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GROWTH RESPONSE OF *PLATYCLADUS ORIENTALIS* (L.) FRANCO SEEDLING TO FOLIAR APPLICATION OF GA3 AND CHELATED NANO N.P.K FERTILIZER.

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ABSTRACT

As part of the ongoing efforts to optimize the application of Nanotechnology in forestry nurseries, the current study came to determine the efficiency of Nano N.P.K-fertilizer and Gibberellic acid in enhancing the growth of the growing-slow species *Platycladus orientalis* (L.) Franco seedlings. One–year old of *P. orientalis* seedlings grown in a greenhouse were been subjected from September 2021 to the end of Jun 2022 to two and four foliar sprays, four different levels of Nano-fertilizer N.P.K (20:20:20) (control, 1 g. L^{-1}, 2 g. L^{-1} and 3 g. L^{-1}) and three GA3 levels (control, 300 mg. L^{-1} and 600 mg.$L^{-1)}$. The experiment was designed according to the RCBD with 1008 seedlings arranged in three replicates with 14 seedlings in each of the 72 experimental units. Duncan's multiple-range test was used for comparing all means. for each factor individually revealed that increasing Nano N.P.K up to 3 g. L^{-1} and GA3 up to 300 and 600 mg.L^{-1} increased significantly the values of most of the studied parameters (seedling high, diameter, number of branches, total seedling dry weight, leaf chlorophyll, Protein (%), and percentage of leaf nutrients content as Nitrogen, Phosphorus and Potassium. Increasing the sprays number from two to four increased the values of the studied parameters except for the Diameter, Nitrogen, Chlorophyll, and Protein parameters. The interaction effect between four sprays, Nano N.P.K 3 g. L^{-1} and GA3 at rate 600 mg.L^{-1} significantly increased the values of all studied parameters except Potassium (%), where two sprays, of 3 g. L^{-1} Nano N.P.K with 600mg.L^{-1} of GA3 recorded the highest values. In general, the study revealed the positive role of the foliar application of Nano N.P.K fertilizer separately and in combination with GA3 in accelerating most growth parameters of the growing-slow *P. orientalis* ornamental shrub.

KEYWORDS: *Thuja orintalis*, Gibberellic acid, Spray application, Seedling growth, Chelate Nano N.P.K Fertilizer.

1. INTRODUCTION

The primary purpose of forest nurseries is to produce good quality of seedlings for planting (Koneshlo, 2001). For ornamental trees and shrubs, both fertilizers and plant growth regulators have a role in enhancing the production of containerized seedlings under nursery growing conditions which increases demand on them for indoor and outdoor planting purposes (El-Keltawi et al., 2012; Ashour, 2018). Most likely more than any other nursery practice, with the possible exception of irrigation, fertilization is considered a common cultural practice in forest nursery which enhances the growth of containerized tree seedlings. For example, Nitrogen is an essential element for plant growth, is an essential constituent of protein and chlorophyll, and promotes growth , developing the stem and vegetative green parts of the seedlings. (Subbaiya et al., 2012). Phosphorus has a role in energy storage and transfer, photosynthesis, respiration, promoting cell division and enlargement (Memon, 1996). Potassium is playing an important role in many biochemical and physiological processes of plants such as photosynthesis, respiration, nitrogen metabolism, leaf stomatal activity, enzyme activation, and growth of meristematic tissues (Chandra, 1989). However, the excessive use of large amounts of conventional fertilizers has resulted in the accumulation of heavy metals in soil and plant parts (Abdel Wahab et al., 2017). While plant cell walls have pore diameters ranging from (5 to 20) nm (Fleischer et al., 1999), the nanoscale fertilizers of (1 and 100) nm with unique physicochemical properties such as a high surface-to-volume ratio and particle size less than the pore size of the leaves of the plant (Rai and Ingle, 2012) could lead to more effective delivery of nutrients and allow them access to a variety of plant surfaces and transport channels (Abobatta, 2018; Avila et al, 2022). Meena et al., (2017) in their review article showed that Nano fertilizers enhance growth parameters of plants like height, leaf area, number of leaves per seedling, dry biomass production, and photosynthesis which results in more production and translocation of photosynthetic products to various parts of the plant compared with traditional fertilizers. Mustafa et al., (2018) carried out an experiment that included spraying one-year "Soultani' fig seedlings with four concentrations of balanced 20-20-20 N.P.K nanoparticles of (100, 200, 300, and 400) ppm, the results showed a significant increase in leaf area, fresh and dry weight and concentrations of N, P and K in leaves. In the same line Hagagg et al., (2018) and Al-Jilihaw, (2020) found a positive effect of applying Nano-fertilizers, as a complementary technique for fertilizer program for both Kalamata olive seedlings which sprayed with nano-fertilizers at (0.2%) and 3 months -old *Citrus aurantium* L. seedlings with 300 mg.L^{-1} Nano fertilizer respectively. More recently Al-Jilihawi & Merza (2020) studied lemon *Citrus aurantifolia* saplings treated with N.P.K at concentrations (0.5, 1.0, 2.0 g /L) every 15 days and spraying with Nano-N.P.K at concentrations of 150, 300 or 450 mg. L^{-1}, the results showed that spraying with N.P.K nanoparticles at a concentration of 450 mg. L^{-1} resulted highest values for the most studied parameters compared to other concentrations and the control treatment. AL-Karam, (2021) in his study on Pear saplings used five levels of 20-20-20 N.P.K Nano fertilizer where three concentrations were ground applied (0, 7.5, 15 g plant-1) and two concentrations were foliar applied (1 and 2 g. L^{-1}), the results showed that both foliar added levels (1 and 2 g. L^{-1}) significantly increased the most morphological and biochemical studied parameters. Shareef, et. al. (2021), studied the effect of spraying with N.P.K Nano and mineral fertilizer on some growth to the characteristics of *Pinus brutia* seedlings and found the superiority of N.P.K Nano fertilizer (20:20:20) compare to mineral N.P.K in terms of increasing seedling high, root length, stem diameter, wet and dry weight of the vegetative parts.

