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Studying the effect of NPK fertilizer and growing media on stain leaf (*chrysophylum oliviforme* l.) Seedlings: the effect on morphological traits.

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Abstract

An experiment was carried out during the two seasons of 2021 and 2022 at the Tropical Farm, Kom- Ombo, ARC, Aswan Governorate, Egypt to study the performance of one year old *Chrysophylum oliviforme* seedlings under different growing media and chemical fertilizer NPK treatments. The rates of NPK were 0, N12:P10:K5 and N24:P20:K10 g/ seedling, while the applied growing media were clay, sand, clay: sand (1:1 v/v) and peat moss. The experiment was arranged in a split-plot as randomized complete block design (RCBD) with three replicates. NPK fertilizer levels as main plots, while the four growing media as sub-plots. Results observed that the addition of NPK fertilizer in different media caused increase of all studied traits i.e. shoot length, stem diameter, leaves number/ seedling, shoot fresh and dry weight of seedling, root fresh and dry weight and leaf area index in the two seasons. The highest values of these parameters was recorded when NPK fertilizer was applied at the rate of N24P20K10. Planting *C. oliviforme* in peat moss, followed by in the mixture of clay: sand (1: 1 v/v) resulted in the highest values of the morphological features. Growing seedlings in peat moss + N24P20K10 increased the studied traits than the other combinations. Therefore, to obtain strong seedlings in the nursery stage for such slow- growing tree species at the beginning growth, they must be planted in a suitable media as peat moss or mixture of clay: sand (1:1 v/v) with addition of NPK at the rate of 24:20:10 g/ seedling.

Keywords: *Chrysophylum oliviforme* L., NPK fertilizer, sand, clay, peatmoss media.

Introduction

Chrysophyllum oliviforme L. tree (stain leaf) belongs to family Sapotaceae, cultivated in many of tropical countries as ornamental tree and it lives wild in a region of Hawaii and French Polynesia. Its wood is hard, heavy, and has a specific gravity of 0.9 g/ cm^3. The tree is used for construction in Cuba **(Little and Wadsworth, 1964).** The tree makes a beautiful addition to the natural landscaping, a good basically plant, and an attractive garden, street, and parking lot tree.

Plant depends mainly on the growing media for growth and production. Growing media provides plant roots with anchorage; the air space in the media allows the plant to breather, providing support for the plant, providing plant with water and essential nutrients and it allows the diffusion of oxygen to roots that giving the plant its basic needs. Sandy soil, the soil that has a high proportion of sand drains easily, so the logging of water is done easily as

well. Moreover, the sandy soils dry out very quickly and the nutrients are washed throughout the soil. Clay soils are heavy to work, don't warm up quickly in the spring and they are sticky when wet and very hard when dry. Also, they keep the water and nutrients well and remain warm in autumn as they don't cool off quickly either. However, a lot of the water they retain will not be taken up by plants as they log water in winter **(James and Michael, 2009).** Tree seedlings are usually planted in the clay soil for its fertility, but sometimes sandy soils are used to grow tree seedlings as well when they are mixed with clay like in reclaimed lands **(Conover and Poole, 1988).** Peat moss was more efficient in improving soil physical and chemical properties and enhancing growth of tree seedling. **AL-Kahtaniand and Ahmed (2012)** indicated that peat moss as a growing media gave the highest values of all vegetative growth parameters including as leaf length, width and area, shoot length, pigments content and leaf mineral contents.

Nursery grown seedlings often exhibit nutrient deficiency soon after planting because slow regeneration and extension of the root system restricts exploitation and absorption of soil nutrients for most of the growing season **(Burdett, 1990)**; hence, growth accruing after planting is highly dependent on internal reserves for nutrient requirements. NPK as chemical fertilizers stimulate the vegetative growth of the trees seedlings. Nitrogen is vital in amino acids, proteins, alkaloids, co-enzymes and some vitamins which is why nitrogen has an essential role in the metabolism process of plants. Phosphorous is exists in all cell nuclei as phosphoric acid combined with other components to form nucleic acid, it is also quite important for root growth. Potassium plays a highly significant role in formation of the proteins and carbohydrates, in water condition regulation in plant cells and the water loss by photosynthesis and transpiration **(Sharma *et al*., 2013).**

