# Influence different concentrations of L-tryptophan and *Spirulina platensis* algae extract on growth behavior and chemical constituents of *Schefflera arboricola*

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## ABSTRACT

This experiment was carried out in pot during spring seasons of 2023 and 2024 at nursery followed to Orn. Plants and Landscape Res. Dep., Hort. Res. Inst., A.R.C., Giza, Egypt. This study aimed to evaluate the impact different concentrations L-tryptophan at (0, 50, 100 or 200 ppm), *Spirulina platensis* algae extract at (0, 1.0, 2.0 or 3.0 ml/l) and their interaction between this treatments on schefflera growth behavior and leaf green color degree as well as some chemical compositions. The tallest plants, thickest stems, heaviest leaves and root weights per plant were noticed in 200 ppm L-Trp alone or with 3ml/l *S. platensis* algae extract treated plants. The highest leaf green color degree (SPAD unit) was recorded with the combination between (200 ppm L-Trp + 3.0 ml *S. platensis* algae extract) compared to the other combinations under study. Increasing concentration each of L-Trp or *S. platensis* algae extract gradually increased total carbohydrates, total nitrogen, total phosphorus and potassium percentages in schefflera leaves. Generally, it could be recommend that, to obtain the best vegetative and roots growth and quality of *Schefflera arboricola*, the plants should be sprayed with L-Trp at 200 ppm and Spirulina extract at 3ml/l every three weeks.

**Keywords:** *Schefflera Arboricola*- L-tryptophan- *Spirulina platensis* algae- Growth- Chlorophyll.

## INTRODUCTION

A member of the Araliaceae family, *Schefflera arboricola* cv. Gold Capella commonly called umbrella plant, it is indigenous to the Chinese Islands of Hainan and Taiwan. *S. arboricola*is an evergreen shrub that can grow up to 3 - 4 meters in height (Everett 1981). Schefflera is an evergreen shrub that makes a wonderful houseplant because of its lovely and imaginative leaves. In the market, a lot of cultivars (cvs) are significant as indoor pot plants (Luseane, Charlotte, and Gold Capella). The most beautiful cultivar is Schefflera "Gold Capella," which has gorgeous variegated foliage with sporadic yellow and gold splotches mixed with green variegation. Because it can grow in both full sun and shade, it was utilized outside as a specimen (El-Khateeb et al., 2023).

In plants, amino acids can have a variety of functions, such as serving as molecular transmitters and regulatory molecules. Additionally, amino acids influence gene expression, oxidation suppression, and the creation and activity of certain enzymes (Rai, 2002). Many chemical molecules, such as proteins, amines, terpenes, vitamins and alkaloids are made up of amino acids (Ibrahim et al., 2010). Tryptophan (Trp) is essential for early growth and aids in the synthesis of indole acetic acid (IAA). However, Phillips (1971) proposed a number of alternate roles for IAA synthesis in plants, all of which began with Trp. As a result, IAA was produced when tryptophan was provided to the majority of plant tissues. Plant root exudates naturally include L-Trp, the precursor of IAA (Villareal et al., 2012). Additionally, it is produced by hydrolyzing dead cell proteins (Patten and Glick, 1996), and it is transformed into indole acetic acid by rhizobacteria that promote plant growth (Sasirekha et al., 2012). Likewise, El-Naggar and Swedan (2009) discovered that the most effective way to promote the growth and flowering of *Hippeastrum vittatum* plants is to spray them with 150 ppm Trp. Also, El-Sayed et al. (2018) noticed that plant height, leaf area, dry weight of leaves, stems and roots and root length of *Khaya senegalensis* were significantly affected by 200ppm L-Trp concentration compared to control.

Spirulina is a microalga belonging to the Cyanophyceae class, yet it is categorized as a bacterium due to its prokaryotic structure

(Koru, 2012). Morais et al. (2015) stated that spirulina is a high-protein food that also contains substantial levels of phenolic compounds and important polyunsaturated fatty acids. Because of its high nutritional value and active biological chemicals, spirulina is one of the most researched microalgae in the world. According to Domenico (2019), all *Portulaca grandiflora* plants applied with Spirulina extract exhibited a notable enhance in plant height and stem number, flower number and diameter, root and vegetative weight, leaf count and flowering time. Abd El-Sadek and Ahmed (2022) demonstrated that in *Capparis cartilaginea*, the administration of *S. platensis* crude extract at 4 mg/l significantly enhanced shoot length, as well as number of leaves per shootlet.

The current study aimed to determine the effects of L-Trp and Spirulina extract on growth traits, leaf green color degree, total carbohydrates and NPK percentages of *S. arboricola* plant.

