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Response of Aralia Plants to Foliar Spray with Green Tea Extract

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Abstract: During 2017 and 2018 seasons, *Polyscias balfouriana* plants treated three times with green tea extract at 0.0, 0.1, 0.2, 0.4 and 0.8 %. This study focused on examining the effect of green tea extract at various concentrations on vegetative growth characters and chemical constituents of Aralia plants. Results showed that foliar application of green tea extract at 0.1 to 0.8% caused a material promotion on all growth characters namely plants height, number of leaves/ plant, stem diameter, leaf area, number of branches/ plant, main root length, fresh and dry weight of leaves / plant, fresh and dry weight of stem/ pland and fresh and dry weight of root per plant, nutrients % (N, P, and K) and plant pigments (chlorophyll a, chlorophyll b, total chlorophylls and total carotenoids) in relative to the check treatment. Negligible promotion was observed on all parameters with increasing concentration from 0.4 to 0.8 %. The promotion was associated with increasing concentrations of green tea extract. For promoting growth and chemical composition of *Polyscias balfouriana* plants, it advised to treating the plants thrice with green tea extract at 0.4%.

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1. Introduction

Garden plants include many plants of attractiveness, elegance and beauty, including plants that are imported from abroad, such as Garonia, Hydrangea, *Sanchesia nobilis* and *Polyscias balfouriana*.

Polyscias balfouriana is a popular foliage plant belongs to family Arabiaceaa (**Sandhya *et al.*, 2010 and Ilyas *et al.*, 2013**). This plant is an ornamental foliage shrub with glossy green colored leaves with white margins *Polyscias balfouriana* plants consists of many varieties and var. "Marginata" is a popular foliage plant in the world floriculture industry. *Polyscias balfouriana* L. var Marginata (PBM) is widely used in landscaping and as a potted ornamental plant (**Bose and Chowdhury, 1991**). The morphology of the leaves provides value for its quality in the export market (**Gunadasa and Dissanayaka, 2012**).

Srilanka has three agrological zone and among them, dry zone consists of a larger area. Therefore, the introduction of floricultural crops could be an important intervention in this regard.

The climatic requirements for PBM are week suited with prevailing climatic conditions of the Batticaloa district. Polycias is tropical foliage prefer high temperature and humidity. Commercial nurseries could be established in the Batticaloa district to cater the foreign demand for policies cuttings. The venture could act as a foreign income generator to the district. Polycias is shada obligate plant and partial shade is recommended for the cultivation in Srilanka.

However, there is no studies carried out to identify the optimal light intensity for PBM in the Batticaloa district. Light level is vital ecological factor influences the cultivation of plants (**Mattana *et al.*, 2006**).

Shade manipulates the growth and quality of ornamental foliage plants. However, there is no site specific recommendation for shade level. Hence, the present study was conducted to find the optimum shade level of *Polyscias balfouriana* L. Var Marginate (PBM) in the Bartticaloa district.

This plant is cultivated in Egypt for ornamental purposes (**Sanbdhy *et al.*, 2010 and Huan *et al.*, 1998**).

Antioxidant compounds derived from plants especially phenols of considerable interest from the view point of food preservation and dietary antioxidant supplementation (**Brow and Rice-Evans, 1998**). Antioxidants are also of interest in medicine because they may help to protect the organism against damage caused by reactive oxygen (ROS) and nitrogen species (RNS) **(Halliwell *et al.*, 1995**).

Green tea (*Camellai sinensis* L.) a species with documented antioxidant properties (**Yen *et al.*, 1997**;

Bachrch and Wang, 2002) reported that green tea contains polypynolic compounds, which account for 30% of the dry weight of the leaves Most of the polypheols are flavanols, of which (-)-epigallocatchin-3- gallate (EGC G) is most abundant. It has also been reported that the quantity of green tea consumed, plays an important role in reducing cancer risk and in delaying cancer outbreak and recurrence. Plant extracts are characterized by their higher content of nutrients, vitamins, organosulfur compounds, volatile components, proteins, fats, tannins, and antioxidants (**Peter, 1999**).