Production of good quality tree seedlings is the main objective of tree nurseries but the slow growth of tree species as *Chrysophyllum oliviforme* limits the high quality seedling production **(Ebeid and Shebany, 2017).** However, using the suitable growing media is an alternative to soil in which physical properties as aeration, drainage and water holding capacity are lacking. Also, applied fertilization as NPK in tree seedlings is considered to be a way to improve its nutrients and obtain vigor growth. Therefore, this study aimed to demonstrate the effect of growing media (sand, clay, sand: clay (1:1 v/v) and peat moss) and NPK fertilizer levels in stimulating and developing the growth of *Chrysophyllum oliviforme* L. under Aswan conditions.

Materials and Methods

The present work was carried out at Kom- Ombo Tropical Farm, Aswan Botanical Garden, ARC, Egypt during the two successive seasons 2021 and 2022 to study the effect of growing media and NPK fertilizer on the morphological features and biochemical of *Chrysophyllum oliviforme* L

seedlings. The chemical analysis of the used growing media was conducted out according to method of **Black (1965)** and presented in Table 1. The plant material in this investigation was one-year-old and

30-35 cm in height of *C. oliviforme* seedlings. Seedlings were transplanted on May 15th of 2021 and 2022 seasons in 30 x 25 cm polyethylene bags (one seedling/bag) filled with one of the growing media according to the tested treatments i.e. clay, sand, the mixture of them 1:1 (V/V) and peat moss. The irrigation was done according to the plants need. Three NPK fertilizer doses were used as N0P0K0, N1P1K1 and N2P2K2, where the amounts of N1 and N2 were 12 and 24 g/pot of ammonium sulphate (20.5 % N).

Table 1. The chemical characteristics of the used media (sand, clay and peat moss).

Soil	pH	CaCO3 %	OM %	EC dSm^{-1}	Soluble cations and anions (meq /100 g)							
					Cations				Anions			
Sand	7.80	2.70	0.04	0.84	Na^+	K^+	Ca^{++}	Mg^{++}	SO_4^-	Cl^-	HCO_3^{--}	CO_3^-
Clay	8.30	0. 45	0.55	0.25	0.10	0.03	0.30	0.11	0.31	0.11	0.12	0
					0.05	0.12	0.41	0.21	0.07	0.04	0.08	0

Chemical properties of the used peat moss media

O.C.%	Total N%	C/N ratio	PH 1:2.5	EC dSm^{-1}	Mineral contents in peat moss media (ppm)					
					P	K	Fe	Mn	Zn	Cu
44.33	0.59	81.13	6.16	0.37	24	660	8.73	4.71	4.50	0.51

Meanwhile, phosphorus used as P1 and P2 were 10 and 20 g/pot of calcium superphosphate (15.5 % P_2O_5). Potassium levels as K1 and K2 were 5 and 10 g/pot of potassium sulphate (48 % K2O). Such NPK fertilizer levels were divided into 4 equal portions and added after two months from transplanting date, with four weeks intervals thereafter until 15th October for each season. The fertilizers were applied as top dressing to the bags then irrigation water was added. This experiment was arranged as completely randomized block design (RCBD) in a split- plot design with three replicates; NPK fertilizer levels as the main plots, while the four growing media as sub-plots. Each replicate contained three *C. oliviforme* seedlings.

At the end of the experiment in 15th November of the two seasons, the following data were recorded: shoot length (cm), stem diameter (mm), number of leaves/ plants, shoot fresh and dry weight (g), root fresh and dry weight (g). The leaf area index (cm^2) was recorded by measuring the 5th leaf from the top according to **Abd El-Maksoud (1988).**

Data on the morphological and chemical traits of both seasons were statistically analyzed as described by **Snedecor and Cochran (1980).** Means of all characters were compared by L.S.D test at 5% level.