## MATERIALS AND METHODS

The Experimental was done on Farm of Ornamental Plants and Landscape Gardening, Res. Dept., Hort. Res. Inst., ARC, Giza, Egypt, a pot experiment was conducted in an open field environment. *Schefflera arboricola* cv. Gold Capella plants were obtained from Mustafa Abo-Eisa Nursery, Belbas District, Sharkia Governorate, Egypt, growing in the greenhouse (20–22 cm height, 5-6 leaves) was obtained. During the two spring consecutive seasons of 2023 and 2024. This study was conducted to evaluate the impact different concentrations of L-tryptophan (0, 50, 100 or 200 ppm), *Spirulina platensis* algae extract (0, 1, 2 or 3 ml/l) and their combinations on plant growth and some chemical constituents of *S. arboricola* plant. Plants were sprayed with L-Trp as well as *S. platensis* algae extract at abovementioned treatments every 21 days throughout the period from March 15$^{th}$ to November 15$^{th}$. All treatment was containing 12 pots. Pots with 25 cm diameter were filled with 4 kg clay + sand (1: 1, v/v). The physical as well as chemical properties of the mixture of the two soil types utilized (average of the both seasons) are given in **Table (A).**

Table (A). Physical and chemical properties of experimental medium

| **Physical analysis** | | | | | | | | | | | | **Soil texture** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Clay (%)** | | | **Silt (%)** | | | | | | **Sand (%)** | | | **Sandy** |
| 21.64 | | | 8.24 | | | | | | 70.12 | | | |
| **Chemical analysis** | | | | | | | | | | | | |
| pH | E.C. (dsm-1) | Soluble cations (m.mol/l) | | | | | Soluble anions (m.mol/l) | | | Available (ppm) | | |
| | | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $Zn^{++}$ | $Mo^{++}$ | $Cl^{-}$ | $HCO_3^{-}$ | $SO_4^{--}$ | N | P | K |
| 7.78 | 0.61 | 1.62 | 0.90 | 0.35 | 1.18 | 1.15 | 3.24 | 1.12 | 0.94 | 131 | 52 | 48 |

Table (B). Spirulina analysis

| **Chemical Composition (g/100g)** | | **Minerals (mg/100g)** | |
|---|---|---|---|
| Total Carbohydrates | 15.81 | Sodium | 762.70 |
| Crude Protein | 56.43 | Magnesium | 7.90 |
| Ash | 13.32 | Selenium | 5.00 |
| Crude Fiber | 3.22 | Phosphorus | 101.10 |
| Fat | 5.92 | Calcium | 153.80 |
| Moisture | 5.3 | | |
| **Amino acids (mg/g)** | | | |
| Histidine | 12.34 | Glutamic acid | 29.88 |
| Cystine | 17.21 | Alanine | 17.58 |
| Threonine | 37.76 | Aspartic acid | 29.88 |
| Valine | 56.25 | Leucine | 66.72 |
| Isoleucine | 60.24 | Tyrosine | 89.67 |
| Phenylalanine | 14.74 | Lysine | 13.59 |
| Proline | 29.78 | Methionine | 71.81 |
| Glycine | 10.45 | Serine | 10.93 |

**Materials sources:**

L-Trp acid [(S)-2-Amino-3-(3-indolyl) porpionic acid ($C_{11}H_{12}N_2O_2$)] was obtained from TECHNO GENE Company, Dokky, Giza, Egypt. Also, 52% of the *S. platensis* algae extract was obtained from Agriculture Microbiological Department, Faculty of Agriculture, Zagazig University, Egypt. Spirulina analysis is presented in Table (B).

**Data recorded:**

**Plant growth:**

Plant height (cm), stem diameter (cm) was measured from the base of the stem 1 cm above the soil surface., leaf number /plant, fresh and dry weights of leaves/plant (g), longest root (cm) as well as root fresh and dry weights/plant (g) were recorded after two weeks of the end of treatments.

**Chemical constituents:**

As stated by **Markwell *et al.* (1995)**, the SPAD-502 meter was used to measure the fresh leaves sample of existing Schefflera plants at the end of the experiment from the planting date during both seasons. Schefflera leaves were air dry after that the percentages of N, P, and K were determined according to AOAC (1990). Additionally, the method outlined by Dubois et al. (1956) was used to calculate the percentage of total carbohydrates in leaves.

**Experimental Design and Data Analysis**

Data were statistically analyzed as factorial experimental**.** There were four concentrations of L-Trp in the main plots, four of *S. platensis* extract were distributed in the subplots and there interaction between different concentrations of L-Trp with *S. platensis* extract. Each treatment contained 3 replicates. Each replicate contained 4 pots.