Therefore, these plant extracts are considered as a source of antioxidants and nutrients supplying the plants with their requirements from all antioxidants and nutrients. Their antioxidative properties appeared for preventing reactive oxygen species (**Kirtikar and Basu, 1984, Botelho, *et al.*, 2007 and Bhanu *et al.*, 2013**).

The target of this study was elucidating the merits of using green tea extract in *Polyscias balfouriana* plants.

2. Materials and Methods

This investigation was carried out at the experimental farm of the tropical Garden at Kom Ombo under directorate of Botanical Garden Aswan (belongs Hort. Res. Instit. ARC), Egypt, during the two seasons of 2017 and 2018.

The objective of the study was to investigate the effect of antioxidants (Green tea) treatments on growth and chemical composition of *Polyuscias balfouriana* plants (plants grown under green house) seventy- five uniform rooted cuttings of *Polyscias balfouriana* having 6-8 leaves and 12-15 cm height were selected for achieving this study. On the first week of April in both seasons, rooted cuttings of *Polyscias balfouriana* were individually planted in 25- cm diameter black polythlene bags (one rooted cuttings / bag) filled with about 3 kg of sandy and compost (1:1 on volume bases).

The physical and chemical analysis of compost used in the study are in shown in Table (1).

Table (1): Physical and chemical analysis of Al- Bostan compost used in the study.

Character	Content	Character	Content
Weight of m^3	560 kg	Ash %	67.79
Humidity %	33	C/N ratio	1: 18.88
pH (1: 10 extract)	7.95	Total phosphorus %	0.83%
EC (1: 10 extract) ds/m	3.84	Total potassium %	1.02
Organic matter %	32.21	Weed seeds	0
Total nitrogen %	0.99	Nematode (pathogenetic)	0
NH4-N (pm)	699	Nematode (non- pathogenetic)	0
NO3-N (ppm)	0		
Organic carbon %	18.68		

The present experiment included the following five treatments of Antioxidants (Spring green tea).

1- Control.
2- Spraying green tea extract at 0.1 % (1 g / L.)
3- Spraying green tea extract at 0.2 % (2 g / L.)
4- Spraying green tea extract at 0.4 % (4 g / L.)
5- Spraying green tea extract at 0.8 % (8 g / L.)

Each treatment was replicated three times, five plants per each (as a plot). Complete randomized block design (CRBD) was done in this study. Antioxidant (green tea extract) was spayed three times (mid of June, July and August). Triton B as a wetting agent was added to all spraying solutions at 0.05%.

At the end of the growth season (first week of October) the following data were recorded.

I- Vegetative growth parameters:

1- Plant height (cm).
2- Stem diameter (mm).
3-Number of leaves/ plant.
4- Leaf area $(cm)^2$.
5-Number of branches / plant.
6- Fresh weight of leaves/ plant (g.)
7-Dry weight of leaves/ plant (g.)
8-Fresh weight of stem/ plant (g.)
9-Dry weight of stem/ plant (g.)
10- Main root length (cm).
11- Fresh weight of root / plant (g.)
12- Dry weight of root / plant (g.)

II- Chemical constituent estimations:

1- Chlorophyll a content (mg / g. F.W.)
2- Chlorophyll b content (mg / g. F.W.)
3- Total chlorophylls content (mg / g. F.W.)
4- Total carotenoids content (mg / g. F.W.)
5- Nitrogen % in the dried leaves.
6- Phosphorus % in the dried leaves.

7- Potassium % in the dried leaves.