Results

The effect of NPK fertilizer and growing media:

I-The effect on morphological features:

1-Shoot length (cm):

The obtained results observed that the addition of NPK fertilizer in soil caused increase of all studied traits i.e. shoot length, stem diameter, leaves number/ seedling, shoot fresh and dry weight of *Chrysophyllum oliviforme* seedling, root fresh and dry weight and leaf area index in the two seasons. The highest values of these parameters in the two seasons was recorded when NPK fertilizer was applied at the level of N24P20K10. Also, *C. oliviforme* seedlings planted in peat moss, followed by in the mixture of clay: sand (1: 1 v/v) resulted in the highest values of the morphological features. Regarding the effect of interaction between NPK levels and growing media on the studied parameters, cultivated seedlings in peat moss + N24P20K10 increased than the other combinations in the mean of seasons.

2-Stem diameter (cm):

Data of the two experimental seasons in Table 3 showed that NPK and growing media treatments as well as their interactions in the two seasons significantly affected stem diameter of *Chrysophyllum oliviforme* seedlings. The addition of the NPK fertilizer slightly increased stem diameter than the control. Application of N24P20K10 level recorded the thickest stem of 0.44 and 0.45 cm in the first and second seasons, respectively. It could be obtained out that

the thickest stem (0.45 and 0.46 cm) in the 1st and 2nd seasons, respectively were recorded by planting in peat moss, followed by mixture of clay: sand (1:1 v/v) as growing media. Concerning the effect of NPK + growing media, data of the same table indicated that addition of N24P20K10 in peat moss media was more effective in increasing stem diameter than the other treatments. Meanwhile, the lowest values of stem diameter (0.33 and 0.35 cm) in this concern were obtained with plants as control in sandy soil in the 1st and 2nd seasons, respectively.

Table 2. Effect of NPK fertilizer on the shoot length (cm) of *Chrysophyllum oliviforme* seedlings grown under different growth media during the seasons of 2021 and 2022.

Treatments	1st season					2nd season				
	Growing media (B)				Mean A	Growing media (B)				Mean A
NPK levels (A)	Clay	Sand	Clay: sand (1:1v/v)	Peat moss		Clay	Sand	Clay: sand (1:1v/v)	Peat moss	
N0P0K0	53.3	44.4	59.1	67.0	56.0	54.0	45.7	59.3	63.9	55.7
N12P10K5	62.8	57.6	67.9	73.9	65.5	63.7	58.5	69.0	**75.8**	66.8
N24P20K10	64.9	61.0	70.7	74.4	67.8	66.3	61.6	71.4	**75.6**	**68.7**
Mean B	60.3	54.3	65.9	71.7		61.3	55.3	**66.6**	**71.8**	
LSD 5%	A= 2.1 B= 2.0 AB=3.5					A=1.8 B=2.0 AB=3.3				

Table 3. Effect of NPK fertilizer on the stem diameter (cm) of *Chrysophyllum oliviforme* seedlings grown under different growth media during the seasons of 2021 and 2022.

Treatments	1st season					2nd season				
	Growing media (B)				Mean A	Growing media (B)				Mean A
NPK levels (A)	Clay	Sand	Clay: sand (1:1v/v)	Peat moss		Clay	Sand	Clay: sand (1:1v/v)	Peat moss	
N0P0K0	0.35	**0.33**	0.37	0.42	0.37	0.35	**0.35**	0.37	0.42	0.37
N12P10K5	0.40	0.38	0.41	**0.46**	0.41	0.43	0.39	0.42	**0.47**	0.43
N24P20K10	0.44	0.41	0.45	**0.48**	**0.44**	0.43	0.43	0.45	**0.49**	**0.45**
Mean B	0.40	0.37	**0.41**	**0.45**		0.40	0.39	**0.42**	**0.46**	
LSD 5%	A=0.015 B=0.012 AB=0.022					A=0.024 B=0.016 AB= 0.032				

3-Number of leaves/ seedlings:

The effect of NPK fertilizer and growing media as well as their interactions were significant in the two studied seasons for number of leaves/ seedling as shown in Table 4. It was quite clear that *C. oliviforme* plants which were treated with N24P20K10 resulted in the highest number of leaves (26.68 and 27.24) in the 1st and 2nd seasons, respectively compared to the other treatments.

Concerning the effect of growing media on number of leaves/ seedlings, it was proved that the highest values (30.62 and 30.89) of leaves number were detected with seedlings planted in peat moss as media, while the lowest ones (19.70 and 19. 87) were due to sandy soil in the 1st and 2nd seasons, respectively. With respect to the combined effect of NPK + growing media, it was found that the most increment of number of leaves/seedling (33.87 and 34.93) was obtained with N24P20K10 plus peat moss growth media.