Regarding the application of exogenous plant growth regulators (PGR), evidences shows the positive influence of PGR on plant growth and development (Ullah et al., 2018). Abdullah & Qassem (2011) investigated how different concentrations of GA3 and their spraying dates (spring and fall) affect on growth characteristics of *Pinus halepensis* seedlings. They found that spraying with (60 mg. L^{-1}) of GA3 influenced significantly on the values of the studied parameter of the seedlings. Ashour, (2018) stated that (*Cupressus macrocarpa*) seedlings were responded to levels of GA3 at concentrations (100, 150, or 250) ppm, and most of the studied vegetative growth traits (plant height, stem diameter, number of branches/seedling, root length, fresh and dry weight of shoots and

roots were increased significantly as a result of foliar application of GA3 at 250 ppm combined with potassium silicate at (100 ppm) or Nano silicon at (50 ppm). Nzegbul & Mbakwe (1999) studied the response of *Nauclea diderrichii* seedlings, when sprayed with GA3 at concentrations of (0, 25, 0.5, 0.1, 1.5, 2 g/L) they noticed a significant increase rate of growth and total dry weight at low concentrations of (0.25, 0.5 g/L). The highest recorded values of the seedling height and dry weight were (0.75 m) and (50. 29 g) respectively, spraying GA3 didn't show any significant difference in the diameter of the seedling. According to many studies, spring GA3 within concentrations (50- 300)ppm, impacted significantly on different ornamental plants such as *Araucaria hetrophylla* by (Gul et al., 2006), *Codiaeum variegatum* by (Eid & Abou-Leila, 2006, 2006; Taha and Trees, 2010), *Cryptostegia grandiflora* by (Hussein, 2009), *Cupressus macrocarpa* by (Ashour, 2018), Muhammad (2015) in pistachio, and Saleem, et. al., (2020) in *Corchorus capsularis*. Ornamental tree *P. orientalis* is a highly demanded species in many nurseries of Iraq that earn income through seedling sales. *P. orientalis* is a slow-growing species, especially at the seedling stage. Therefore, efficient use of nutrient elements and growth regulators could improve the quality parameters of the produced seedlings of *P. orientalis* and accelerate their growth to reach a plantable size in a short period with lower costs. Accordingly, and because of the lack of studies on the effect of foliar application of nano N.P.K alone or in combination with GA3 on the growth of *P. orientalis* this study came to evaluate the influence of spray times, four levels of N.P.K nano fertilizer and three levels of GA3 on some seedling growth traits of *P. orientalis* under nursery growing conditions.

2. MATERIALS AND METHODS

2.1. Study Site

The study site is located in the fields of the Directorate of Horticulture - Dohuk Governorate at latitude (36° 51'43.879 N), longitude (42° 5616'.827" E), and altitude of 522 m a.s.l.. The experiment was conducted under greenhouse growing conditions from the period mid - September 2021 up to the end of June 2022. Monthly mean values of temperature (°C) and relative humidity (%) inside and outside the greenhouse at the study site were recorded using a digital Thermo Hydrometer that recorded the data every day from September 2021 to June 2022 (Table 1). Some of the chemical and physical properties of the growing media were analyzed (Table 2).

Table (1): Monthly mean values of Temperature (°C) and Relative humidity (%) during the study period.

Months	Air temperature (°C)		Inside Relative Humidity (%) -Inside greenhouse
	Inside greenhouse	Outside greenhouse	
September	29.5	25.1	31.2
October	29.2	24.8	31.5
November	22.4	20.8	34
December	15.5	13.3	37.7
January	13.4	10.5	40.4
February	19	17	35.4
March	20.4	17.2	35
April	24	23	32.4
May	29	26.2	32
June	38	36.4	27.6

2.2. Targeted species

In the cypress family Cupressaceae, Platycladus is considered a monotypic genus of evergreen coniferous trees, containing only one species which is *Platycladus orientalis*, also known as Oriental arborvitae, Biota or Oriental thuja. *P. orientalis* is a slow-growing, evergreen coniferous shrub species (Lei et al., 2010). According to Shahbaz (2010), this species is commonly cultivated as an ornamental shrub in Iraqi cities and towns with the common names Thuya (Kurd., Arab.). This species shows high resistance to cold, drought, and nutrient deficiency. The compact crowns and pyramidal columnar forms of this species give the possibility of creating green walls. *P. orientalis* propagated by seeds easily when sown after being soaked in water for 24-28 hours and vegetatively could be propagated by using both Semi-hardwood and Hardwood cuttings (Griffin et al., 1998).

2.3.1. Experimental design and Treatments:

A three-factorial experiment was conducted in a randomized complete block design (RCBD). The three studied factors represent four concentrations of Nano N.P.K fertilizer (control, 1 g. L^{-1}, 2 g. $L^{-1}$and 3 g. L^{-1}) (Shareef et al., 2021), three concentrations of GA3 (control, 300 mg. L^{-1}, 600 mg. L^{-1}) and two foliar frequencies, the first one sprayed two times on (20-9-2021 and 20-3-2022) and the second one sprayed four times on (20-9-2021, 20-10-2021, 20-3-2022, and 20-4- 2022). The control treatment represented spraying the seedlings with distilled water only (Zero concentration). The experiment was replicated three times and each experimental unit included 14 seedlings. The total number of the experimental units was 1008 *P. orientalis* seedlings in this study(4 Nano N.P.K Con. * 3 GA3 Con.* 2 Spray frequency * 3 Replicates * 14 seedlings per each experimental unit). One-year-old uniform *P. orientalis* seedlings in plastic bags with sizes (15 cm width * 25 cm height almost have the same size prepared and used in the experiment. The seedlings were moved to the plastic greenhouse before spraying with the different levels of the studied factors on 20 September 2021. The seedlings' height , diameter, and number of branches were recorded to quantify the increase in the seedling growth during the studied period.

Fig. (1) : ***Platycladus orientalis*** seedlings arranged for Nano N.P.K and GA3 treatments according to RCBD design under greenhouse growing conditions locating in the fields of the Directorate Horticulture Department - Duhok Governorate.

Table (2) : Some chemical and physical soil properties of the used containerized seedlings.

pH	EC (mS/cm)	Particle-size distribution (Psd %)			N%	P%	K%
7.8	0.5	Sand	Clay	Silt			
		64.55	19.7	15.75			
		Sandy loam			0.023	0.000632	0.0006

2.3.2. The application of Nano N.P.K fertilizer & GA3.

Nano N.P.K (20:20:20) purchased from AL-KHDRA Company I.R., labeled that the N.P.K production based on the pure elements of N.P.K. The suggested Nano Chelated N.P.K Fertilizer (20:20:20) levels were prepared by dissolving of 1 g, 2 g, and 3 g on one letter of distilled water.