The lay-out of the experiment was designed in a split-plot design and test of Least Significant Difference (L.S.D.) at $p \leq 0.05$ was used for comparison among means according to Gomez & Gomez (1984). A computer tool called Statistix version 9 was used to compare the means (Analytical software, 2008).

## RESULTS AND DISCUSSION

**Plant growth:**

**1- Effect of L-Trp, *S. platensis* extract concentrations and their interaction on plant height and stem diameter (cm)**

For L-Trp data listed in **Table (1)** show that any L-Trp concentration significantly affected Schefflera growth traits (plant height and stem diameter) during both seasons. The tallest plants (53.42 and 54.75 cm) were achieved in plants treated with 200 ppm L-Trp at 1st and 2nd seasons, respectively. Stem thickness recorded the highest values for plants treated with L-Trp at 100 or 200 ppm without significant difference between them in two seasons (1.26 cm in 1st or 1.31 cm in 2nd, respectively).

In *S. platensis* treating *S. arboricola* cv. Gold Capella plants with *S. platensis* extract at any concentration (1, 2 or 3 ml/l) significantly increased all recorded growth traits (plant height and stem diameter).

Regarding the influence of the interaction between different concentrations of L-Trp and *S. platensis* extract, it was noticed that the combination between the highest concentration of L-Trp (200 ppm) and the highest rate of S. platensis extract (3 ml/l) gained the maximum of all investigated plant growth parameters values (65.00 and 58.00 cm, respectively) for plant height and (1.34 and 1.39 cm, respectively) for stem diameter on the contrary, the minimum values of these traits were obtained when plants were sprayed with the lowest concentration of L-Trp and sprayed with tap water instead of *S. platensis* extract.

The L-trp role is well known: it has an indirect role on the growth via its impact on auxin synthesis which reflects in enhancing growth traits of plant (Phillips, 1971). Several authors reported the improving influence of L-Trp acid on ornamental plants growth (Abou Dahab and Abd El-Aziz, (2006) on *Philodendron erubescens* where

tryptophan increased the number of leaves and stem diameter; Abdel Aziz et al., (2009) on *Antirrhinum majus* and AL-Zurfi et al., (2023) on *Petunia hybrida*. For effect of *S. platensis* extract similar results were obtained on *zinnia elegans* (Mohammed et al., 2022).

**Table (1).** Effect of L-Trp, *S. platensis* extract concentrations and their interaction on plant height (cm) and stem diameter (cm) of *S. arboricola* plant during both seasons.

| Treatments | | Plant height (cm) | | Stem diameter (cm) | |
|---|---|---|---|---|---|
| | | 1st season | 2nd season | 1st season | 2nd season |
| **Effect of L-Trp concentration (ppm)** | | | | | |
| **0.0** | | 46.58 | 48.42 | 1.12 | 1.10 |
| **50** | | 48.33 | 50.33 | 1.16 | 1.14 |
| **100** | | 52.58 | 54.33 | 1.26 | 1.31 |
| **200** | | 53.42 | 54.75 | 1.26 | 1.31 |
| **L.S.D. at 5 %** | | **0.38** | **0.69** | **0.01** | **0.01** |
| **Effect of Spirulina extract concentrations (ml/l)** | | | | | |
| **0.0** | | 47.58 | 49.08 | 1.15 | 1.16 |
| **1.0** | | 50.00 | 50.67 | 1.18 | 1.20 |
| **2.0** | | 50.58 | 53.00 | 1.21 | 1.23 |
| **3.0** | | 52.75 | 55.08 | 1.25 | 1.27 |
| **L.S.D. at 5 %** | | **0.44** | **0.67** | **0.01** | **0.01** |
| **Effect of L-Trp × Spirulina extract concentrations** | | | | | |
| **0.0** | **0.0** | 45.00 | 46.67 | 1.11 | 1.08 |
| | **1.0** | 46.33 | 47.33 | 1.11 | 1.09 |
| | **2.0** | 36.33 | 49.33 | 1.12 | 1.12 |
| | **3.0** | 48.67 | 50.33 | 1.13 | 1.12 |
| **50** | **0.0** | 47.00 | 48.33 | 1.13 | 1.10 |
| | **1.0** | 47.33 | 49.33 | 1.16 | 1.14 |
| | **2.0** | 47.67 | 50.33 | 1.16 | 1.14 |
| | **3.0** | 51.33 | 53.33 | 1.20 | 1.18 |
| **100** | **0.0** | 49.33 | 50.67 | 1.19 | 1.21 |
| | **1.0** | 52.33 | 52.33 | 1.23 | 1.28 |
| | **2.0** | 53.67 | 55.67 | 1.27 | 1.33 |
| | **3.0** | 55.00 | 58.67 | 1.33 | 1.39 |
| **200** | **0.0** | 49.00 | 50.67 | 1.17 | 1.23 |
| | **1.0** | 54.00 | 53.67 | 1.23 | 1.28 |
| | **2.0** | 54.67 | 56.67 | 1.29 | 1.33 |
| | **3.0** | 56.00 | 58.00 | 1.34 | 1.40 |
| **L.S.D. at 5 %** | | **0.85** | **1.34** | **0.02** | **0.02** |

