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Response of Schefflera (Schefflera arboricola L.) plant to different water regimes treatments

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Abstract
Schefflera arboricola plant is an important ornamental plant used extensively in interior decoration and is native to Australia and belongs to the Araliaceae family.. A pot experimental trial was carried out during 1st and 2nd seasons of 2022/2023 and 2023/2024 and at the Horticultural Rresearch Station in Al-Qanater Al-Khairia , Horticultural Research Institute,Agriculture Research Center Qalyubia Governorate, cooperation of faculty of Agriculture Benha University to study the effect of four treatments water regimes treatments, i.e 100, 70 , 50 and 30 % of the field capacity (FC) of Schefflera arboricola L.plant. The results showed, plant height, shoots fresh and dry weights and root parameters of Schefflera arboricola L. plant were significantly affected by using deficient irrigation treatments. As the field capacity level decreased, the above mention parameters decreased., and the lowest value was scored by 30 % FC . Furthermore, the richest percentage of N,P,K and total carbohydrates % were significantly increased by the high level of irrigation and was recorded at (100%FC) treatment, followed in descendingly by(70%FC). Conclusively, it is preferable to the treatment 100 % FC followed descendingly by 70 % FC register the maximum values of the growth and the chemical constituents of Schefflera arboricola L. plant.

Keywords: Schefflera arboricola., water regimes, vegetative growth and chemical compositions.

I INTRODUCTION

Schefflera arboricola plant is an important ornamental plant used extensively in interior decoration and is native to Australia and belongs to the Araliaceae family. Due to its distinctive umbrella-like leaves and its great ability to adapt to indoor conditions, it has become popular in interior decoration of houseplant **(1)**. This plant with its glossy green leaves and strong, healthy growth has made it a popular choice among plant lovers, which has led to its great popularity. In addition, its attractiveness and beauty, it has become popular for interior decoration and beautification of houseplant and workplaces **(3)**. Due to the increasing competition for water resources, which have become limited between agricultural and domestic consumption and many industries, there has become a need to use water resources efficiently. Researchers are interested in facing the challenges facing water availability in arid and semi-arid areas that have few water resources, as well as in tropical and subtropical areas that are characterized by hot and dry weather**(**30**) .**Furthermore, climate changes has a major impact on plants, in addition to the limited water resources, which is a problem facing Egypt. Therefore, we must think about rationalizing the use of water in various fields, as water is one of the factors in plant production. In Egypt, rainfall is scarce, and therefore agricultural production depends largely on irrigation,the River Nile water is decreasing, and the focus has become on groundwater. Therefore, we must conserve water and find solutions to preserve it and rationalize its use **(8).** The River Nile in the Arab Republic of Egypt is the main source of water, and the water share is about 100 billion cubic meters annually. The most important problem we face is a study of how to use water currently and in the future and how to preserve it, as Egypt suffers from a large population increase with a stable share of water **(19)**

Water stress has a significant impact on plant growth, as vegetative growth and chemical content within the plant, in addition to the chemical content of the leaves of N%, P%, K% and the total carbohydrate content, which has a significant impact **(22).** Also, **Agina et al .,(2021)** they stated that using FC at 100% in order to gave the best levels of vegetative growth parameters and chemical compositions for rosemary plant. In general, we can say that water is very important for plants and their growth, as water has a great impact on plant life, and the appropriate amounts of water must be provided to each plant to obtain the best growth and productivity.

Therefore, this study was conducted to find out the effect of water regime treatments on the growth and chemical constituents of Schefflera plant.

MATE1RIALS AND METHODS

This investigation was carried out during two successive seasons of 2022/2023 and 2023/2024 and at the Horticultural Rresearch Station in Al-Qanater Al-Khairia , Horticultural Research Institute,Agriculture Research Center Qalyubia Governorate, to study the effect of water regimes on the growth and chemical compositions of Schefflera arboricola L.plant.

A. Plant materials:

Schefflera arboricola at plants One-year-old of were taken from the Qanater Khayriyah Horticultural Research Station, affiliated with the Horticultural Research Institute in Qalyubia Governorate. The plants were taken at a length of 41 cm and the average number of leaves per plant was 12 leaves and were repotted in plastic pots of 20 cm diameter (one plant / pot), filled with a mixture of 1 clay: 1 sand (v:v) on 1st March, for 1st and 2nd seasons. The physical and chemical properties of the soil under study were determined as described by(29) and(23) and presented in Table,1.

Table ,1 : The main properties of the soil under study.