Pure GA3 purchased from Alternatif Medikal Tıbbi Cihz. ve Lab. Malz. Company. The required concentrations of GA3 were prepared by dissolving the required weight of 300 mg. and 600 mg. respectively on one letter of distilled water. Using a manual compressed air sprayer (Hand Kisan Kraft 2- liter), the sprayings were applied in the early morning until complete wetness following the spraying schedules and concentrations. The distance between the experimental unit's rows was 50 cm and 2 meters between the replicates. A plastic sheet was used during spray to avoid the mix of the different GA3 and Nanao N.P.K concentrations among the studied treatments. Regarding the interaction treatment (GA3 Hormone +Nano N.P.K fertilizer) the suggested concentrations of GA3 were applied first then followed by the concentrations of NanoN.P.K. after 3 days. Tween 0.25% was added at a rate of drops to increase the adhesion of the sprayed materials on seedlings' leaves. The seedlings were irrigated one day before the spraying of GA3 and Nano NPK to increase the efficiency of the seedlings in absorbing the sprayed material as moisture has a role in the process of bulging guard cells and opening stomate pores. As well as irrigation enhancese reduction the concentration of soluble materials in leaf cells, that increases the ions penetration from the sprayed solution into the leaf cells (Al-Sahaf, 1989). The seedlings were irrigated when required. While, the weeds control were done manually.

2.3.3. The studied parameters.

At the end of the experiment, half of the seedlings were randomly sampled and the following parameters were measured.

First: Morphological parameters.

1- The increase in the seedling height (cm).

2- The increase in the seedling diameter (mm).

3- The increase in the seedling branches.

5- The total dry weight (g) is measured by drying the shoot and root plant parts in the oven at 70ºC until constant weight.

Second: Chemical parameters.

The mid-crown leaves of 7 seedlings were randomly sampled from each experimental unit for determination of parameters:

1- Leaves total chlorophyll content: determined according to Wintermans and Demots (1965).

2- Nitrogen (%): determined in digestive solution by micro-kjeldahl method as described by Kapur and Govil, (2000).

3-Protein (%): calculated by multiplying the total nitrogen value by 6.25 (Helrich, 1990).

4- Phosphorus (%): determined calorimetrically by using spectrophotometer model UV2100 as described by Jackson (1973).

5- Potassium (%): determined, using the flame-photometer method as described by Tandon (1993).

2.3.4. Statistical analysis :

The experiment contained three treatments, Nano NPK fertilizer in four concentrations, GA3 in three concentrations, and foliar spray frequencies (two and four times), each treatment was replicated three times and arranged in Complete Randomized Block Design (CRBD). A three-way ANOVA was run by SAS 9.1 to test the statistically significant difference between the three treatments and their interactions in respect to the studied parameters. Moreover, the Duncan test at ($p < 0.05$) probability was performed to compare between means of the tested treatments.

3. RESULTS

3.1. Morphological parameters

According to the comparison of the means by using the Duncan test (Tables 3 up to 7), the obtained results revealed that the most studied parameters increased with increasing the treatment levels of Nano N.P.K (control, 1 g. L^{-1}1, 2 g. $L^{-1}$and 3 g. L^{-1}), and GA3 (control, 300 mg. L^{-1}, 600 mg. L^{-1}) and foliar spray numbers (two to four). In respect of the morphological features of the *P. orientalis* seedling, the seedling height was (15.6 cm), diameter (3.8 mm), the number of branches (4.8), and the total seedling dry weight (31.7 g) increased significantly with increasing the applied levels of Nano N.P.K compare to the control which was (11.2 cm), diameter (2.7 mm), (3.2g) and (22.1 g) respectively. Regarding the effect of the applied levels of GA3 on the studied parameters, the results showed significant increase with increasing the GA3 levels compared to the control. The most effective level of GA3 was (300 mg. L^{-1}) on the following parameters, which gave the higher diameter (3.5 mm), the number of branches (4.1), and the total seedling dry weight (30.1 g) compare to the control (3.1 mm), (3.4 g) and (22 g) respectively. The stem height recorded the highest value of GA3 in comparison with the control which was (14.9 cm) at (600 mg. L^{-1}) compare to the control (11.2 cm). From the obtained results, it seems that the increasing percentages obtained by the influence of Nano N.P.K regarding the morphological studied parameters were small in compared to the influence of GA3, where the increasing % in seedlings height was (21.13 %), in the diameter was (27.8 %), in the number of branches was (25.7 %), and in the total seedlings dry weight was (16.1 %). Considering the spraying numbers, in general spraying four times showed a significant increase in the morphological features of the *P. orientalis* seedling such as seedling height (15.0 cm), the number of branches (4.23), and the total seedling's dry weight (27.7 g) comparing with sprying two times which gave (12.25 cm), (3.58) and (25.41 g) respectively. Duncan's multiple-range test showed also a significant difference between the means of the combined treatments, where the optimum combination for the Nano N.P.K with GA3 was 3 g. L^{-1} and 300 g. L^{-1} for the studied parameters, seedlings height was (17.23 cm), for diameter was (4.1 mm), while for number of branches (5.86), and the total seedling dry weight was (38.79 g) compare to their lowest values (9.7 cm), (2.14 mm) and (2.7) and (16.1 g) in control respectively. Regarding both GA3 vs. Sprays number and Nano N.P.K vs. Spray number, the seedlings recorded the highest significant values in seedling height (16.64 cm) when sprayed GA3 at 600 mg. L^{-1} with four times spraying, while recorded (17.2 cm) height at the interaction between four spraying times and 3 g. L^{-1} of Nano N.P.K fertilier. Depending on the stem diameter the highest value was (3.72mm)obtained when treated with GA3 300 gL^{-1} and sprayed four times, where recorded (3.95mm) when treated with 2 g. L-1 of Nano N.P.K, with four times spraying. the higher number of branches was (4.7) found at the interaction effect of four times of spraying of GA3 300 g. L^{-1} and obtained (5.5) number of branches at four sprays of 3g. L^{-1} of Nano N.P.K, and (31.44)g total dry weight at four sprays of GA3 300 g. L^{-1} and (33.4 g) at four sprays of 3g.L^{-1} of Nano N.P.K. The cumulative influence of the three factors (Spray numbers, GA3, Nano N.P.K) increased significantly in most of the studied parameters. The seedling height reached its maximum significant increment height (18.9) cm at the interaction of four sprays times of Nano N.P.K 3g L^{-1} with 600mg L^{-1} of GA3, when recorded the highest value (4.35) mm for diameter at the interaction effect of two sprays of 3g L^{-1} Nano N.P.K with 300mg L^{-1} as well as recorded the higher number of branches were (7) and (39.8) g of total dry weight at the interaction between four sprays of 3g L^{-1} Nano N.P.K with 300mg L^{-1} of GA3.

Table (3) : Effect of Nano (N.P.K) fertilizer and GA3 levels, foliar spray numbers and their interactions on the increase in the height (cm) of *Platycladus orientalis* seedlings.