**2- Effect of L-Trp, *S. platensis* extract concentrations and their interaction on number of leaves and leaf fresh and dry weights per plant (g)**

All L-Trp concentrations significantly improved leaf number per plant and fresh and dry weights of leaves per plant (g) compared to control **(Table 2).** The best treatment in this connection was 200 ppm of L-Trp compared to the other concentrations during both seasons (13.50 1st, 13.25 2nd leaf/plant, 89.431st, 94.53 2nd g and 28.48 1st, 28.56 2nd g, respectively).

For *S. platensis*, number of leaves and their fresh and dry weights reached their highest value when treated with *S. platensis* extract at a concentration of 3 ml/l compared to the control group. Furthermore, there was a positive relationship between S. platensis extract rate and values of these traits.

While the interaction between L-Trp at (200 ppm) and S. platensis at (3 ml/l) resulted in the highest number of leaves and the highest fresh and dry weights.

In this respect, Fouad et al. (2022), also agree with these results, as treating *Calendula officinalis* with L-Trp at a concentration of 45 mg $l^{-1}$ led to a significant increase in plant height and fresh and dry weight. On the other hand, the best

concentration of *S. platensis* liquid extract was 2%, which enhanced seedling growth, number of leaves, fresh and dry weight of leaves of *triticum aestivum* comparison with other treatments and control (Hamouda et al., 2022). Also Mohammed et al. (2022) fresh and dry weight of the aerial parts of *zinnia elegans* roses with *S. platensis* treatments

**Table (2).** Effect of L-Trp, *S. platensis* extract concentrations and their interaction on number of leaves per plant and leaf fresh and dry weights per plant (g) of *S. arboricola* plant during both seasons.

| Treatments | | Number of leaves/plant | | Fresh weight of leaves/ plant (g) | | dry weight of leaves/ plant (g) | |
|---|---|---|---|---|---|---|---|
| | | 1st season | 2nd season | 1st season | 2nd season | 1st season | 2nd season |
| **Effect of L-Trp concentration (ppm)** | | | | | | | |
| **0.0** | | 9.83 | 10.00 | 76.78 | 76.63 | 24.14 | 24.10 |
| **50** | | 11.17 | 11.17 | 82.02 | 79.69 | 25.83 | 25.23 |
| **100** | | 13.33 | 12.33 | 89.55 | 93.48 | 27.82 | 28.43 |
| **200** | | 13.50 | 13.25 | 89.43 | 94.53 | 28.48 | 28.56 |
| **L.S.D. at 5 %** | | **0.61** | **0.61** | **0.86** | **0.97** | **0.29** | **0.26** |
| **Effect of Spirulina extract concentrations (ml/l)** | | | | | | | |
| **0.0** | | 10.67 | 10.25 | 77.49 | 73.99 | 24.91 | 23.79 |
| **1.0** | | 11.42 | 11.42 | 79.58 | 84.62 | 25.49 | 25.80 |
| **2.0** | | 12.50 | 12.17 | 87.51 | 90.53 | 27.11 | 27.75 |
| **3.0** | | 13.25 | 12.92 | 93.21 | 95.20 | 28.77 | 28.98 |
| **L.S.D. at 5 %** | | **0.64** | **0.63** | **0.72** | **0.73** | **0.31** | **0.48** |
| **Effect of L-Trp × Spirulina extract concentrations** | | | | | | | |
| **0.0** | **0.0** | 9.00 | 8.00 | 73.27 | 71.53 | 22.60 | 21.80 |
| | **1.0** | 9.33 | 9.67 | 75.37 | 73.57 | 23.37 | 23.23 |
| | **2.0** | 10.33 | 10.67 | 77.80 | 79.80 | 24.67 | 25.23 |
| | **3.0** | 10.67 | 11.67 | 80.70 | 81.63 | 25.93 | 26.13 |
| **50** | **0.0** | 9.67 | 10.00 | 77.90 | 73.13 | 24.27 | 23.77 |
| | **1.0** | 10.67 | 11.33 | 78.80 | 76.03 | 24.63 | 24.20 |
| | **2.0** | 11.33 | 11.67 | 80.87 | 83.73 | 25.70 | 26.40 |
| | **3.0** | 13.00 | 11.67 | 90.50 | 85.87 | 28.73 | 26.53 |
| **100** | **0.0** | 11.67 | 11.00 | 79.37 | 74.03 | 25.80 | 24.40 |
| | **1.0** | 13.00 | 11.67 | 82.87 | 93.50 | 26.47 | 27.90 |
| | **2.0** | 14.33 | 13.00 | 95.13 | 98.90 | 28.93 | 29.57 |
| | **3.0** | 14.33 | 13.67 | 101.83 | 107.50 | 30.07 | 31.87 |
| **200** | **0.0** | 12.33 | 12.00 | 79.43 | 77.27 | 26.97 | 25.20 |
| | **1.0** | 12.67 | 13.00 | 82.27 | 95.37 | 27.50 | 27.87 |
| | **2.0** | 14.00 | 13.33 | 96.23 | 99.70 | 29.13 | 29.80 |
| | **3.0** | 15.00 | 14.67 | 99.30 | 105.80 | 30.33 | 31.37 |
| **L.S.D. at 5 %** | | **1.26** | **1.24** | **1.51** | **1.58** | **0.60** | **0.86** |