Soil property	Value
Clay	20.12
Silt	11.11
Fine sand	43.16
Coarse sand	25.61
Textural class	Sandy Clay loam
$CaCO_3$ (gkg^{-1})	2.65
Organic matter ($g\ kg^{-1}$)	0.59
Available N ($mg\ kg^{-1}$) (KCl extract)	200
Available K ($mg\ kg^{-1}$) (AB-DTPA extract)	306
Available P ($mg\ kg^{-1}$) (AB-DTPA extract)	6.04
pH (paste extract)	7.90
EC dSm^{-1} (paste extract)	5.20
Saturation (SP) %	50.92
Field capacity (FC) %	25.46
Cations and anions in soil paste extract ($mmol_cL^{-1}$)	
Na^+	12.80
K^+	1.55
Ca^{2+}	21.70
Mg^{2+}	15.90
CO_3^{2-}	0.00
HCO_3^-	8.31
Cl^-	25.23
SO_4^{2-}	18.41
SAR	2.95

Experimental layout and procedur

The layout of the experiment was a simple randomized block design included four treatments with three replicates., each replicate contained 5 pots

Water regime treatment

In the mention afore treatments all pots were irrigated with tap water. i.e 100, 70 , 50 and 30 % of the field capacity (FC). In the summer, the plants were watered twice a week. In the winter, the plants were watered once a week, or four times a month. The number of irrigation was calculated over a period of six months in the summer, six months in the winter, and also for a period of 12 months., The weight of the soil was 2250 gm/pot. The field capacity of the studied soil (Soil prepared by mixing clay and sand by the ratio 1:1) was 25.46 %. The pots were irrigated with patient water to reach 100% ,70% , 50 % and 30 % of the field capacity of the studied soil. Table (c) shows the total amount of irrigation water consumed in a 6-month at summer ,winter and total 12-month periods.and the cost of water used in irrigation in the different irrigation systems used in Egypt per(m3) is shown in the Table (2)

Table, 2 : The amount of water used in the irrigation process in the six summer and the six winter months and their total in(m^3)for Schefflera **plant.**

Time Irrigation treatment	Six months summer (m^3)	Six month winter(m^3)	Total (m^3)
100%	27.497	13.748	41.245
70%	19.248	9.624	28.872
50%	13.748	6.874	20.623
30%	8.249	4.125	12.374

Data recorded

At the end of the experiment, and after a year of planting the plants, different growth readings are taken for the Schefflera plant in 1st and 2nd seasons.

1)Vegetative growth

1. Height of plant (cm).
2. Shoots fresh weight / plant(g).
3. Shoots dry weight / plant. (g)

2) Root growth

1- Root volume (cm^3)
2- Roots fresh weight (g)/ plant.
3- Roots dry weight (g)/ plant.

3) Chemical constituents: -

In the dried leaves of the plant, the percentage of total nitrogen, phosphorus, potassium and the percentage of total carbohydrates were estimated according to the methods shown in(**17**),(**18**) , **(16)** and**(13),** respectively .

Statistical analysis of data: -

The L.S.D method was used to discriminate between means according **(32),** hence data obtained in the two study seasons were subjected to analysis of variance as simple experiments with a randomized complete block design, In addition, the differences between the mean values of various treatments were compared by Duncan's multiple range test (**7**).

RESULTS AND DISCUSSION

Effect of water regime treatments on :

Vegetative growth characteristics:

Plant height, shoots fresh and dry weights:

Table (3) Plant height, using deficit irrigation treatments, the fresh and dry shoot weights of Schefflera arboricola L. were affected. The parameters mention above were decreased with a decrease in the level of field capacity, and the lowest value was registered by 30 % FC treatment for 1st and 2nd seasons. Furthermore, the maximum values in this concern resulted by 100%FC in 1st and 2nd seasons.

Root volume, root fresh and dry weights:

Table (4) Root volume, root fresh and dry weights of Schefflera arboricola L. plant were significantly affected by using deficient irrigation treatments. Hence these parameters mention afore were increased with a decrease in the level of field capacity until 50 % FC in both seasons. , and the highest value was scored by 100 % FC treatment. Additionally, the minimum values in this concern resulted by 30 %FC in .

From the above, the results showed that irrigation levels significantly affected vegetative growth. Cell growth is significantly affected by water stress, and water deficiency affects plant turgor, leading to reduced cell growth and slower growth, especially in the stem and leaves. Growth is thus reduced, which is reflected in reduced plant height. Thus, it is clear that water deficiency affected Schefflera arboricola, manifested in a lack of vegetative shoots, **(28).** The previous results are in agreement with**(33)** in Rosmarinus officinalis, **(11)** on Salvia officinalis L. and S. officinalis cv. 'Maxima'(26**)** on Conocarpus erectus, **(5)** on stevia (Stevia rebaudiana Bertoni),**(21)** on Dracocephalum moldavica L.,**(24)** found that, water stress due to reduced crop height on spearmint (Mentha spicata L.) under different irrigation regimes.**(10)** on Origanum majorana L. and **(20)** they showed that, water stress affected on the fresh and dry weight and also the partitioning of dry matter to leaves, flowers, and stems on Basil (Ocimum basilicum).

