Effect of Some Fertilization Treatments with Macro and Micro Elements on Growth and Chemical Composition of *Scindapsus Aureus* Plant

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Abstract: This study was conducted at the experimental Nursery of the ornamental Horticulture department in the tropical farm at Kom Ombo under directorate of Aswan out during 2016 and 2017 seasons. With the aim of investigating the effect of macro and micro elements fertilization on growth and chemical composition of *Scindapsus aureus* plants grown under green house conditions. The plants were grown in (20 cm) plastic pots of the soil a mixture (compost + sand) 1:1 by volume. Fertilize with NPK (19: 19:19) three times as soil dressing during the growing season at 1 to 3 g /plant and spraying NPK (19: 19:19) or citrine compound (2% Fe + 2% Zn + 2% Mn) each at 0.2 % three times during each season at the middle of June, July and August. Supplying the soil with NPK (19: 19:19) or spraying with NPK (19: 19:19) or citrine compound had a significant effect in increasing some of the characteristics of the vegetative growth and chemical composition, namely plant height, stem diameter, number of leaves/ plant, fresh and Dry weight of leaves/ plant, fresh and dry weight of stem/ plant, fresh and dry weight of roots/ plant, main root length, chlorophylls a, b, total chlorophylls and total carotenoids, percentages of N, P, K Fe, Zn, and Mn in the leaves compared with the control treatment. The best results were obtained regarding the growth characteristics and chemical composition of *Scindapsus aureus* plants grown in a pot inside a greenhouse when fertilized three times during the season in middle June, July and August with 2 g / plant of NPK (19: 19:19) as soil dressing and foliar spraying with a citrine compound (Zn + Fe + Zn) three times also during (Mid, June, July and August) at 0.2%.

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1. Introduction

Scindapsus aureus (*Epipremnum aureum*) plants belong to the Araceae family and are among the most popular house plants (like all indoor foliage plants) the quality of *Scindapsus aureus* (*Epipremnum aureum*) plants and their ability to grown vigorosly indoors depend to a great extent on the environmental conditions (light intensity and relative humidity) under which the plants are kept as well as, the cultural practices used for the maintenance of plants.

Nutrients especially nitrogen, phosphore and potassium have many important functions for all plants. They have responsible for enhancing organic foods biosynthesis, cell division, enzymes and water uptake (**Nijjar, 1985**). Fertilization with N, P and K is essential for inducing higher growth in various ornamental plants. Adjusting the optimum rates from these nutrients leads to shorten the vegetative growth stage. Previous studies revealed that balancing nitrogen, phosphore and potassium fertilization in horticultural crops especially ornamental plants was followed by enhancing growth (**Salem *et al.,* 2002; Qasim *et al.,* 2003; El- Mohandes *et al.,* 2005; Al-Thabet 2006; Abdou *et al.,* 2006, Rao *et al.,* 2007, El- Sanafawy, 2007; Khalil *et al.,* 2008; Awad and Gharib, 2009; Abd El- Zaher *et al.,* 2009; Babaiy *et al.,* 2009; Ardelam *et al.,* 2010; Abdou *et al.,* 2011; Braz *et al.,* 2011 and Hassan, 2012**).

Several scientists have also shown that micronutrients are essential for the growth of indoor plants, especially when applied in combination with N, P and K fertilization (**Foopg and Yang 1988)**, on *Philodendron sclloum, Aglaonema pseudobnacteatum* and *Dracaena surculosa* cv. **Punctutata Said (1997)** on Croton **and El- Deeb (1999)** on *Asplenium* and *philodendron*.

The study was conducted to study the effect of a balanced soluble nitrogen, phosphore and potassium fertilizer applied and a spraying at different intervals alone or in combination with some micronutrients on the growth of *Scimdapsus aureus* plants. The information provided by this study can be used. As recommendation for the proper maintenance of *Scindapsus aureus* plants and may be used as guidelines for fertilization of other indoor plants similar growth patterns.

2. Materials and Methods

This study was carried out during 2016 and 2017 seasons in the tropical for at Kom Ombo under directorate of Botanical Garden a Aswan (belongs Hort. Res. Isntit. ARC). The objective of the study was to investigate the effect of some fertilization

treatments with macro and micro elements, on growth and chemical composition of *Scinapsus aureus* plants (plants grown under green house). Ninety uniform rooted terminal cuttings of *Scinapsus aureus* (15- 20 cm long, with 4-5 leaves) were obtained from tropical at Kom Ombo. The rooted cuttings were planted on 25 April 2016 and 2017 (in the first and second seasons respectively) in 20 cm diameter plastic pots (one –rooted cutting) pot in a mixture of compost and sand (1:1) on volume bases.