### 3- Effect of L-Trp, *S. platensis* concentrations and their interaction on root length (cm) and roots fresh and dry weights per plant (g)

Data in **(Table 3)** revealed that for L-Trp, the maximum values of root length (31.83 1st and 32.17 2nd cm), roots fresh weight (12.94 1st and 14.19 2nd g) and dry weight (4.19 1st and 4.83 2nd g) per plan were detected with the highest concentration of L-Trp (200ppm). On the other side, the minimum values of these parameters were observed on control treatment.

For *S. platensis*, the root specifications were positively affected by increasing the concentration of *S. platensis* extract, reaching maximum values at a concentration of 3 ml/l.

Regarding the interaction effect between different concentrations of L-Trp with *S. platensis* extract, it can be noted that treatment with the highest concentration of L-Trp (200 ppm) with the highest rate of *S.* platensis extract (3 ml/L) achieved the highest root parameter.

For the above data, Abu Al-Dhahab and Abdel Aziz, (2006), also agree with these

results, stating that the application of tryptophan to *Philodendron erubescens* significantly improved the length of the roots and their fresh and dry weights. While Hamouda et al. (2022) reported that *S. platensis* at 2% concentration induced root length and fresh and dry weight on *triticum aestivum*.

**Table (3).** Effect of L-Trp, *S. platensis* concentrations and their interaction on root length (cm) and roots fresh and dry weights per plant (g) of *S. arboricola* plant during both seasons.

| Treatments | | Root length (cm) | | Fresh weight of roots/ plant (g) | | dry weight of roots/ plant (g) | |
|---|---|---|---|---|---|---|---|
| | | 1st season | 2nd season | 1st season | 2nd season | 1st season | 2nd season |
| **Effect of L-Trp concentration (ppm)** | | | | | | | |
| **0.0** | | 25.33 | 27.25 | 11.07 | 11.55 | 2.98 | 3.03 |
| **50** | | 27.92 | 29.75 | 12.26 | 12.58 | 3.67 | 3.83 |
| **100** | | 30.92 | 30.50 | 12.96 | 13.56 | 3.57 | 4.16 |
| **200** | | 31.58 | 32.17 | 12.94 | 14.19 | 4.19 | 4.83 |
| **L.S.D. at 5 %** | | **0.94** | **0.78** | **0.33** | **0.21** | **0.25** | **0.12** |
| **Effect of Spirulina extract concentrations (ml/l)** | | | | | | | |
| **0.0** | | 26.58 | 26.25 | 11.00 | 11.66 | 2.99 | 3.36 |
| **1.0** | | 27.83 | 29.42 | 12.00 | 12.43 | 3.39 | 3.77 |
| **2.0** | | 29.50 | 30.83 | 12.84 | 13.45 | 3.84 | 4.17 |
| **3.0** | | 31.83 | 33.17 | 13.38 | 14.34 | 4.19 | 4.54 |
| **L.S.D. at 5 %** | | **0.59** | **0.63** | **0.20** | **0.20** | **0.16** | **0.11** |
| **Effect of L-Trp × Spirulina extract concentrations** | | | | | | | |
| **0.0** | **0.0** | 23.67 | 26.33 | 10.43 | 10.93 | 2.88 | 2.91 |
| | **1.0** | 24.67 | 26.33 | 10.83 | 11.27 | 2.94 | 3.01 |
| | **2.0** | 25.67 | 27.67 | 11.37 | 11.77 | 3.04 | 3.09 |
| | **3.0** | 27.33 | 28.67 | 11.63 | 12.23 | 3.06 | 3.10 |
| **50** | **0.0** | 25.67 | 26.67 | 11.00 | 11.60 | 2.98 | 3.12 |
| | **1.0** | 26.33 | 28.33 | 11.93 | 12.30 | 3.10 | 3.51 |
| | **2.0** | 28.33 | 30.67 | 12.90 | 12.83 | 4.03 | 4.07 |
| | **3.0** | 31.33 | 33.33 | 13.20 | 13.60 | 4.59 | 4.60 |
| **100** | **0.0** | 28.67 | 25.67 | 11.20 | 11.80 | 3.01 | 3.30 |
| | **1.0** | 29.67 | 30.33 | 12.50 | 12.87 | 3.24 | 4.11 |
| | **2.0** | 32.00 | 31.67 | 13.43 | 14.10 | 3.66 | 4.42 |
| | **3.0** | 33.33 | 34.33 | 14.70 | 15.47 | 4.37 | 4.81 |
| **200** | **0.0** | 28.33 | 26.33 | 11.37 | 12.30 | 3.08 | 4.09 |
| | **1.0** | 30.67 | 32.67 | 12.73 | 13.30 | 4.29 | 4.44 |
| | **2.0** | 32.00 | 33.33 | 13.67 | 15.10 | 4.63 | 5.11 |
| | **3.0** | 35.33 | 36.33 | 14.00 | 16.07 | 4.74 | 5.66 |
| **L.S.D. at 5 %** | | **1.38** | **1.34** | **0.48** | **0.41** | **0.38** | **0.22** |