N.P.K Nano Fertilizer 20:20:20 (%)	GA3 Conc.	Sprays Number		Effect of Nano NPK x GA3 Conc.	Effect of Nano N.P.K Fertilizer 20:20:20 (%)
		2 sprays	4 sprays		
Control	Control	10.45 fh	9.00 h	9.725 e	11.207 c
	300 mg/L^{-1}	9.47 h	10.00 gh	9.735 e	
	600 mg/L^{-1}	15.40 a-d	12.77 c-h	14.087 bd	
1g/L^{-1}	Control	11.48 e-h	15.15 be	13.317 d	13.188 b
	300 mg/L^{-1}	10.26 gh	15.37 a-d	12.814 d	
	600 mg/L^{-1}	10.47 fh	16.40 ac	13.433 cd	
2g/L^{-1}	Control	11.04 fh	14.90 b-e	12.972 d	14.445 ab
	300 mg/L^{-1}	12.48 d-h	16.42 ac	14.446 bd	
	600 mg/L^{-1}	13.40 c-g	18.43 ab	15.917 ac	
3g/L^{-1}	Control	12.68 c-h	14.17 c-f	13.425 dc	15.669 a
	300 mg/L^{-1}	16.00 a-d	18.47 ab	17.233 a	
	600 mg/L^{-1}	13.73 c-g	18.97 a	16.350 ab	
Effect of Spray No.		**12.25 b**	**15.00 a**	**Effect of GA3 Conc.**	
Effect of GA3 Conc. X Effect of Spray No.	Control	11.45 c	13.30 b	12.378 c	
	300 mg/ L^{-1}	12.05 bc	15.06 a	13.557 b	
	600 mg/ L^{-1}	13.25 b	16.64 a	14.947 a	
Effect of Nano N.P.K Conc. X Effect of Spray No.	Control	11.822 d	10.591 d		
	1g/ L^{-1}	10.737 d	15.639 ab		
	2 g/ L^{-1}	12.306 cd	16.583 a		
	3 g/ L^{-1}	14.139 bc	17.200 a		

-Values followed by the same letter (s) are not significantly different at $P \leq 0.05$ according to Duncan's multiple range test.
-The control treatment represented spraying the seedlings with distilled water only.

Table (4) : Effect of Nano (N.P.K) fertilizer and GA3 levels, foliar spray numbers and their interactions on the increase in the stem diameter (mm) of *Platycladus orientalis* seedlings.

N.P.K Nano Fertilizer 20:20:20 (%)	GA3 Conc.	Sprays Number 2 sprays	Sprays Number 4 sprays	Effect of Nano NPK x GA3 Conc.	Effect of Nano N.P.K Fertilizer 20:20:20 (%)
Control	Control	1.89 f	2.41 ef	2.148 e	**2.713 b**
	300 mg/L^{-1}	2.61 ed	2.95 b-f	2.782 de	
	600 mg/L^{-1}	3.36 a-e	3.06 b-e	3.209 cd	
1g/L^{-1}	Control	3.89 ac	3.02 b-e	3.454 a-d	**3.395 a**
	300 mg/L^{-1}	3.11 b-e	3.69 a-d	3.403 a-d	
	600 mg/L^{-1}	3.04 b-e	3.61 a-d	3.326 bd	
2g/L^{-1}	Control	2.94 c-f	3.84 ac	3.393 a-d	**3.540 a**
	300 mg/L^{-1}	3.68 a-d	4.31 a	3.994 ab	
	600 mg/L^{-1}	2.75 c-f	3.72 a-d	3.232 bd	
3g/L^{-1}	Control	3.82 ac	3.55 a-d	3.687 ac	**3.793 a**
	300 mg/L^{-1}	4.35 a	3.92 ab	4.134 a	
	600 mg/L^{-1}	3.38 a-e	3.73 a-d	3.559 ac	
Effect of Spray No.		**3.24 a**	**3.48 a**	**Effect of GA3 Conc.**	
Effect of GA3 Conc. X Effect of Spray No.	Control	3.14 b	3.21 ab	**3.170 b**	
	300 mg/ L^{-1}	3.44 ab	3.72 a	**3.578 a**	
	600 mg/ L^{-1}	3.13 b	3.53 ab	**3.332 ab**	
Effect of Nano N.P.K Conc. X Effect of Spray No.	Control	2.620 d	2.806 cd		
	1g/ L^{-1}	3.348 ac	3.442 ab		
	2 g/ L^{-1}	3.123 bd	3.956 a		
	3 g/ L^{-1}	3.852 a	3.734 a		

-Values followed by the same letter (s) are not significantly different at P ≤ 0.05 according to Duncan's multiple range test.
--The control treatment represented spraying the seedlings with distilled water only.

Table (5) Effect of Nano (N.P.K) fertilizer and GA3 levels, foliar spray numbers and their interactions on the increase in the number of the branches of *Platycladus orientalis* seedlings.

N.P.K Nano Fertilizer 20:20:20 (%)	GA3 Conc.	Sprays Number 2 sprays	Sprays Number 4 sprays	Effect of Nano NPK x GA3 Conc.	Effect of Nano N.P.K Fertilizer 20:20:20 (%)
Control	Control	2.60 df	2.82 s-f	2. 708 d	**3.298 b**
	300 mg/L^{-1}	2.57 ef	3.30 c-f	2.937 d	
	600 mg/L^{-1}	4.90 bd	3.60 c-f	4.250 bd	
1g/L^{-1}	Control	3.20 c-f	4.07 c-f	3.633 bd	**3.519 b**
	300 mg/L^{-1}	3.38 c-f	4.47 b-e	3.922 bd	
	600 mg/L^{-1}	3.20 c-f	2.80 c-f	3.000 cd	
2g/L^{-1}	Control	4.10 b-f	2.10 f	3.100 cd	**3.922 b**
	300 mg/L^{-1}	3.53 c-f	4.80 b-e	4.167 bd	
	600 mg/L^{-1}	2.70 c-f	6.30 ab	4.500 ac	
3g/L^{-1}	Control	3.05 c-f	4.83 b-e	3.942 bd	**4.875 a**
	300 mg/L^{-1}	4.73 b-f	7.00 a	5.867 a	
	600 mg/L^{-1}	4.93 bc	4.70 d-e	4.817 ab	
Effect of Spray No.		3.58 b	4.23 a	**Effect of GA3 Conc.**	
Effect of GA3 Conc. X Effect of Spray No.	Control	3.23 c	3.58 bc	**3.403 b**	
	300 mg/ L^{-1}	3.56 bc	4.77 a	**4.166 a**	
	600 mg/ L^{-1}	3.93 ac	4.35 ab	**4.142 a**	
Effect of Nano N.P.K Conc. X Effect of Spray No.	Control	3.358 b	3.239 b		
	1g/ L^{-1}	3.259 b	3.778 b		
	2 g/ L^{-1}	3.444 b	4.400 b		
	3 g/ L^{-1}	4.239 b	5.511 a		

-Values followed by the same letter (s) are not significantly different at P ≤ 0.05 according to Duncan's multiple range test.
-The control treatment represented spraying the seedlings with distilled water only.