Table (1): Chemical and physical analysis of compost used in the study

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

The present experiment included the following ten treatments of fertilization with macro and micronutrients:

1- Unfertilization.
2- 1 g NPK (19: 19: 19) / plant as soil dressings.
3- 2 g NPK (19: 19: 19) / plant as soil dressings.
4- 3 g NPK (19: 19: 19) / plant as soil dressings.
5- 1 g NPK (19: 19: 19) / plant as soil dressings + spraying NPK (19: 19: 19) at 0.2%.
6- 2 g NPK (19: 19: 19) / plant as soil dressings + spraying NPK (19: 19: 19) at 0.2%.
7- 3 g NPK (19: 19: 19) / plant as soil dressings + spraying NPK (19: 19: 19) at 0.2%.
8- 1 g NPK (19: 19: 19) / plant as soil dressings + spraying citrine compound (Fe + Zn + Mn) at 0.2%
9- 2 g NPK (19: 19: 19) / plant as soil dressings + spraying citrine compound (Fe + Zn + Mn) at 0.2%
10-3 g NPK (19: 19: 19) / plant as soil dressings + spraying citrine compound (Fe + Zn + Mn) at 0.2%

Therefore, the experiment involved ten treatments. Each treatment was replicated three times, three plants per each (as a plot). Complete randomized block design (CRBD) was adopted. The experiment consisted of ten NPK (19:19:19) added as soil dressing and/ or as foliar spraying of NPK (19:19:19) and citrine compound (2 % Fe + 2 % Zn +2 % Mn) each at 0.2% NPK (19:19:19) added as soil dressing each at 1 to 3 g. / plant three times (June, July and August) and spraying NPK (19:19:19) or citrine compound (Fe + Zn + Mn) each at 0.2% three times during each seasons (at the middle of June, July and August). Triton B as a wetting agent was added to all solutions at 0.05%, the untreated plants were sprayed with water containing Triton B. Spraying was done till run of.

At the termination of each season (middle of October during both seasons). The following data were recorded: plant height (cm), stem diameter (mm), number of leaves/ plant, fresh and dry weights of leaves/ plants (g.), fresh and dry weight of stem/ plant (g.), length of main root (cm.) and fresh and dry weight of roots /plant (g).

Plant pigments namely chlorophyll a, b, total chlorophylls and total carotenoids (as mg/ 1.0 g F.W.) were determined in the fresh leaves situated at the middle of branches (1st week of November) according to the method of **Fadle and Seri- El- Deen (1978)**. While N, P, K, Fe, Zn, and Mn content in the dried leaves were determined following the method reported by **Chapman and Pratt (1975) and Wild *et al.*, (1985).**

All the obtained data were tabulated and statistically analyzed according to the method described **Mead *et al.*, (1993)** and new L.S.D. test at 0.05 was used to make all comparisons between the means of treatments.

3. Results

1-Growth characters:

Data in Tables (2, 3) show that fertilization of *Scindapsus aureus* plants with NPK (19: 19: 19) at 1 to 3 g / plant three times alone or in combination with spraying the three NPK (19: 19: 19) and citrine compound (Fe+ Mn + Zn) at 0.2% significantly was followed by great promotion on these growth characters namely plant height, stem diameter, number of leaves/ plant, fresh weight of leaves/ plant, dry weight of leaves/ plant, fresh weight of stem/ plant, dry weight of stem plant/ main root length, fresh weight of roots/ plant and dry weight of roots / plant of *Scidapsus aureus* plants in relative to the

control treatment (unfertilization). Increasing NPK (19: 19: 19) three times levels from 1 to 3 g/ plant caused a significant and gradual promotion on these growth traits. Combined application of NPK (19: 19: 19) and spraying NPK (19: 19: 19) and citrine compound was preferable than using NPK (19: 19: 19) as soil dressing alone in this respect.