**Chemical constituents:**

**1- Effect of L-Trp, *S. platensis* extract concentrations and their interaction on leaf green color degree (SPAD) and total carbohydrates (%)**

Data presented in **(Table 4)** showed leaf green color degree (SPAD) and total carbohydrates% were changed significantly in response to L-Trp concentration. The increases in leaf green color degree were about (16.71 1st and 23.082nd %) for 200 ppm L-Trp and (8.19 1st and 12.972nd %) for 100 ppm L-Trp compared to control plants. The total carbohydrates percentage of Schefflera plant was the highest with foliar spraying of L-Trp at 200 ppm compared to the other concentrations under study in two seasons.

Regard *S. platensis*, the influences of various Spirulina extract rates on the chemical constituents of Schefflera plant, the obtained findings pointed out that Spirulina extract at 3.0 ml/l caused a significant improvement in leaf green color degree, total carbohydrates %.

For interaction between L-Trp and *S. platensis* extract, reveal that, in two seasons, applying Schefflera plants with the combination treatment of 200 ppm of L-Trp and 3ml/l of *S. platensis* extract significantly

raised each of leaf green color degree and percentage of total carbohydrates.

In this concern, treatment *Philodendron aerobisense* with L-Trp increased the chlorophyll content of the leaves, (Abu Al-Dhahab and Abdel Aziz, 2006).

Khattab et al. (2016) suggested that the maximum chlorophyll and total carbohydrates contents of gladioli leaf values were found at 300 ppm concentration of Tryptophan compared to control. Regarding, Spirulina extract effect, Domenico (2019) demonstrated how adding Spirulina to the culture medium can have a major impact on *Portulaca grandiflora* growth this led to a notable increase in chlorophyll content. Also, Mohamed et al. (2022) recorded the highest values for photosynthetic pigments on *zinnia elegans* with *S. platensis* at 1% treatment and Seğmen and Ünlü (2023) found that chlorophyll (SPAD) values of *Capsicum annuum* leaves were highest in 2000 ppm spirulina application, *S. platensis* at 2% concentration enhanced carbohydrates content *in triticum aestivum* (Hamouda et al., 2022).

**Table (4).** Effect of L-Trp, *S. platensis* extract concentrations and their interaction on leaf green color degree (SPAD) and total carbohydrates (%) of *S. arboricola* plant during both seasons.