Pigments determination:

Chlorophylls a, b, total chlorophylls and total carotenoids contents were determined in leaf samples (mg/ g fresh weight) after one month of the last treatment in both seasons according to the method cited from (**Fadl and Sari El- Deen (1978**). Fresh samples of leaves (0.5 g) were homogenized with acetone (86% v/v) in the presence of little amount of Na_2 CO_3 and silica quartz (fine sand) then filtered through centered glass funnel (G4), the residue was washed several times with Acetone until the filtrate become colorless, the combined extract was completed to a known volume (10 ml) apportion of this extract was taken for the colorimetric determination of pigments.

The determination was conducted using Acetone (86% v/v) as blank at wavelengths of 662, 644 and 440.5 nm for chlorophylls a, b, total chlorophylls and total carotenoids, respectively. Then calculated using the following equations.

Chlorophyll a = (9.784 x E 662) – (0.99 x E 644) =… mg/ g F.W.

Chlorophyll b = (21.426 x E 644) – (4.65 x E 662) =… mg/ g F.W.

Total chlorophylls = chlorophyll a + chlorophyll b = mg/ g F.W.

Total carotenoids = (4.695x E 440.5 – 0.268 (E 662- E 644) = mg/ g F.W.

E/ optical density at given wave length.

NPK determination

The percentage of N, P and K in the leaves of *Polyscias balfouriana* plants was determined as follow:

The dried leaves were ground to a fine powder for determination of N, P and K elements in the acid digested solution according to (**Hach *et al.,* 1985**) by using a mixture of hydrogen peroxide and sulphuric acid (4: 10) on 0.2 g of the dried samples.

1- Nitrogen was determined by Microkeldehal method as described by (**Wild *et al.,* 1985**).

2-Phosphorsu was determined colometrically using the method described by (**Jackson, 1973**).

3-Potassium was estimated using Flam-photometery method according to (**Cottenie *et al.,* 1982**).

The dried leaves were ground to a five powder for determination of N, P and K elements in the acid designed solution according to **Hache *et al.,* (1985)** by using a mixture of hydrogen peroxide and sulphuric acid (4: 10) on 0.2 g of the dried leaves samples.

Statistical analysis:

The data of the experiment was subjected to statistical analysis of variance using **Mstate- C (1986)** New L.S.D. at 5% was used to compare the average means of treatments.

3. Results and Discussion

1-Vegetative growth characters:

Data in Tables (2 to 4) clearly show that foliar application of green tea extract at 0.1 to 0.8 % significantly stimulated growth aspects namely plant height (cm), stem diameter (mm), number of leaves per plant, leaf area $(cm)^2$, main root length (cm), number of branches per plant, fresh weight of leaves per plant (g.), dry weight of leaves per plant (g.), fresh weight of stem per plant (g.), dry weight of stem per plant (g.), fresh weight of root per plant (g.) and dry weight of root per plant (g.) of *Polyscias balfouriana* plants comparing with control treatment (non- application). The promotion on such growth characters was associated with increasing green tea extract concentrations. Significant differences on these growth characters were recorded in most cases among all concentrations except among the higher two concentrations namely 0.4, and 0.8%. Therefore, the recommended concentration in this respect was 0.4 % green tea extract. The maximum values were recorded on the plants treated with green tea extract at 0.8%. Untreated plant produced the lowest values. These results were true during both seasons. The promoting effect of plant extracts on growth aspects might be attributed to their higher content of nutrients, proteins, amino acids, organosulphur compounds, tannins, vitamins, plant pigments, fats, falvonoids, sugars, capslcin, nigellone and fatty acids that are responsible for enhancing cell divisions as well as the biosynthesis of hormones (**Omeh and Mazza 1998; Peter 1999 and Kamra *et al.,* 2012**). The effect of these plant extracts on supplying the plants with their requirements from all mineral and organic nutrients as well as enhancing the tolerance of the threes to disorders as well as biotic and abiotic stresses give another explanation (**Kirtikar and Basu, 1984; Koch and Lowson, 1996**).