The best results regard to the ten growth characters were recorded with spraying citrine compound at 0.2% and NPK (19: 19: 19) at 0.2% in ascending order. Supplying the plants with 2 g NPK (19: 19: 19) / plant and spraying citrine compound (Fe + Zn+ Mn) at 0.2% three times effectively maximized these growth aspects. A central treatment the plants gave the lowest values. These results were true during 2016 and 2017 seasons.

Table (2): Effect of some fertilization treatments with macro and micro elements on some growth characters of *Scindapsus aureus* plants during 2016 and 2017 seasons.

Treatment	Plant height (cm.)		Stem diameter (mm)		Number of leaves/ plant		Fresh weight of leaves / plant (g.)		Dry weight of leaves / plant (g.)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Unfertilization	55.5	56.7	3.12	3.32	15.20	16.21	20.5	20.9	9.5	9.9
1 g NPK (19: 19: 19) / plant	58.0	59.2	3.52	3.82	17.22	18.20	22.1	22.6	11.1	11.6
2 g NPK (19: 19: 19) / plant	60.6	61.8	3.92	4.01	19.50	20.60	28.2	28.7	13.9	14.1
3 g NPK (19: 19: 19) / plant	61.1	62.2	4.02	4.22	20.00	20.70	29.9	30.6	14.1	14.8
1 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	63.6	64.8	4.52	4.82	22.41	23.00	31.1	32.1	15.1	15.4
2 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	65.4	66.6	5.52	5.72	25.50	26.60	33.5	34.9	16.2	16.9
3 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	65.9	67.0	5.62	5.82	26.20	27.10	35.6	36.5	16.8	16.9
1 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	69.4	70.6	6.02	6.42	28.50	29.15	38.9	39.2	17.2	17.7
2 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	71.0	72.2	7.02	7.52	31.25	32.55	40.1	41.2	18.8	19.3
3 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	71.5	72.7	7.12	7.62	32.30	33.40	41.3	42.5	19.4	19.9
New L.S.D. at 5 %	2.1	2.3	0.08	0.09	1.2	1.1	1.3	1.4	0.6	0.7

Table (3): Effect of some fertilization treatments with macro and micro elements on some growth characters of *Scindapsus aureus* plants during 2016 and 2017 seasons.

Treatment	Fresh weight of stem / plant (g.)		Dry weight of stem/ plant (g.)		Main root length (cm.)		Fresh weight of roots / plant (g.)		Dry weight of roots/ plant (g.)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Unfertilization	12.4	12.7	5.0	5.3	20.50	20.80	10.5	10.8	4.6	4.9
1 g NPK (19: 19: 19) / plant	14.8	15.2	6.5	6.8	22.12	22.40	12.3	12.6	6.0	6.2
2 g NPK (19: 19: 19) / plant	17.9	18.3	7.8	8.1	23.98	24.15	14.4	14.9	6.8	7.0
3 g NPK (19: 19: 19) / plant	18.9	20.1	8.3	8.5	24.11	25.10	15.3	15.9	7.2	7.4
1 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	22.1	23.1	9.9	10.2	26.00	26.98	17.5	18.2	8.1	8.6
2 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	24.8	25.3	10.8	11.2	28.10	29.50	19.6	20.1	8.9	9.2
3 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	25.9	26.3	11.1	11.6	29.05	29.90	20.5	21.0	9.4	9.9
1 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	27.8	28.2	12.3	12.8	30.60	31.10	22.6	23.2	10.3	10.6
2 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	29.9	30.3	13.9	14.2	32.70	33.00	24.9	25.2	10.9	11.5
3 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	30.8	31.1	14.1	14.6	33.50	34.00	26.5	26.9	11.8	12.3
New L.S.D. at 5 %	1.2	1.3	0.6	0.6	1.2	1.1	0.8	0.8	0.3	0.4

2-Plant pigments:

Data in Table (4) indicated that contents of the photosynthetic pigments: chlorophyll a, chlorophyll b, total chlorophylls and total carotenoids in the leaves were greatly increased as a result of using different soil and foliar fertilization treatments.

Fertilizating of *Scindapsus aureus* plants with NPK (19: 19: 19) at 1 to 3 g / plant three times alone

or in combination with spraying the three times NPK (19: 19: 19) and citrine compound (Fe+ Mn + Zn) each at 0.2% significantly was followed by great promotion on these plant pigments namely chlorophylls a, b, total chlorophylls and total carotenoids in the leaves in relative to the control treatment.