Table (3): Effect of different irrigation treatments on height of plant, shoots fresh and dry weights of Schefflera arboricola L. during 2022 /2023 and 2023 /2024 seasons.

Parameters Irrigation treatments	Height of plant /cm	shoots fresh weight/g	shoots dry weight/g
1st season			
100% F.C.	64.22a	97.01a	19.22a
70% F.C.	64.00a	87.01b	14.33b
50% F.C.	64.02a	82.11b	15.01b
30% F.C.	50.11b	29.33c	6.05c
2nd season			
100% F.C.	66.18a	99.22a	20.30a
70% F.C.	61.00b	83.01b	14.97b
50% F.C.	66.02a	88.00b	15.50b
30% F.C.	51.02c	30.33c	6.41c

Table (4): Effect of different irrigation treatments on root volume, root fresh and dry weights of Schefflera arboricola L. during 2022 /2023 and 2023 /2024 seasons.

Parameters Irrigation treatments	Root volume/cm^3	Root fresh weight/g	Root dry weight/g
1st season			
100% F.C.	20.01c	4.00v	30.01b
70% F.C.	23.50b	5.01ab	25.02c
50% F.C.	31.00a	6.50a	37.33a
30% F.C.	9.00d	2.07c	10.00d
2nd season			
100% F.C.	21.02b	4.43bc	31.00b
70% F.C.	24.11b	5.50ab	25.50c
50% F.C.	32.02a	7.01a	38.01a
30% F.C.	7.52c	2.30c	10.51d

Chemical composition:

N and P %:

Table (5) declares that a decrease in nitrogen and phosphorus levels in 1st and 2nd seasons by reducing the irrigation level from 100% to 30% FC., the highest values were recorded when 100% FC were applied. However, the lowest values of parameters mention above achieved by the lowest irrigation level (30% FC). The rest treatments came in-between the mentioned above treatments .

K and total carbohydrates %:

Table (6) illustrated that, the richest percentage of potassium and total carbohydrates % was significantly decreased by deficit irrigation and was recorded at (100%FC) treatment, followed in descendingly by(70%FC). However, at 30%FC recorded the lowest values in this respect.

These results showed that low irrigation was associated with reduced growth due to low nutrient content, while low irrigation had the opposite effect on the chemical components of Schefflera arboricola. High irrigation levels can compensate for nutrient deficiency, consistent with **Silber et al., (2003)** on the contrary deficit irrigation had a positive effect on carbohydrates due to the fact that carbohydrates are the dissolved organic substances that are very important and preferred for plants, affecting the growth of leaves and increasing their size. It is very affected by deficient irrigation, which affects the mechanism of absorption and the availability of food, which in turn affects the general condition of plant growth.

Table (5): Effect of different irrigation treatments on N and P %of Schefflera arboricola L. during 2022 /2023 and 2023 /2024 seasons.

Parameters Irrigation Treatments	N%	P%
1st season		
100% F.C.	2.20a	0.27a
70% F.C.	1.93ab	0.22c
50% F.C.	1.73ab	0.24b
30% F.C.	1.53b	0.19d
2nd season		
100% F.C.	2.40a	0.29a
70% F.C.	2.27a	0.27b
50% F.C.	1.67b	0.23c
30% F.C.	1.50b	0.20d

Table (6): Effect of different irrigation treatments on K and total carbohydrates % %of Schefflera arboricola L. during 2022 /2023 and 2023 /2024 seasons.

Parameters Irrigation treatments	K%	Total carbohydrates %
1st season		
100% F.C.	2.57a	25.63a
70% F.C.	2.48a	24.85a
50% F.C.	1.83b	19.68b
30% F.C.	1.57c	15.10c
2nd season		
100% F.C.	2.50a	25.43a
70% F.C.	2.33b	23.90b
50% F.C.	1.83c	20.97c
30% F.C.	1.47d	15.43d

(14). In this respect the results are in agreement with**(12)** on rosemary plant,**(6)** on Jatropha curcas L. seedlings,**(15)** on peppermint (Mentha piperita L.) leaf, **(9)** on Rosmarinus officinalis L.,**(27)** declared that, increased amount of soluble sugar content and malondialdehyde content observed at 60% and 40% FC on Moldavian balm (Dracocephalum moldavica),**(4)** on Sweet Basil and**(25)** declared that, nutrient (nitrogen, phosphorous and potassium) concentration reduced by water-limiting irrigation, were enhanced with mycorrhizal inoculation on the lavender , rosemary and thyme .

Conclusively, it is preferable to the treatment 100 % FC followed descendingly by 70 % FC gave the maximum values of the growth and the chemical constituents of Schefflera arboricola L. plant

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