These results are in agreement with those obtained by **(Yousef, 2000)** on potato**; Abd El-Mageed *et al.,* 2009; Hanafy *et al.,* 2012)** on Schefflera**; Abdelaal and Aly (2013)** on Roomy seedless grapevines**; Abada (2014)** on Thompson seedless grapevines **and Ahmed *et al.,* (2014)** on Superior grapevines**.**

Table (2): Effect of spraying green tea extract on some growth characters of *Polyscias balfouriana* during 2017 and 2018 seasons.

Treatments	Plant height (cm)		Stem diameter (mm)		Number of leaves/ plant		Leaf area $(cm)^2$		Main root length (cm)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Control	29.3	30.0	2.10	2.12	13.0	14.0	21.0	21.3	13.4	13.5
Spraying green tea extract at 0.1% (1 g /L.)	31.8	32.6	2.71	2.77	15.0	16.0	23.0	23.5	15.5	15.8
Spraying green tea extract at 0.2% (2 g /L.)	34.2	35.0	2.86	2.90	17.0	18.0	26.4	26.8	17.3	17.8
Spraying green tea extract at 0.4% (4 g /L.)	36.5	37.0	3.11	3.14	19.0	20.0	31.0	31.5	19.2	20.0
Spraying green tea extract at 0.8% (8 g /L.)	37.1	37.4	3.12	3.16	21.0	22.0	31.6	32.0	20.1	20.6
New L.S.D. at 0.5 %	1.9	1.8	0.13	0.11	2.0	2.0	1.9	1.8	1.4	1.3

2- Some leaf pigments:

Data in Tables (4, 5) show the effect of spraying of green tea extract at 0.1 to 0.8% on chlorophyll a, chlorophyll b, total chlorophylls and total carotenodis in the leaves of *Polyscias balfouriana* plants during 2017 and 2018 seasons.

It is obvious from the obtained data that supplying *Polyscias balfouriana* plants with green tea extract at 0.1 to 0.8% significantly was responsible for enhancing chlorophyll a, chlorophyll b, and total chlorophylls as well as total carotenoides over the control. Significant differences on some leaf pigments were recorded in most cases among all concentrations except the higher two concentrations namely 0.4 and 0.8. Therefore, the recommended concentration in this respect was 0.4% green tea extract. The maximum values of chlorophyll a (3.02, 3.12 mg./ g F.W.), chlorophyll b (1.68, 1.73 mg./ g F.W.), total chlorophylls (4.70, 4.85 mg./ g F.W.) and total carotenoids (1.64, 1.68 mg./ g F.W.) were recorded on the plants treated with spraying green tea extract at 0.8%. Untreated plants produced the lowest values. These results were true during both seasons.

The higher own content of green tea extract from different polyphenols namely gallic acid, catchin, theogallin, gallocatechin, epicatechin, pigalla catechin, vitamins A, C, and E flavonids theonine, caffeine, t annius, volatile oils and zinc that counter the effects for reactive oxygen species and promote the activity of the plants cells (**Grohar, 1992**). Three results are in harmony with those obtained by (**Hanafy *et al.*, 2012; Abdelaal and Aly, 2013; Abada, 2014; and Ahemd *et al.*, 2 014)**.

Table (3): Effect of spraying green tea extract on some growth characters of *Polyscias balfouriana* during 2017 and 2018 seasons.

Treatments	Number of branches/plant		Fresh weight of leaves/plant (g.)		Dry weight of leaves/plant (g.)		Fresh weight of stem/plant (g.)		Dry weight of stem/plant (g.)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Control	2.55	2.60	25.5	25.8	11.2	11.5	11.0	11.3	4.9	5.4
Spraying green tea extract at 0.1% (1 g /L.)	2.70	2.75	27.8	28.0	12.8	13.0	11.8	12.2	5.5	6.2
Spraying green tea extract at 0.2% (2 g /L.)	2.88	2.92	30.0	30.4	13.2	13.5	12.9	13.2	6.3	6.8
Spraying green tea extract at 0.4% (4 g /L.)	3.00	3.03	32.2	32.5	14.0	14.3	14.5	14.9	7.0	7.3
Spraying green tea extract at 0.8% (8 g /L.)	3.05	3.10	32.5	32.9	15.2	15.5	15.1	15.4	7.4	7.6
New L.S.D. at 0.5 %	0.10	0.09	1.6	1.7	0.6	0.5	0.7	0.6	0.3	0.2

Table (4): Effect of spraying green tea extract on Fresh and dry weight root/plant and plant pigments of *Polyscias balfouriana* during 2017 and 2018 seasons.