Table 4. Effect of NPK fertilizer on the number of leaves/ seedlings of *Chrysophyllum oliviforme* grown under different growth media during the seasons of 2021 and 2022.

Treatments	1st season					2nd season				
	Growing media (B)				Mean A	Growing media (B)				Mean A
NPK levels (A)	Clay	Sand	Clay: sand (1:1v/v)	Peat moss		Clay	Sand	Clay: sand (1:1v/v)	Peat moss	
N0P0K0	19.20	16.40	22.10	26.73	21.11	19.13	17.90	22.23	26.77	21.51
N12P10K5	22.53	20.33	23.33	31.27	24.37	23.37	19.67	22.60	30.97	24.15
N24P20K10	24.67	22.37	25.83	33.87	26.68	25.53	22.03	26.47	34.93	27.24
Mean B	22.13	19.70	23.76	30.62		22.68	19.87	23.77	30.89	
LSD 5%	A=1.75 B=1.38 AB=2.55					A=0.90 B= 1.59 AB=2.40				

4-Shoot fresh weight/ seedling (g):

The effect of NPK and growing media as well as their interactions on shoots fresh weight/ seedling was significant in the two seasons as presented in Table 5. It was noticed that, the addition of N24P20K10 fertilizer in soil caused significant increase of fresh weight of shoots compared with control. This increment was increased gradually with increasing the rate of NPK fertilizer. However, the heaviest fresh weight of shoots (12.32 and 12.23 g) was of plants treated with N24P20K10 in the first season and second seasons, respectively. With respect to the effect of growing media, it could be observed that the heaviest fresh weight of shoot (12.07 and 12.24 g) was of seedlings planted in peat moss growing media in the first and second seasons, respectively. Concerning the effect of NPK treatments and the tested growing media, data recorded in the same table revealed the heaviest fresh weight reached 13.63 and 13.80 g in the 1st and 2nd seasons, respectively was by using N24P20K10 + peat moss growing media.

Table 5. Effect of NPK fertilizer on the shoot fresh weight/ seedling (g) of *Chrysophyllum oliviforme* grown under different growth media during the seasons of 2021 and 2022.

Treatments	1st season					2nd season				
	Growing media (B)				Mean A	Growing media (B)				Mean A
NPK levels (A)	Clay	Sand	Clay: sand (1:1v/v)	Peat moss		Clay	Sand	Clay: sand (1:1v/v)	Peat moss	
N0P0K0	8.53	7.20	9.33	10.67	8.93	8.13	7.27	9.10	10.80	8.83
N12P10K5	10.03	9.17	11.30	11.90	10.60	9.87	9.10	10.80	12.13	10.48
N24P20K10	12.33	10.63	12.67	13.63	12.32	12.07	11.07	12.00	13.80	12.23
Mean B	10.30	9.00	11.10	12.07		10.02	9.14	10.63	12.24	
LSD 5%	A= 0.23 B=0.62 AB=0.91					A=0.40 B=0.55 AB=0.87				

5-Shoot dry weight/ seedling (g):

The effect of NPK levels and growing media types as well as their interactions on shoots dry weight/ seedling was significant in the two seasons as shown in Table 6. It was obvious that, *C. oliviforme* plants treated with N24P20K10 had significant increase than other treatments in both seasons. The heaviest average dry weight of shoots (6.15 and 6.20 g) was of plants treated with N24P20K10. As regard to, the effect of growing media treatments was also reported in the same table and it was found that using peat moss as growing media caused heaviest value (5.86 and 6.01 g) in the 1st and 2nd seasons, respectively. Regarding the effect of interaction between NPK fertilizer and growing media on dry weight of shoots, it was noticed that the addition of NPK with growing media showed also a remarkable influence on dry weight of shoots. Since the heaviest dry weight of shoots of (6.90 and 6.80 g) was of plants fertilized with N24P20K10 with peat moss media in the 1st and 2nd seasons, respectively.

Table 6. Effect of NPK fertilizer on the shoot dry weight/ seedling (g) of *Chrysophyllum oliviforme* grown under different growth media during the seasons of 2021 and 2022.

