted to 0.644 cm^2, while the average area decreased at the treatment F0C0, which amounted to 0.428 cm^2.

Table 4. The Effect of Chemical Fertilizer NPK and Cytokinin CPPU on the Average Nesting Area (cm2) for the Rubber Plant Nitida.

	C_0	C_1	C_2	Average F
F_0	0.428	0.458	0.428	0.446
F_1	0.440	0.526	0.440	0.493
F_2	0.454	0.644	0.454	0.547
F_3	0.477	0.524	0.477	0.505
Average c	0.450	0.538	0.450	
LSD F		0.020		
LSD C		0.017		0.05
LSD F*C		0.034		

Average Diameter of Secondary Branches (mm):

The results of (Table 5) showed the presence of significant differences between the coefficients of the studied factors in the average area of the nesting, The treatment of chemical fertilizer NPK, which is denoted by the symbol F_2, was significantly superior in the average diameter of the secondary branches and amounted to 6.441 mm, while the average diameter of the secondary branches decreased when the comparison treatment F_0, amounting to 5.354 mm. With regard to the CPPU treatment, the treatment was characterized by a concentration of 3 mg L^{-1}, which is denoted by the code C_1, and amounted to 6.196 mm in the average diameter of the secondary branches, while the average diameter of the secondary branches decreased during the comparison treatment and amounted to 5.235 mm.

The results of the same table confirmed the existence of a significant difference in the treatment of bilateral interference between the study factors, the interference treatment f2c1 was significantly superior in the average diameter of the secondary branches, which amounted to 7.160 mm, while the average diameter of the secondary branches decreased at the treatment F0C0, which amounted to 5.150 mm.

Table 5. The Impact of the Chemical Fertilizer NPK and Cytokinin CPPU on the Average Diameter of the Secondary Branches in the Leaves (leaf^{-1}) of the Rubber Plant Nitida

	C_0	C_1	C_2	Average F
F_0	5.150	5.583	5.330	5.354
F_1	5.227	6.943	5.320	5.830
F_2	5.230	7.160	6.933	6.441
F_3	5.333	5.097	5.220	5.217
Average c	5.235	6.196	5.701	
LSD F		0.133		
LSD C		0.115		0.05
LSD F*C		0.230		

Percentage of Dry Matter of Leaves (%):

The results of (Table 6) showed that there was a clear significant difference in all the studied transactions, and it turned out that the treatment of chemical fertilizer NPK was distinguished at treatment F3 in the percentage of dry matter in the leaves, which recorded 23.756 %, while the dry matter rate in the leaves was lower at the comparison treatment, which amounted to 14.25%, With regard to cytokine transactions, transaction C1 was significantly distinguished from the rest of the transactions, which amounted to 22.169%, while the dry matter ratio to papers decreased at the comparison transaction and recorded 17.970%.

The data of the same table confirmed a significant increase in the coefficients of bilateral interference between the study factors, the coefficients F_1C_1 and F_2C_2 were distinguished significantly in the percentage of dry matter, which amounted to 24.369 and 24.269%, In contrast, the control treatment recorded the lowest dry matter percentage at 11.080%.

Table 6. The Impact of Chemical Fertilizer NPK and Cytokinin CPPU on the Percentage Rate of Dry Matter (%)

	C_0	C_1	C_2	Average F
F_0	11.080	17.025	15.171	14.425
F_1	21.211	24.470	22.677	22.786
F_2	16.553	23.215	24.396	21.388
F_3	23.034	23.964	24.269	23.756
Average c	11.080	22.169	21.629	
LSD F		0.858		
LSD C		0.743		0.05
LSD F*C		1.486		

Total chlorophyll content of leaves (mg g^{-1}):

The findings from (Table 7) validate significant distinctions among plant treatments with NPK chemical fertilizer. The chlorophyll Content in the leaves notably increased in the F_2 treatment, measuring 1.386 mg per gram, whereas it decreased in the comparison treatment to 1.333%. In the case of spraying treatments with CPPU, there was a notable increase in the chlorophyll percentage in the leaves when treated with the growth regulator (CPPU C_1), measuring 1.384 mg g. Conversely, the comparison treatment exhibited a decrease, reaching 1.341 mg per gram. The data from the same table demonstrate a substantial enhancement in the combined treatment of NPK fertilizer and the cytokine CPPU. Specifically, the F2C1 treatment showed a significant increase in the chlorophyll content of the leaves, measuring 1.443 mg per gram, while the comparison treatment exhibited a decrease to 1.317 mg per gram.

Table 7. NPK and cytokine CPPU Chemical Fertilizer Effect on Chlorophyll Percentage in Leaves (mg g^{-1}) of Nitida Rubber Plant

	C_0	C1	C_2	Average F
F_0	1.317	1.35	1.333	1.333
F_1	1.337	1.357	1.32	1.338
F_2	1.347	1.443	1.367	1.386
F_3	1.363	1.387	1.357	1.369
Average C	1.341	1.384	1.344	
LSD F		0.012		
LSD C		0.01		0.05
LSD F*C		0.02		

Phosphorus in Leaves (%):

The results of (Table 8) indicated the absence of statistically significant differences, both at the level of mono-factors and bilateral interference coefficients in the phosphorus ratio of the leaves.