| Treatments | | Leaf green color degree (SPAD) | | Total carbohydrates (%) | |
|---|---|---|---|---|---|
| | | 1st season | 2nd season | 1st season | 2nd season |
| **Effect of L-Trp concentration (ppm)** | | | | | |
| **0.0** | | 24.42 | 23.83 | 15.72 | 16.20 |
| **50** | | 25.00 | 24.50 | 16.00 | 16.13 |
| **100** | | 26.42 | 26.92 | 16.19 | 16.08 |
| **200** | | 28.50 | 29.33 | 16.40 | 16.28 |
| **L.S.D. at 5 %** | | **0.58** | **0.37** | **0.03** | **0.14** |
| **Effect of Spirulina extract concentrations (ml/l)** | | | | | |
| **0.0** | | 24.75 | 24.67 | 15.89 | 15.98 |
| **1.0** | | 25.58 | 25.08 | 15.99 | 16.12 |
| **2.0** | | 26.67 | 27.08 | 16.14 | 16.22 |
| **3.0** | | 27.33 | 27.75 | 16.28 | 16.37 |
| **L.S.D. at 5 %** | | **0.64** | **0.75** | **0.07** | **0.12** |
| **Effect of L-Trp × Spirulina extract concentrations** | | | | | |
| **0.0** | **0.0** | 23.33 | 22.67 | 15.56 | 15.87 |
| | **1.0** | 24.00 | 22.67 | 15.64 | 16.24 |
| | **2.0** | 25.33 | 25.00 | 15.77 | 16.33 |
| | **3.0** | 25.00 | 25.00 | 15.88 | 16.34 |
| **50** | **0.0** | 24.33 | 24.00 | 15.77 | 15.91 |
| | **1.0** | 25.00 | 24.00 | 16.02 | 16.18 |
| | **2.0** | 25.00 | 25.33 | 16.07 | 16.21 |
| | **3.0** | 25.67 | 24.67 | 16.12 | 16.23 |
| **100** | **0.0** | 25.00 | 25.33 | 15.98 | 16.05 |
| | **1.0** | 25.67 | 26.00 | 16.09 | 15.92 |
| | **2.0** | 26.67 | 27.33 | 16.25 | 16.15 |
| | **3.0** | 28.33 | 29.00 | 16.44 | 16.19 |
| **200** | **0.0** | 26.33 | 26.67 | 16.24 | 16.10 |
| | **1.0** | 27.67 | 27.67 | 16.22 | 16.12 |
| | **2.0** | 29.67 | 30.67 | 16.45 | 16.20 |
| | **3.0** | 30.33 | 32.33 | 16.67 | 16.71 |
| **L.S.D. at 5 %** | | **1.26** | **1.36** | **0.13** | **0.25** |

**2- Effect of L-Trp, *S. platensis* extract concentrations and their interaction on total nitrogen, total phosphorus and potassium percentages**

As shown in (Table, 5) for L-Trp, the highest N (2.238 1st and 2.273 2nd %), P (0.335 1st and 0.331 2nd %) and K (2.278 1st and 2.307 2nd %) were attained in plants treated with 200 ppm L-Trp, whereas the

lower values in these constituents were obtained in control plants.

Also, for *S. platensis*, N, P and K percentages compared to other treatments and control were increased when treated with Spirulina extract achieving the highest values with 3ml/l.

As interaction, concentrations of *S. platensis* extract at 2 and 3 ml/l, under any L-Trp concentration the chemical constituents of Schefflera leaves also raised reaching maximum when applying L-Trp 200 ppm with *S. platensis* extract at a concentration of 3 ml/l which recorded N (2.253 and 2.300), P (0.335 and 0.334), K (2.303 and 2.273) in both seasons.

Also Domenico (2019) on *Portulaca grandiflora* demonstrated that adding Spirulina to the culture medium led to a notable better NPK absorption and Mohamed et al. (2022) found that rising N, P and K absorption of *zinnia elegans* seedlings treated with ***S. platensis*** at concentration 1%.

**Table (5).** Effect of L-Trp, *S. platensis* extract concentrations and their interaction on total nitrogen, total phosphorus and potassium percentages of *S. arboricola* plant during both seasons.