Table (6) : Effect of Nano (N.P.K) fertilizer and GA3 levels, foliar spray numbers and their interactions on the Total dry weight (g) of *Platycladus orientalis* seedlings.

N.P.K Nano Fertilizer 20:20:20 (%)	GA3 Conc.	Sprays Number 2 sprays	Sprays Number 4 sprays	Effect of Nano NPK x GA3 Conc.	Effect of Nano N.P.K Fertilizer 20:20:20 (%)
Control	Control	2.60 df	2.82 s-f	2. 708 d	**3.298 b**
	300 mg/L^{-1}	2.57 ef	3.30 c-f	2.937 d	
	600 mg/L^{-1}	4.90 bd	3.60 c-f	4.250 bd	
1g/L^{-1}	Control	3.20 c-f	4.07 c-f	3.633 bd	**3.519 b**
	300 mg/L^{-1}	3.38 c-f	4.47 b-e	3.922 bd	
	600 mg/L^{-1}	3.20 c-f	2.80 c-f	3.000 cd	
2g/L^{-1}	Control	4.10 b-f	2.10 f	3.100 cd	**3.922 b**
	300 mg/L^{-1}	3.53 c-f	4.80 b-e	4.167 bd	
	600 mg/L^{-1}	2.70 c-f	6.30 ab	4.500 ac	
3g/L^{-1}	Control	3.05 c-f	4.83 b-e	3.942 bd	**4.875 a**
	300 mg/L^{-1}	4.73 b-f	7.00 a	5.867 a	
	600 mg/L^{-1}	4.93 bc	4.70 d-e	4.817 ab	
Effect of Spray No.		3.58 b	4.23 a	**Effect of GA3 Conc.**	
Effect of GA3 Conc. X Effect of Spray No.	Control	3.23 c	3.58 bc	**3.403 b**	
	300 mg/ L^{-1}	3.56 bc	4.77 a	**4.166 a**	
	600 mg/ L^{-1}	3.93 ac	4.35 ab	**4.142 a**	
Effect of Nano N.P.K Conc. X Effect of Spray No.	Control	3.358 b	3.239 b		
	1g/ L^{-1}	3.259 b	3.778 b		
	2 g/ L^{-1}	3.444 b	4.400 b		
	3 g/ L^{-1}	4.289 b	5.511 a		

-Values followed by the same letter (s) are not significantly different at $P \leq 0.05$ according to Duncan's multiple range test.

-The control treatment represented spraying the seedlings with distilled water only.

3.2 Chemical parameters.

The results showed that spraing N.P.K.Nano-fertilizers, and GA3 on P. orientalis seedlings significanlty improved the total chlorophyll content , the protein content in the leaves , as well as increased the percentages of nitrogen (%), phosphorus (%), potassium (%).Duncan tests indicated that leaf total chlorophyll, Protein, and measured nutrient content improved by applying N.P.K. Nano-fertilizers, and GA3 compare to the control.

Data in tables (7 up to 11) generally show that the 3 g. L^{-1} of Nano N.P.K notably enhanced the values of leaf total chlorophyll (1.045) mg.g $^{L-1}$, nitrogen (1.514%), phosphorus (0.112%), potassium (1.238 %) and protein (9.65%) compare to the control. In line with Nano N.P.K's tendency of increasing, also, it appears from the results that the studied parameters increased with increasing the foliar application of GA3 600 mg. L^{-1} where the recorded values for leaf total chlorophyll was (0.989 mg.g $^{L-1}$), nitrogen was(1.47%), phosphorus was (0.108%) potassium was (1.166 %) and protein was (9.190%) compare to the control. Both spray numbers, two and four sprays did not show significant differences with measured chlorophyll, nitrogen, and protein. From the obtained results, it appear that the increasing rates of the leaf's mineral content were close between the effects of Nano N.P.K compared to the GA3 effect, where the values of leaf chlorophyll increased in rate (14.6 %), and nitrogen (2.23 %), phosphorus (8.6 %), potassium (9.7%) and protein (6.4 %). In the same tables, Duncan's multiple-range test showed also significant differences between the means of the combined interacted treatments with a clear cumulative influence, where the significant optimum combination was found between heights level of the Nano N.P.K 3 g. $L^{-1}$with GA3 600 mg. L^{-1} which were for chlorophyll (1.132 mg.g L^{-1}), and nitrogen (1.660%), phosphorus (0.128%), potassium (1.308 %) and protein (10.375%) compare to the control.

The interaction between four sprays vs. 600 mg. L^{-1} GA3 significantly recorded the highest values for nitrogen (1.52%), phosphorus (0.116%) potassium (1.20%) and protein (9.490%) compare to the control, while the interaction between four sprays vs. 3 g. L^{-1} of Nano N.P.K significantly recorded the highest values for total chlorophyll (1. 109) mg.g L^{-1}, nitrogen (1.55%), phosphorus (0.124%) potassium (1.264%) and protein (9.722 %) compared to the control. Regarding the combination of the three study factors, four sprays of 3 g. L^{-1} Nano N.P.K with 600 mg. $L^{-1}$of GA3 significantly recorded the maximum values for total chlorophyll (1.318 mg.g $^{L-1}$), nutrients % of nitrogen(1.77%), phosphorus (0.149%), and protein (11.065%) compare to the control, for potassium (1.34%) was at two sprays of 3 g. L^{-1}Nano N.P.K with 600 mg. $L^{-1}$of GA3.

Table (7) : Effect of Nano (N.P.K) fertilizer and GA3 levels, foliar spray numbers and their interactions on the leaf total Chlorophyll (mg. g -1) of *Platycladus orientalis* seedlings.