The highest values for the four pigments were obtained by application of NPK (19: 19: 19) at 2 g per plant three times and spraying three times citrine compound at 0.2% these results were true during two seasons.

3-Chemical constituents:

It is evident from the data in Tables (4, 5) that fertilizing *Scindapsus aureus* plants with NPK (19: 19: 19) as soil dressing and spraying NPK (19: 19: 19) and citrine compound (Fe + Mn + Zn) either singly or in combination significantly was very effective in enhancing percentages of N, P, K, Fe, Mn and Zn in the leaves rather than unfertilized plants.

Increasing NPK (19: 19: 19) three times leaves/ from 1 to 3 g plant caused a significant and gradual promotion on these chemical consistent. Combined application of NPK (19: 19: 19) and spraying three times NPK (19: 19: 19) and citrine compound (Zn+ Fe+ Mn) each at 0.2% was preferable using NPK (19: 19: 19) a soil dressings alone in this respect.

The best results with regard to the N, P, K, Fe, Zn and Mn % in the *Scindapsus aureus* plants were recorded with spraying citrine compound at 0.2% and NPK (19: 19: 19) at 0.2% in ascending order. Supplying the plants with 2 g NPK (19: 19: 19) / plant as soil dressings three times and spraying citrine compound (Fe + Zn +Mn) at 0.2 % three times effectively maximized these aspects. Unfertilized the plants gave the lowest values. These results were true during 2016 and 2017 seasons.

Table (4): Effect of some fertilization treatments with macro and micro elements on some plant pigments (mg/ 1.0 g F.W.) and percentage of N in leaf of *Scindapsus aureus* plants during 2016 and 2017 seasons.

Treatment	Chlorophyll a (mg/ 1.0 g F.W.)		Chlorophyll b (mg/ 1.0 g F.W.)		Total chlorophylls (mg/ 1.0 g F.W.)		Total carotenoids (mg/ 1.0 g F.W.)		N %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Unfertilization	2.24	2.35	0.98	1.10	3.22	3.45	1.17	1.21	2.11	2.11
2.161 g NPK (19: 19: 19) / plant	2.71	2.80	1.25	1.35	3.96	4.15	1.45	1.50	2.23	2.28
2 g NPK (19: 19: 19) / plant	3.01	3.13	1.45	1.49	4.46	4.62	1.67	1.70	2.35	2.39
3 g NPK (19: 19: 19) / plant	3.15	3.20	1.50	1.54	4.65	4.74	1.79	1.82	2.38	2.43
1 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	3.21	3.30	1.75	1.80	4.96	5.10	1.95	1.99	2.51	2.56
2 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	3.70	3.81	1.92	1.98	5.62	5.79	2.22	2.29	2.62	2.67
3 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	3.81	3.92	2.05	2.10	5.86	6.02	2.31	2.38	2.65	2.69
1 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	4.25	4.30	2.35	2.40	6.60	6.70	2.52	2.69	2.77	2.82
2 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	4.70	5.75	2.56	2.60	7.26	8.35	2.81	2.83	2.86	2.91
3 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	4.79	4.84	2.65	2.70	7.44	8.54	2.92	2.98	2.89	2.94
New L.S.D. at 5 %	0.10	0.11	0.08	0.09	0.12	0.13	0.07	0.08	0.09	0.11

Table (5): Effect of some fertilization treatments with macro and micro elements on some percentages of P and K and content of Fe, Mn and Zn (as ppm) of *Scindapsus aureus* plants during 2016 and 2017 seasons.

Treatment	P %		K %		Fe ppm		Mn ppm		Zn ppm	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Unfertilization	0.18	0.19	1.08	1.11	30.0	30.8	25.0	25.6	27.0	27.8
1 g NPK (19: 19: 19) / plant	0.25	0.26	1.17	1.20	34.0	34.5	34.2	34.9	30.0	31.0
2 g NPK (19: 19: 19) / plant	0.30	0.31	1.27	1.31	36.2	36.9	36.0	36.5	34.2	35.0
3 g NPK (19: 19: 19) / plant	0.31	0.32	1.29	1.33	37.0	37.9	36.6	36.9	35.0	36.0
1 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	0.36	0.37	1.39	1.42	43.0	43.8	39.2	39.8	38.1	38.7
2 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	0.40	0.41	1.49	1.50	44.5	45.0	41.0	41.5	40.3	40.8
3 g NPK (19: 19: 19) / plant+ spraying NPK (19:19: 19) at 0.2%	0.41	0.43	1.51	1.53	45.5	46.7	42.5	43.0	41.0	41.5
1 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	0.46	0.48	1.62	1.64	52.2	53.3	45.0	45.3	44.2	44.9
2 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	0.50	0.51	1.70	1.72	54.4	55.0	46.0	46.4	46.0	46.5
3 g NPK (19: 19: 19) / plant+ spraying citrine compound (Fe + Mn + Zn) at 0.2%	0.51	0.53	1.72	1.75	55.2	55.6	46.7	47.5	46.6	46.9
New L.S.D. at 5 %	0.04	0.05	0.05	0.06	1.9	2.0	1.1	1.0	1.9	1.9