| Treatments | | Total nitrogen (%) | | Total phosphorus (%) | | Potassium (%) | |
|---|---|---|---|---|---|---|---|
| | | 1st season | 2nd season | 1st season | 2nd season | 1st season | 2nd season |
| **Effect of L-Trp concentration (ppm)** | | | | | | | |
| **0.0** | | 2.153 | 2.124 | 0.315 | 0.314 | 2.153 | 2.149 |
| **50** | | 2.163 | 2.175 | 0.320 | 0.320 | 2.178 | 2.173 |
| **100** | | 2.188 | 2.207 | 0.324 | 0.322 | 2.219 | 2.224 |
| **200** | | 2.200 | 2.230 | 0.328 | 0.329 | 2.256 | 2.238 |
| **L.S.D. at 5 %** | | **0.008** | **0.011** | **0.002** | **0.002** | **0.022** | **0.017** |
| **Effect of Spirulina extract concentrations (ml/l)** | | | | | | | |
| **0.0** | | 2.132 | 2.125 | 0.317 | 0.316 | 2.155 | 2.160 |
| **1.0** | | 2.154 | 2.165 | 0.319 | 0.320 | 2.197 | 2.187 |
| **2.0** | | 2.191 | 2.204 | 0.324 | 0.322 | 2.220 | 2.208 |
| **3.0** | | 2.228 | 2.242 | 0.327 | 0.326 | 2.233 | 2.229 |
| **L.S.D. at 5 %** | | **0.007** | **0.009** | **0.002** | **0.002** | **0.017** | **0.017** |
| **Effect of L-Trp × Spirulina extract concentrations** | | | | | | | |
| **0.0** | **0.0** | 2.110 | 2.080 | 0.311 | 0.309 | 2.103 | 2.127 |
| | **1.0** | 2.140 | 2.110 | 0.314 | 0.313 | 2.147 | 2.133 |
| | **2.0** | 2.167 | 2.137 | 0.317 | 0.315 | 2.173 | 2.157 |
| | **3.0** | 2.197 | 2.170 | 0.318 | 0.317 | 2.187 | 2.180 |
| **50** | **0.0** | 2.120 | 2.123 | 0.316 | 0.313 | 2.140 | 2.137 |
| | **1.0** | 2.133 | 2.150 | 0.318 | 0.320 | 2.180 | 2.167 |
| | **2.0** | 2.180 | 2.193 | 0.321 | 0.323 | 2.197 | 2.183 |
| | **3.0** | 2.220 | 2.233 | 0.324 | 0.324 | 2.193 | 2.203 |
| **100** | **0.0** | 2.147 | 2.133 | 0.318 | 0.315 | 2.167 | 2.167 |
| | **1.0** | 2.160 | 2.197 | 0.322 | 0.319 | 2.223 | 2.227 |
| | **2.0** | 2.203 | 2.233 | 0.327 | 0.322 | 2.237 | 2.243 |
| | **3.0** | 2.240 | 2.263 | 0.329 | 0.331 | 2.250 | 2.260 |
| **200** | **0.0** | 2.150 | 2.163 | 0.323 | 0.326 | 2.210 | 2.210 |
| | **1.0** | 2.183 | 2.203 | 0.322 | 0.326 | 2.237 | 2.220 |
| | **2.0** | 2.213 | 2.253 | 0.331 | 0.328 | 2.273 | 2.250 |
| | **3.0** | 2.253 | 2.300 | 0.335 | 0.334 | 2.303 | 2.273 |
| **L.S.D. at 5 %** | | **0.015** | **0.019** | **0.004** | **0.004** | **0.036** | **0.030** |

## CONCLUSION

From above mentioned results, it is preferable to spray *S. arboricola* cv. Gold Capella plants with L-Trp at 200 ppm combined with *S. platensis* algae extract at 3 ml/l to enhance the plant growth behaviour as well as leaf green color degree, total carbohydrates and NPK percentages.

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## الملخص العربي

# تأثير تركيزات مختلفة من التربتوفان ومستخلص طحالب سبيرولينا على النمو والمكونات الكيميائية لنبات الشفليرا *Schefflera arboricola*

**محمود عبد الفتاح السيد الاشوح**

**قسم بحوث نباتات الزينة وتنسيق الحدائق -معهد بحوث البساتين – مركز البحوث الزراعية**

أُجريت هذه التجربة في أصص خلال فصلي الربيع لعامي 2023 و2024 في المزرعة التجريبية التابعة لقسم بحوث الزينة وتنسيق الحدائق، ، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر. هدفت هذه الدراسة إلى تقييم تأثير تركيزات مختلفة من حمض التريبتوفان (0، 50، 100 او200 جزء في المليون) مستخلص السبيرولينا (0، 1، 2 او3 مل/لتر) والتفاعل بين هذه التركيزات على نمو نبات الشفليرا ودرجة اللون الأخضر للأوراق، بالإضافة إلى بعض التركيبات الكيميائية. لوحظ ان أطول النباتات، وأسمك السيقان، وأثقل الأوراق، ووزن الجذور للنبات الواحد في النباتات المعاملة بالتريبتوفان 200 جزء في المليون مع او بدون مستخلص السبيرولينا 3 مل/لتر. سُجِّلت أعلى درجة لون أخضر للأوراق (وحدة SPAD) عند الجمع بين أعلى تركيز للتريبتوفان ومستخلص سبيرولينا، مقارنةً بالتركيزات الأخرى قيد الدراسة. وأدت زيادة كلٍّ من تركيز التريبتوفان أو مستخلص سبيرولينا تدريجيًا إلى زيادة نسب الكربوهيدرات الكلية، والنيتروجين الكلي، والفوسفور الكلي، والبوتاسيوم في أوراق الشفليرا.