N.P.K Nano Fertilizer 20:20:20 (%)	**GA3 Conc.**	**Sprays Number**		**Effect of Nano NPK x GA3 Conc.**	**Effect of Nano N.P.K Fertilizer 20:20:20 (%)**
		2 sprays	**4 sprays**		
Control	Control	2.60 df	2.82 s-f	2. 708 d	**3.298 b**
	300 mg/L^{-1}	2.57 ef	3.30 c-f	2.937 d	
	600 mg/L^{-1}	4.90 bd	3.60 c-f	4.250 bd	
1g/L^{-1}	Control	3.20 c-f	4.07 c-f	3.633 bd	**3.519 b**
	300 mg/L^{-1}	3.38 c-f	4.47 b-e	3.922 bd	
	600 mg/L^{-1}	3.20 c-f	2.80 c-f	3.000 cd	
2g/L^{-1}	Control	4.10 b-f	2.10 f	3.100 cd	**3.922 b**
	300 mg/L^{-1}	3.53 c-f	4.80 b-e	4.167 bd	
	600 mg/L^{-1}	2.70 c-f	6.30 ab	4.500 ac	
3g/L^{-1}	Control	3.05 c-f	4.83 b-e	3.942 bd	**4.875 a**
	300 mg/L^{-1}	4.73 b-f	7.00 a	5.867 a	
	600 mg/L^{-1}	4.93 bc	4.70 d-e	4.817 ab	
Effect of Spray No.		3.58 b	4.23 a		**Effect of GA3 Conc.**
Effect of GA3 Conc. X Effect of Spray No.	Control	3.23 c	3.58 bc		**3.403 b**
	300 mg/ L^{-1}	3.56 bc	4.77 a		**4.166 a**
	600 mg/ L^{-1}	3.93 ac	4.35 ab		**4.142 a**
Effect of Nano N.P.K Conc. X Effect of Spray No.	Control	3.358 b	3.239 b		
	1g/ L^{-1}	3.259 b	3.778 b		
	2 g/ L^{-1}	3.444 b	4.400 b		
	3 g/ L^{-1}	4.239 b	5.511 a		

-Values followed by the same letter (s) are not significantly different at $P \leq 0.05$ according to Duncan's multiple range test.
-The control treatment represented spraying the seedlings with distilled water only.

Table (8) : Effect of Nano (N.P.K) fertilizer and GA3 levels, foliar spray numbers and their interactions on the leaf Nitrogen content (%) of *Platycladus orientalis* seedlings.

N.P.K Nano Fertilizer 20:20:20 (%)	GA3 Conc.	Sprays Number 2 sprays	Sprays Number 4 sprays	Effect of Nano NPK x GA3 Conc.	Effect of Nano N.P.K Fertilizer 20:20:20 (%)
Control	Control	1.12 e	1.31 b-e	1.213 e	**1.306 b**
	300 mg/L^{-1}	1.25 de	1.26 de	1.253 de	
	600 mg/L^{-1}	1.43 bd	1.47 bd	1.452 bc	
1g/L^{-1}	Control	1.43 bd	1.26 de	1.340 ce	**1.365 b**
	300 mg/L^{-1}	1.40 ce	1.42 bd	1.410 bd	
	600 mg/L^{-1}	1.29 de	1.40 bd	1.345 ce	
2g/L^{-1}	Control	1.26 ab	1.49 bd	1.370 ce	**1.455 a**
	300 mg/L^{-1}	1.57 bd	1.57 ab	1.570 ab	
	600 mg/L^{-1}	1.42 bd	1.43 bd	1.425 bd	
3g/L^{-1}	Control	1.38 bd	1.48 bd	1.428 bd	**1.514 a**
	300 mg/L^{-1}	1.49 bd	1.42 bd	1.455 bc	
	600 mg/L^{-1}	1.55 ac	1.77 a	1.660 a	
Effect of Spray No.		**1.38 a**	**1.44 a**	**Effect of GA3**	
Effect of GA3 Conc. X Effect of Spray No.	Control	1.30 c	1.38 bc	**1.338 b**	
	300 mg/ L^{-1}	1.43 ab	1.42 ab	**1.422 a**	
	600 mg/ L^{-1}	1.42 ab	1.52 a	**1.470 a**	
Effect of Nano N.P.K Conc. X Effect of Spray No.	Control	1.267 d	1.345 cd		
	1g/ L^{-1}	1.372 bd	1.358 bd		
	2 g/ L^{-1}	1.415 bc	1.495 ab		
	3 g/ L^{-1}	1.473 ac	1.556 a		

-Values followed by the same letter (s) are not significantly different at $P \leq 0.05$ according to Duncan's multiple range test.
-The control treatment represented spraying the seedlings with distilled water only.

Table (9) : Effect of Nano (N.P.K) fertilizer and GA3 levels, foliar spray numbers and their interactions on the leaf Phosphorus (%) of *Platycladus orientalis* seedlings.

N.P.K Nano Fertilizer 20:20:20 (%)	**GA3 Conc.**	**Sprays Number**		**Effect of Nano NPK x GA3 Conc.**	**Effect of N.P.K Nano Fertilizer 20:20:20 (%)**
		2 sprays	**4 sprays**		
Control	Control	0.0783 i-h	0.0770 i	0.078 e	
	300 mg/L^{-1}	0.0860 e-i	0.0923 d-h	0.089 de	**0.086 c**
	600 mg/L^{-1}	0.0960 c-i	0.0840 fg	0.090 de	
1g/L^{-1}	Control	0.0787 h-i	0.0835 f-i	0.081 e	
	300 mg/L^{-1}	0.1005 c-i	0.1303 ab	0.115 ab	**0.099 b**
	600 mg/L^{-1}	0.0820 g-i	0.1185 bd	0.100 bd	
2g/L^{-1}	Control	0.0777 h-i	0.1097 b-g	0.094 ce	
	300 mg/L^{-1}	0.1013 c-g	0.1243 ac	0.113 ac	**0.106 ab**
	600 mg/L^{-1}	0.1135 b-e	0.1110 b-f	0.112 ac	
3g/L^{-1}	Control	0.0973 c-i	0.1130 b-e	0.105 bd	
	300 mg/L^{-1}	0.0957 c-i	0.1105 b-g	0.103 bd	**0.112 a**
	600 mg/L^{-1}	0.1065 b-g	0.1490 a	0.128 a	
Effect of Spray No.		**0.093 b**	**0.109 a**	**Effect of GA3**	
Effect of GA3 Conc. X Effect of Spray No.	Control	0.083 c	0.096 b	**0.089 b**	
	300 mg/ L^{-1}	0.096 b	0.114 a	**0.105 a**	
	600 mg/ L^{-1}	0.100 b	0.116 a	**0.108 a**	
Effect of Nano N.P.K Conc. X Effect of Spray No.	Control	0.087 c	0.08 4c		
	1g/ L^{-1}	0.087 c	0.111 ab		
	2 g/ L^{-1}	0.098 bc	0.115 a		
	3 g/ L^{-1}	0.100 bc	0.124 a		

-Values followed by the same letter (s) are not significantly different at P ≤ 0.05 according to Duncan's multiple range test.