Treatments	1st season					2nd season				
	Growing media (B)				Mean A	Growing media (B)				Mean A
NPK levels (A)	Clay	Sand	Clay: sand (1:1v/v)	Peat moss		Clay	Sand	Clay: sand (1:1v/v)	Peat moss	
N0P0K0	3.63	3.03	4.30	5.30	4.07	3.23	3.03	4.13	5.43	3.96
N12P10K5	5.10	4.37	5.17	5.37	5.00	4.63	4.30	5.20	5.80	4.98
N24P20K10	6.23	5.03	6.43	**6.90**	**6.15**	6.57	5.10	6.33	**6.80**	**6.20**
Mean B	4.99	4.14	5.30	**5.86**		4.81	4.14	5.22	**6.01**	
LSD 5%	A=0.45 B=0.49 AB=0.81					A=0.38 B=0.32 AB=0.58				

6-Root fresh weight/ seedling (g):

The effect of chemical fertilizer NPK and growing media types as well as their interactions on root fresh weight/ seedling was significant in the two seasons as shown in Table 7. As for NPK nutrition treatments, results indicated that NPK levels increased root fresh weight than the control plants in two seasons. The heaviest root fresh weights (6.26 and 6.51 g) in the 1st and 2nd seasons, respectively was of seedlings fertilized with N24P20K10 compared to the other treatments. Application of growing media caused significant differences in root fresh weight in the two seasons. Peat moss as growing medium was more effective in increasing root fresh weight comparing with the other media. The highest values of root fresh weight (7.02 and 6.99 g) was of seedlings grown in peat moss, followed by clay: sand (5.83 and 6.22 g) as growth media in the 1st and 2nd seasons, respectively. Concerning the effect of NPK fertilizer and growing media interactions, the data in the same table pointed out that the heaviest fresh weight of roots (7.73 and 7.63 g) resulted by using peat moss, followed by clay: sand (6.70 and 7.33 g) with N24P20K10 in the 1st and 2nd seasons, respectively.

Table 7. Effect of NPK fertilizer on the root fresh weight/ seedling (g) of *Chrysophyllum oliviforme* grown under different growth media during the seasons of 2021 and 2022.

Treatments	1st season					2nd season				
	Growing media (B)				Mean A	Growing media (B)				Mean A
NPK levels (A)	Clay	Sand	Clay: sand (1:1v/v)	Peat moss		Clay	Sand	Clay: sand (1:1v/v)	Peat moss	
N0P0K0	4.13	3.37	5.03	6.27	4.70	4.13	3.60	5.17	6.43	4.83
N12P10K5	4.77	4.50	5.77	7.07	5.53	4.83	4.77	6.17	6.90	5.67
N24P20K10	5.50	5.10	**6.70**	**7.73**	**6.26**	5.77	5.30	**7.33**	**7.63**	**6.51**
Mean B	4.80	4.32	**5.83**	**7.02**		4.91	4.56	**6.22**	**6.99**	
LSD 5%	A=0.33		B=0.31	AB=0.54		A=0.35		B=0.35	AB= 0.59	

7-Root dry weight/ seedling (g):

The effects of chemical fertilizer NPK and growing media as well as their interactions on root dry weight/ seedling were significant in the two seasons as presented in Table 8. Also, data indicated that NPK levels increased root dry weight than the control seedlings in the two seasons. However, the heaviest root dry weights (3.03 and 3.11 g) in the 1st and 2nd seasons, respectively was of plants fertilized with N24P20K10 level compared to the other treatments. Using of growing media caused significant differences in root dry weight in both seasons. Planting in peat moss as growing media was more effective in increasing root dry weight compared to the other media. Moreover, the highest values of root dry weight (3.22 and 3.27 g) was of plants grown in peat moss as growth media in the 1st and 2nd seasons, respectively. Concerning the interaction effect of NPK levels and growing media, the data in the same table pointed out that the heaviest dry weight of roots (3.80 g) resulted from using peat moss as growing media with N24P20K10 in the mean of seasons.

Table 8. Effect of NPK fertilizer on the root dry weight/ seedling (g) of *Chrysophyllum oliviforme* grown under different growth media during the seasons of 2021 and 2022.