Table 8. The impact of chemical fertilizer NPK and cytokinin CPPU on the percentage of phosphorus in the leaves (%) of the rubber plant Nitida

	C_0	C1	C_2	Average F
F_0	0.173	0.220	0.187	0.193
F_1	0.197	0.283	0.230	0.237
F_2	0.203	0.390	0.310	0.301
F_3	0.227	0.270	0.223	0.240
Average C	0.200	0.291	0.238	
	LSD F		N.S	
	LSD C		N.S	0.05
	LSD F*C		N.S	

Nitrogen Percentage in the leaves (%):

The findings from (Table 9) highlight significant variations among plant treatments with NPK chemical fertilizer. The nitrogen percentage in the leaves significantly increased in the F2 treatment, reaching 2.664%, whereas it decreased in the comparison treatment to 2.396%. In terms of CPPU spraying, the C1 treatment showed a significant increase, reaching 2.666% nitrogen in the leaves, while the control treatment exhibited a decrease to 2.424%. The data from the same table affirmed a substantial enhancement in the combined interference of NPK fertilizer and the cytokine CPPU. Specifically, the nitrogen percentage in the leaves increased significantly with the F2C1 treatment. reaching 2.860%, while the comparison treatment exhibited a decrease to 2.390%.

Table 9. NPK and cytokine CPPU Chemical Fertilizer Effect on Nitrogen Percentage in Leaves (%) of Nitida Rubber Plant

	C_0	C_1	C_2	Average F
F_0	2.39	2.417	2.38	2.396
F_1	2.407	2.71	2.583	2.567
F_2	2.437	2.86	2.697	2.664
F_3	2.463	2.677	2.553	2.564
Average C	2.424	2.666	2.553	
LSD F			0.032	
LSD C			0.028	0.05
LSD F*C			0.055	

Percentage of Potassium in Leaves (%):

The results of (Table 10) indicated that there were significant differences between the plant treatments with chemical fertilizer NPK, the percentage of potassium in the leaves increased at the F_2 treatment and amounted to 1.648 % , while it decreased at the comparison treatment and amounted to 1.179% , Regarding the transactions of spraying with CPPU, the potassium content in the leaves increased significantly when treated with a growth regulator at an intensity of 3 mg/L-1C_1, reaching 1.585%. In contrast, with the control treatment, the potassium level in the leaves dropped and eventually reached 1.194%. The results of the same table confirmed a significant

increase in the interaction between NPK chemical fertilizers and CPPU cytokinins. F_2C_1 treatment significantly exceeded in terms of potassium percentage in the leaves, reaching 1.923%, while the potassium percentage in the leaves under the comparison treatment decreased to 1.163%.

Table 10. The impact of chemical fertilizer NPK and cytokinin CPPU on the percentage of potassium in the leaves (%) of the rubber plant Nitida

	C_0	C_1	C_2	Average F
F_0	1.163	1.200	1.173	1.179
F_1	1.187	1.793	1.653	1.544
F_2	1.203	1.923	1.817	1.648
F_3	1.223	1.423	1.350	1.332
Average C	1.194	1.585	1.498	
LSD F		0.015		
LSD C		0.013		0.05
LSD F*C		0.025		

Discussion:

The results confirmed that the chemical fertilization treatment of the shining rubber plant had a significant impact on the characteristics of vegetative, root, and chemical growth. The third treatment, F2, demonstrated superior results across various studied characteristics, such as rate of increase in the number of secondary branches (Plant Branch-1), the area of the plant nesting, average diameter of secondary branches (mm), Percentage of dry matter of leaves (%), chlorophyll relative, phosphorus, nitrogen, and potassium percentages in the leaves. The combination of fertilizers consisting of 2g of urea, 6g of DAB, and 4g of potassium sulfate contributes to the enhancement of vegetative, root, and chemical growth characteristics. This improvement is primarily attributed to the role of nitrogen in chemical fertilization, which plays a crucial role in plant life by contributing to the formation of RNA and DNA acids, the enzymatic coenzymes NAD and NADP, and participating in the process of photosynthesis (El-Badawy and Sultan, 2020). The rapid mobility of nitrogen within the plant, shifting from older leaves to newer leaves, promotes vegetative growth. Nitrogen is a fast-moving element within plants and moves from old leaves to modern leaves and encourages vegetative growth and because of the added nitrogen, the plant is long and its leaves are large, wide and bright green in color, Nitrogen has an important role in the construction of some basic cell organelles, where it participates in the construction of cell membranes, mitochondria and chloroplasts. Phosphorus plays a role in cell division and branch elongation, leading to increased leaf growth in plants, Phosphorus has an important role as it participates in the formation of cell membranes in combination with lipids and the vacuolar membrane and also contributes to the synthesis of the enzymatic conjugates of the NADP and NADPH and nucleic acids RNA and DNA and contributes to the oxidation and reduction process and participates in the process of photosynthesis and respiration.

Conclusions:

1. The ground addition of the chemical fertilizer NPK at the F2 level had a significant effect, as it achieved the best results in the vegetative growth characteristics and chemical content of Ficus nitida seedlings.
2. Foliar spraying with CPPU achieved an increase in growth characteristics, especially the C2 concentration of 3 mg L-1, which was distinguished by giving the best moral results for vegetative growth characteristics and chemical content of leaves.

3- The interaction between ground application of the chemical fertilizer NPK at the F2 level and foliar spraying with CPPU shows a positive effect on the growth traits studied, as the F2C1 treatment achieved the best significant effect in most traits.

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