-The control treatment represented spraying the seedlings with distilled water only.

Table (10) : Effect of Nano (N.P.K) fertilizer and GA3 levels, foliar spray numbers and their interactions on the leaf Potassium (%) of *Platycladus orientalis* seedlings.

N.P.K Nano Fertilizer 20:20:20 (%)	GA3 Conc.	Sprays Number		Effect of Nano NPK x GA3 Conc.	Effect of Nano N.P.K Fertilizer 20:20:20 (%)
		2 sprays	4 sprays		
Control	Control	1.03 f-i	1.01 i	1.018 e	**1.050 c**
	300 mg/L^{-1}	1.04 f-i	1.09 e-h	1.067 de	
	600 mg/L^{-1}	1.05 f-i	1.08 e-i	1.065 de	
1g/L^{-1}	Control	1.08 f-i	1.10 e-h	1.087 de	**1.105 b**
	300 mg/L^{-1}	1.12 d-g	1.13 d-g	1.124 bd	
	600 mg/L^{-1}	1.15 c-f	1.06 f-i	1.105 ce	
2g/L^{-1}	Control	1.16 b-f	0.95 i	1.058 de	**1.100 b**
	300 mg/L^{-1}	1.15 c-f	0.96 hi	1.055 de	
	600 mg/L^{-1}	1.24 a-d	1.13 d-g	1.187 bc	
3g/L^{-1}	Control	1.16 b-f	1.22 a-e	1.192 bc	**1.238 a**
	300 mg/L^{-1}	1.29 ab	1.14 c-f	1.213 b	
	600 mg/L^{-1}	1.34 a	1.28 ac	1.308 a	
Effect of Spray No.		**1.10 b**	**1.15 a**	**Effect of GA3 Conc.**	
Effect of GA3 Conc. X Effect of Spray No.	Control	1.07 d	1.11 bd	**1.089 b**	
	300 mg/ L^{-1}	1.08 cd	1.15 ab	**1.115 b**	
	600 mg/ L^{-1}	1.14 ac	1.20 a	**1.166 a**	
Effect of Nano N.P.K Conc. X Effect of Spray No.	Control	1.059 ce	1.040 de		
	1g/ L^{-1}	1.096 cd	1.114 c		
	2 g/ L^{-1}	1.016 e	1.184 b		
	3 g/ L^{-1}	1.212 ab	1.264 a		

Values followed by the same letter (s) are not significantly different at P ≤ 0.05 according to Duncan's multiple range test.
The control treatment represented spraying the seedlings with distilled water only.

Table (11) : Effect of Nano (N.P.K) fertilizer and GA3 levels, foliar spray numbers, and their interactions on the leaf Portion (%) of *Platycladus orientalis* seedlings.

N.P.K Nano Fertilizer 20:20:20 (%)	GA3 Conc.	Sprays Number 2 sprays	4 sprays	Effect of Nano NPK x GA3 Conc.	Effect of Nano N.P.K Fertilizer 20:20:20 (%)
Control	Control	7.000 e	8.166 be	7.583 e	**8.161 b**
	300 mg/L^{-1}	7.812 de	7.843 de	7.828 df	
	600 mg/L^{-1}	8.937 bd	9.208 bd	9.073 bc	
1g/L^{-1}	Control	8.906 bd	7.843 de	8.375 ce	**8.531 b**
	300 mg/L^{-1}	8.750 bd	8.875 bd	8.813 bd	
	600 mg/L^{-1}	8.062 ce	8.750 bd	8.406 ce	
2g/L^{-1}	Control	7.843 de	9.281 bd	8.563 ce	**9.094 a**
	300 mg/L^{-1}	9.812 ab	9.812 ab	9.813 ab	
	600 mg/L^{-1}	8.875 bd	8.937 bd	8.906 bd	
3g/L^{-1}	Control	8.625 bd	9.229 bd	8.927 bd	**9.465 a**
	300 mg/L^{-1}	9.312 bd	8.875 bd	9.094 bc	
	600 mg/L^{-1}	9.687 ac	11.065 a	10.375 a	
Effect of Spray No.		**8.635 a**	**8.990 a**	**Effect of GA3**	
Effect of GA3 Conc. X Effect of Spray No.	Control	8.094 c	8.630 bc	**8.362 b**	
	300 mg/ L^{-1}	8.922 ab	8.852 ab	**8.887 a**	
	600 mg/ L^{-1}	8.891 ab	9.490 a	**9.190 a**	
Effect of Nano N.P.K Conc. X Effect of Spray No.	Control	7.917 d	8.406 cd		
	1g/ L^{-1}	8.573 bd	8.490 bd		
	2 g/ L^{-1}	8.844 bc	9.344 ab		
	3 g/ L^{-1}	9.208 ab	9.722 a		

-Values followed by the same letter (s) are not significantly different at P ≤ 0.05 according to Duncan's multiple range test.
-The control treatment represented spraying the seedlings with distilled water only.

4. DISCUSSION

Nanotechnology is a fast-growing field of science and is used by a wide range of scientific disciplines including Agriculture. In forestry, the potential application of nanotechnology as nano fertilizers still requires research and evidence (Singh et al., 2021) particularly in producing good quality seedlings under nursery growing conditions. The influence of N.P.K nano-fertilizer and GA3 applied as foliar spraying has been suggested as an important way of amplifying plant growth of different plant species without impact on the environment (Al-Juthery et al., 2018, Mohamed and Elsadek, 2020).