Treatments	1st season					2nd season				
	Growing media (B)				Mean A	Growing media (B)				Mean A
NPK levels (A)	Clay	Sand	Clay: sand (1:1v/v)	Peat moss		Clay	Sand	Clay: sand (1:1v/v)	Peat moss	
N0P0K0	2.00	1.50	2.27	2.93	2.18	2.03	1.57	2.43	3.17	2.30
N12P10K5	2.37	2.10	2.57	2.93	2.49	2.47	2.20	2.47	2.83	2.49
N24P20K10	2.63	2.37	3.30	3.80	3.03	2.53	2.50	3.60	3.80	3.11
Mean B	2.33	1.99	2.71	3.22		2.34	2.09	2.83	3.27	
LSD 5%	A=0.32		B=0.24	AB=0.45		A=0.39		B=0.28	AB=0.53	

8-Leaf area index (cm^2):

Data taken on the leaf area index were presented in Table 9. It could be showed that seedlings fertilized with NPK levels had significant increase in leaf area index when compared with control ones. However, the widest leaf area was (22.13 and 22.42 cm^2) in the 1st and 2nd seasons, respectively with N24P20K10 fertilizer incorporated. Concerning the effect of growing media on leaf area index, there were significant differences between the growth media for this character in the two seasons. The widest leaf area (26.48 and 26.61cm^2)

was by planting in peat moss media in the 1st and 2nd seasons. But the planting in sandy soil as media resulted in the lowest values (15.26 and 14.81 cm^2) of leaf area in the 1st and 2nd seasons, respectively. The effect of interaction between NPK fertilizer and growing media for leaf area was significant in the two seasons. It was also clear from the same table that, the addition of N24P20K10 with peat moss produced the widest leaf area (27.60 and 27.63 cm^2) compared to the other interactions in the 1st and 2nd seasons, respectively.

Table 9. Effect of NPK fertilizer on leaf area index (cm^2) of *Chrysophyllum oliviforme* grown under different growth media during the seasons of 2021 and 2022.

Treatments	1st season					2nd season				
	Growing media (B)				Mean A	Growing media (B)				Mean A
NPK levels (A)	Clay	Sand	Clay: sand (1:1v/v)	Peat moss		Clay	Sand	Clay: sand (1:1v/v)	Peat moss	
N0P0K0	20.10	15.20	21.37	25.57	20.56	20.00	13.97	22.67	25.87	20.63
N12P10K5	20.63	15.00	22.70	26.27	21.15	20.90	14.87	23.50	26.33	21.40
N24P20K10	21.57	15.57	23.80	27.60	22.13	22.30	15.60	24.13	27.63	22.42
Mean B	20.77	15.26	22.62	26.48		21.07	14.81	23.43	26.61	
LSD 5%	A=0.31 B=1.11 AB=1.60					A=0.35 B=1.05 AB=1.52				

Discussion

The effect of NPK levels on the morphological traits of *C. oliviforme* i.e. shoot length, stem diameter, number of leaves/ seedling, shoots fresh and dry weight/ seedling and roots fresh and dry weight as well as leaf area index were significant in the two seasons. It was obvious that, the *C. oliviforme* seedlings treated with N24P20K10 level had significant increase than other treatments in both seasons. Our results were in agreed with the previous studies obtained by **Habba (1985); Nasr *et al*. (1987); Taha (1994); Watfa (2009)**; **Hamdan (2012)** Also, **Al-Menaie *et al* (2012)** revealed that, application of N: P: K at 1g/l on *Cassia nodosa* and *Cassia fistula* seedlings exhibited maximum number of leaves. **Ponder (1980)** found that application of NPK on *Eucalyptus saligna* and *Juglans nigra* was significantly increased the plant height and stem diameter in fertilized seedlings. **Krohn (1981)** and **Sundralingam (1982)** proved that the plant height of *Tectona grandis* was significantly improved by NPK treatment with compared to the control. However, the positive effect on the vegetative growth parameters may be due to the role of NPK in the plant growth, which plays a vital role in plant growth and development because NPK have important role in the different physiological processes of metabolites that enhance cell elongation and division in cambium zone **(Zhang *et al*., 2010).**