Treatments	Fresh weight of root/ plant (g.)		Dry weight of root/plant (g.)		Chlorophyll a (mg/1.0 g.F.w.)		Chlorophyll b (mg/1.0 g.F.w.)		Total chlorophylls (mg/1.0 g.F.w.)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Control	6.6	6.9	3.1	3.3	2.22	2.25	1.13	1.15	3.25	3.40
Spraying green tea extract at 0.1% (1 g /L.)	7.8	8.0	3.7	3.9	2.45	2.61	1.32	1.38	3.77	3.99
Spraying green tea extract at 0.2% (2 g /L.)	9.5	9.8	4.1	4.4	2.68	2.77	1.49	1.51	4.17	4.28
Spraying green tea extract at 0.4% (4 g /L.)	10.6	10.9	4.9	5.2	2.95	2.99	1.60	1.66	4.55	4.65
Spraying green tea extract at 0.8% (8 g /L.)	11.1	11.4	5.4	5.5	3.02	3.12	1.68	1.73	4.70	4.85
New L.S.D. at 0.5 %	0.4	0.5	0.08	0.09	0.06	0.07	0.05	0.04	0.9	0.9

3- Leaf chemical composition:

Data in Table (5) show the effect of spraying green tea extract on the percentages of N, P and K in the leaves of *Polyscias balfouriana* planst during 2017 and 2018 seasons.

Treating *Polyscias balfouriana* plants three times with green tea extract at 0.1 to 0.8 % significantly enhanced the percentages of N, P and K in the leaves over eh check treatment. There was a gradual and significant promotion on these chemical characters with increasing green tea extract concentrations. Increasing concentrations from 0.4 to 0.8 % had in most cases no significant promotion on these percentages N, P and K.

The maximum values were recorded on the plants that received green tea extract at 0.8 %. The minimum values were recorded on untreated plants. Similar trend was noticed during both seasons.

The higher content of these plant extracts from nutrients could explain the present results. (**Giovanni *et al.*, 2012**).

These results are in harmony with those obtained by **Abdelaal and Aly (2013); Abada (2014) and Ahmed *et al.*, (2014).**

As a conclusion, treating *Polyscias balfouriana* plants three times during each season (at the m iddle of June, July and August) with green tea extract at 0.4% effectively improved growth and chemical composition.

Table (5): Effect of spraying green tea extract on Total carotenoids and percentages of N,P and K of *Polyscias balfouriana* during 2017 and 2018 seasons.

Treatments	Total carotenoids (mg/1.0g,F.W.)		N%		P%		K%	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	1.27	1.30	1.61	1.63	0.18	0.19	1.02	1.04
Spraying green tea extract at 0.1% (1 g /L.)	1.38	1.41	1.97	1.98	0.22	0.24	1.12	1.13
Spraying green tea extract at 0.2% (2 g /L.)	1.46	1.50	2.08	2.11	0.29	0.32	1.25	1.27
Spraying green tea extract at 0.4% (4 g /L.)	1.56	1.63	2.15	2.17	0.33	0.36	1.38	1.40
Spraying green tea extract at 0.8% (8 g /L.)	1.64	1.68	2.18	2.21	0.37	0.40	1.41	1.43
New L.S.D. at 0.5 %	0.05	0.06	0.04	0.05	0.01	0.02	0.04	0.04

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