4.1. The effects of Nano N.P.K. fertilizer

In this study the leaf treatments of *P. orientalis* seedlings with N.P.K Nano-fertilizer individually or in combinations with GA3 and spray numbers had significant positive effects on the morphological parameters including seedling stem height , stem diameter, number of branches, and the total seedling dry weight. Generally, this effect increased significantly with increasing the applied levels of Nano N.P.K (3 and g. L^{-1}) compare to the control, likely the main reason behind this positive effect almost returns to the rapid introduce of added nutrients through foliar spraying on the leaves which content stomata then reach into the cells, which helps the delivery of nutrients necessary for plant metabolic processes (Rajasekar et al., 2017). Nano fertilizers have a high surface-to-volume ratio. Particles with a smaller size than the size of the stomalal pores in the leaves which enable them to enter easily into the plant tissues which improves nutrient efficiency (Dimkpa et al., 2015 and Qureshi et al., 2018). More specifically, the reason for the increase in stem diameter and seedling high may be attributed to the increase in the level of addition of the nano-composite NPK fertilizer that contains the main ingredients required for plant growth and development. The role of nutrients N, P, and K in plant metabolic reactions and shaping plant architecture is well documented, as nitrogen regulates cell division and expansion, so tissue growth increases due to the activity of the cambium layer, which gives when divided, an increase in the stem diameter. (Luo, et al., 2020). Nano-fertilizer enhances seedling height probably through increasing the meristematic activity and stimulation of cell elongation in plants (Mahil & Kumar, 2019). The increase in the number of branches is almost related to the physiological role of the macronutrient N.P.K which is responsible for improving the shoot growth and probably the accumulation of the carbohydrate substances in the seedlings stimulate the growth of the lateral branches (Bang, 2021). The role of Nano N.P.K in increasing seedling total dry weight and the elevated percentage of total chlorophyll content in this study might be due to the beneficial effects of Nano fertilizers that increase the availability of necessary nutrients to the growing seedlings that increased chlorophyll formation, photosynthesis rate, dry matter production, and result improve overall growth of the plant (Hediat & Salama, 2012, Wajid et al., 2017, Al-Hchami & Alrawi 2020), this is in line with the results obtained recently by Shareef (2021). The positive impact of the N.P.K Nano-fertilizer on the increasing the percentage of N, P, and K in leaves in this study probably attribute to the idea that nanoparticles when foliary applied to plants they easy to enter stomata by increasing the osmotic pressure of the stomata cells, then more frequently opening the stomatal cells and enabled the plant to receive more nutrients loaded on the surface of nanoparticles as indicated by Van et al., (2013), Dimkpa et al., (2015), Qureshi et al., (2018). These results coincide with Shareef et al., (2021) and Hagagg (2018) who showed that nano N.P.K enhanced significantly the uptake of nitrogen, phosphorous, potassium in *Pinus brutia*, *Aggizi olive* seedlings respectively. The increase in the protein content in the leaves of *P. oreintalis* may be due to the effect of nitrogen on the structure of the ribosome and the biosynthesis of certain hormones involved in the synthesis of protein (Jameel & Arkan 2017).

4.2. The effects of Gibberellic acid

Chemical growth regulators especially GA3 perform an important role in the growth and development of seedlings by enhancing many physiological and biochemical processes (Gupta & Chakrabarty, 2013). Generally, the results of this study showed that GA3 can play an important role in the growth of *P. orientalis* compare to the control. Individually, the GA3 showed close results to that obtained with Nano N.P.K, particularly at 300 mg. L^{-1}. Generally, the foliar application of GA3 at concentrations of 600 mg. $L^{-1}$and 300 mg. L^{-1} increased the morphological parameters including seedling stem height , diameter, number of branches, and the total seedling dry weight. In most studies, spraying the plants with any concentration of GA3 resulted in a steady significant increase in the growth parameters viz plant height, stem diameter, number of branches/seedling, and dry weights of shoots and roots as compared to untreated control plants (Ashour, 2018). The marked influence of GA3 on increasing the plant growth parameters may be attributed to its impact on stimulating enzymes and proteins biosynthesis, cambial activity cell division, and cell elongation (Hauvermale et al., 2012, Mohamed et al., 2020) which in turn leads to increase stem length, stem diameter and dry weight of studied plants. The foliar sprays of GA3 at 300 mg L^{-1} and 600 mg L^{-1} concentrations were more effective for *P.oreintalis* total dry weight as compared to the control treatment, this might be because GA3 improves the total chlorophyll content required for photosynthesis(Hartmannet al., 2002) that leads to increase in dry matter of plant and significant improvement in absolute growth rate. The effect of GA3 treatments on increasing the studied vegetative properties is in good accordance with those recorded by El-Sallami & Mahros (1997) on *Cupressus sempervirens*, Mansour et al., (2010) on *Conocarpus erectus*, El-Keltawi et al., (2012) on *Cupressus macrocarpa*, Vasantha et al., (2014) on *Tamarindus indica*, Muhammad (2015) in pistachio seedlings, Sandeep et al., (2016) on *Delonix regia*, Ashour (2018) in *Cupressus macrocarpa*, (Ullah et al, 2018) in olive cuttings. The highest chlorophyll contents noted at the treatment of GA3 600 mg L^{-1} in all *P.oreintalis* seedlings is in line with the idea that the leaves of plants sprayed with GA3 concentrations as compared to untreated control plants return to the inhibitory role for GAs in chlorophyll degradation in GA3 treated plants by inhibiting the effect of ethylene on degradation chlorophyllase the green pigment that plants use to make food and develop during photosynthesis (Jacob et al., 1999, Li et al., 2010). The results of increasing total chlorophylls contents in plants receiving GA3 treatments are in agreement with those reported by Ilango et al., (2003) on *Albizia lebbeck*, Eid and Mazher (2004) on *Casuarin gluca*, Eid and Abou-Leila (2006) and Taha and Trees (2010) on croton plants, El-Khateeb et al., (2010) on *Calia secundiflora*, Mazher et al., (2014) on *Schefflera arboricola* and AbdelKader et al., (2016) on *Magnolia grandiflora.*

Evidently, data in tables (8, 9, 10, and 11) show that absorption and accumulation of the tested nutrients (N, P, K, and protein)% in leaves of *P.oreintalis* seedlings were conspicuously increased by foliar spraying of GA3 treatments. Such increases in N, P, or K and protein % due to foliar application of GA3 treatments are similar to those obtained by Eid and Mazher (2004), Eid and Abou-Leila (2006), and Ibrahim et al., (2010), El-Keltawi et al., (2012), Mazher et al., (2014) and AbdelKader et al., (2016). The increase in such studied nutrients in leaves of seedlings receiving GA3 treatments may be attributed to the role of GA3 which played in stimulating the protein synthesis that reflects the remarkable augmentation of vegetative growth, and consequently augmentation of the uptake and accumulation of elements in plant tissues (Ashour, 2018).

5. CONCLUSION

According to obtained results, increasing N.P.K nano-fertilizer to 3g L^{-1}, GA3 to 300 and 600 mg L^{-1} and spray times up to four times positively influences the most morphological parameters and the main leaf nutrients content of *P. orientalis* seedlings compared to other treatments. It can be concluded that the foliar application of N.P.K Nano-fertilizer and GA3 can increase the growth of *P. orientalis*. However, unexpectedly the effect of increasing Nano N.P.K individually in increasing the vegetative and leaf chemical properties recorded a small increase if compared with the effect of the GA3, this is showing the need to conduct a study testing concentrations beyond 3g L^{-1} nano N.P.K fertilizer.

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