4. Discussion

The use of inorganic NPK and some micronutrients fertilizers is well established practice in orchards, ornamental and medicinal trees and shrubs. An adequate, well balanced fertilizers was known to improve vegetative growth characters and chemical composition of such plants. Mineral nutrition is an important phase of tree physiology because an adequate supply of certain mineral elements is essential for successful growth.

Mineral nutrients have many functions in plants. Among their more important roles are constituents of plant tissues. Catalysts in various reactions, osmotic regulators, constituents of buffer systems and regulators of membrane permeability (**Kramer and Kozlowski, 1960**).

NPK nutrients are among the macronutrients required in fairly large quantities for plant growth and development. It might be convenient to review in brief, the most important roles to each one of these three nutrients and their impact on different vegetative growth characters and chemical constituents studied in the present investigation. N has an essential role as an constituents of amino acids, which are the building blocks of proteins. It occurs in a variety of other compounds such as purines and alkaloids and in many vitamins N deficiency is accompanied by failure to synthesis normal amounts of chlorophylls which affects directly the photosynthesis rate and by sequence other physiological and morphological aspects.

P is a constituent of nucleoproteins and phospholipids and the high- energy bonds associated with phosphate groups seem to constitute the chief medium of energy transfer in plants.

K is involved in enzyme activity and a deficiency is said to hinder translocation of carbohydrates and nitrogen metabolism. But this may be an indirect rather than direct effect. It is also known that potassium is highly mobile in plant (**Bidwell, 1974**).

The role of Fe, Zn, and Mn fertilizers in increasing vegetative growth characters and chemical composition of plants was studied.

Zn, Fe and Mn were essential elements and play various important roles in plant growth and development. Zinc for example is considerate as a factor for many enzymes. It influences RNA synthesis and consequently, protein formation and control the synthesis of tryptophan which is the procures of IAA. On the other hand, manganese is involved in many plant metabolism processes such as chlorophyll synthesis, photosynthesis, amino acids, nitrate redacts and protein synthesis, phytohormon regular and enzyme activator (**Garg *et al.*, 1986).**

Manganese application led to a favorable influence on oxygen assimilation by soil and roots (**Dozontseva and Ignatev, 1983).**

Many authors emphasized the role of NPK mineral fertilizers in augmenting vegetative growth characters and chemical composition of *Ficus benjamina* (**Saleh *et al.*, 1998**) *Leucaena Leucacephala* (**Ahmed, 1995**); *Casssia siamea* (**Kannan and Polwal, 1995**); *Switenia mahogany* (**El- Mahrouk, 2000**); *Acacia saligna* (**Badran *et al.*, 2003**); *Jojoba* (**Saeed *et al.*, 2004 and Helmy, 2009)** and *moringa* (**Peulah *et al.*, 2014 and Fagbenro *et al.*, 2013**).

The increase in growth characters and chemical composition of *Scindapsus aureus* plants as results of the different fertilization treatment with macro and micronutrients is in agreement with the findings of **Broschat (1982)** on *Brassaia actinophylla* and *Philodendron selloum* **Abou- Dahab (1996)** on *B. aroicala* **Said (1997)** on *Codiaeum variegatum* **El-Deeb (1999)** on philodendron as well as **Fare and Halcomb (2000)** on Red Sunset" red maple and **Salem *et al.*, (2002**) on *Scindapsus pictus.*

As a conclusion, for promoting growth characters and chemical constituents of *Scindapsus aureus* plants, it is advised to fertilizing the plants with NPK (19: 19: 19) at 2 g / plant and spraying citrine compound (Fe + Zn + Mn) at 0.2 % three times during each season at the middle of June, July and August.

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