Using of the different growing media types caused significant differences in the tested vegetative parameters i.e. shoot length, stem diameter, number of leaves/ seedling, shoots fresh and dry weight/ seedling and roots fresh and dry weight as well as leaf area index in the two studied seasons. Moreover, planting in peat moss as growing media was more effective in increasing these growth parameters compared to the other media, while the lowest values of

these traits were produced as a result of sandy soil as growing media. However, the positive effective of peat moss growing media on the growth parameters of *C. oliviforme* seedlings might be due to stability of cell walls with peat moss, which stimulates formation of new leaves and increases the height of seedling more than that with the other media. These results are in agreement with those reported by **Saleh (2000)**; **El-Khateeb *et al.* (2006)**; **Ceglie *et al.* (2015); Saber *et al.* (2019).** However, the positive effective of peat moss as growing media could be attributed to the physical properties as the soil aeration, moisture retention and bulk density rather than mineral nutrient compositions. On the other hand, the lowest values of vegetative parameters of *C. oliviforme* seedlings were recorded with sandy soil compared to the other media. In this respect, among the sandy soil characteristics is that contains a high proportion of sand, low water retention, low specific surface area, low fertility and high infiltration rate, low organic content, and also the nutrients are easily washed through the soil, and these characteristics led to decrease growth parameters (**Ebeid *et al.*, 2022)**. Also, the obtained results assured that only sand or clay soil were totally unsatisfactory. These results were in agreed with those obtained by **El-Sallami (1996)** on *Ficus benjamina***, El-Deeb (1999)** on *Asplenium nidus* plants, **El-Khateeb *et al.* (2006)** on *Ficus alii* and **EL-Quasni *et al* (2014)**.

Concerning the interaction between NPK and growing media on the growth of *C. oliviforme*, the obtained results showed that application of NPK at the rate of 24:20:10 with peat moss, followed by clay: sand (1:1 v/v) as growing media produced the highest values of the growth parameters during the studied seasons. **Watfa (2009)** postulated that, NPK fertilization with peat moss as growing media significantly increased the vegetative growth of Aleppo pine seedlings. The enhancement of the growth parameters may be due to the benefits of interactions between NPK fertilizer at the rate of 24:20: 10 and growth media contained either peat moss or clay: sand in improving porosity, soil temperature, soil texture, water holding capacity and nutrient status in the medium, which caused increased the vegetative parameters and then increased the photosynthesis pigments and mineral contents. These results were in agreed with the findings of **Okunomo *et al.* (2009) and AbouRayya *et al.* (2019). Al-Menaie *et al* (2012)** showed that, application of N: P: K at 1g/l in a growing medium comprising of peat moss on *Cassia nodosa* and *Cassia fistula* seedlings exhibited maximum growth parameters. Also, **EL-Quasni *et al* (2014)** studied the interaction between NPK fertilization and the media of peat moss on *Magnolia grandiflora* showed that, increasing fertilization rates up to 15 g/plant caused significant increase in the growth parameters in both seasons of study. Among the nutrients, nitrogen is the fundamental nutrient that needs the most for crop production; phosphorus is a vital nutrient for plant growth and productivity that modifies cell division, enzyme activity, and carbohydrate processes (**Malhotra *et al*., 2018)**.

Conclusion

Comparing the results obtained from the growth traits of *Chrysophyllum oliviforme* as affected by growing media and NPK fertilization**,** it can be concluded that:

1- One of the major causes of improved growth of *C. oliviforme* seedlings is using appropriate growing media as peat moss. Due to high cost of this media, a mixture of clay and sand at 1:1 (v/v) can be used to produce strong seedlings in the nursery stage.

2- To improve the seedling quality of *C. oliviforme* seedlings in the nursery stage, integrated NPK fertilizer should be used at the rate of 24:20:10 g/ seedling. Such NPK fertilizer rate should be divided at 4 equal portions and added after two months from transplanting date, with four weeks intervals thereafter. Therefore, to obtain strong seedlings in the nursery stage for such slow- growing tree species at the beginning growth, they must be planted in a

suitable media as peat moss or mixture of clay: sand (1:1 v/v) with addition of NPK at the rate of 24:20:10 g/ seedling.

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