*J. Plant Production, Mansoura Univ., Vol. 9 (5): 449 - 458, 2018*

# Effect of Cyanobacterial Extract and Compost tea on some Growth, Flowering Parameters and Biochemical Properties of *Pelargonium zonale*,(L) L'Hérit plants

**Samia M. Z. El-Bably[1]; Ahlam A. Mehesen[2] and M. E. Shalaby[3]**
**[1] Hort. Res. Inst., Agric. Res. Center, Giza, Egypt**
**[2] Soil, Water and Environ. Res., Inst., Agric. Res. Center**
**[3] Agric. Botany Dept., Fac. of Agric. Kafr El-Sheikh Univ., Egypt**



## ABSTRACT

The effects of cyanobacterial extract and tea of the composted rice straw on some growth, flowering parameters and biochemical properties of *Pelargonium zonale* plants were investigated. As soil drench and foliar spraying, treatments were applied in pots trial during two successive seasons. Results indicated significant enhancements of the tested vegetative growth parameters i.e. plant height, number of branches, stem diameter, fresh and dry weights of the aerial parts due to all treatments, with relative superiority of the mix treatment as foliar spraying. Due to use the mix treatment, averages data of aerial parts dry matter during both seasons reached 19.64 % as foliar spraying and 19.42 % as soil drench compared with 10.30 % for control treatment. Similarly, root length, number of roots, fresh and dry weights of roots were also increased due to application of all treatments especially the mix treatment but as soil drench in both seasons compared with control plants. The use of the mix treatment, average data of root dry matter during the studied seasons reached 25.10 % as foliar spraying and 27.32 % as soil drench compared with 16.83 % for control treatment. So, vegetative growth parameters were increased by foliar spraying and root parameters were remarkably enhanced due to soil drench application. Moreover, all treatments tended to induce significantly increase in number of inflorescences/plant, number of florets/ inflorescence, inflorescence diameter, as well as inflorescence fresh weight, peduncle length and flowering duration. In addition, results indicated that, chlorophyll (a), chlorophyll (b) and total carbohydrates, percentages of nitrogen, phosphorus and potassium in the leaves were also significantly increased. So, application of combined treatment of cyanobacterial filtrate and compost tea, three weeks as drench soil and/or foliar spraying after transplanting of *Pelargonium zonale* plants, four times with two weeks' interval was recommended under similar experimental conditions of the presented study.

**Keywords:** Cyanobacteria, Compost tea, *Pelargonium zonale*, Biochemical tests, Vegetative and flowering.

## INTRODUCTION

*Pelargonium zonale*, (L) L'Hérit. (Family Geraniaceae) is used as an ornamental plant (great in landscapes and containers), aromatic and folkloric medicinal plant. It normally grows to about one m in height but potentially up to three m. Its stems are succulent, hairy when young becoming woody with age. The leaves often have a dark mark shaped like a horseshoe, giving rise to both the scientific and common name. The flowers are borne in an umbel. Flowers at all times of the year, but particularly in spring (Lawrence and Ebrahim, 2002). The flowers are hermaphrodite (have both male and female organs) It can tolerate soils with pH ranging from neutral to alkaline, and prefers well-drained, dry or moist, light (sandy) and medium (loamy) soils (PFAF, 2014).

In the current situation needs for ornamental products at the international market is increasing. It is high opportunity for production of sustainable benefit using of natural resources. The increasing of awareness of environment due to use of bio organic fertilizers i.e. compost tea and cyanobacteria that may contribute to sustainable agro-ecosystems and decrease the pollution of the agricultural environment by making them less dependent on inorganic fertilizer and produce safety product. Bio-organic fertilizers have emerged as a promising natural resource for improving and increasing growth performance without affecting soil health and environment. Cyanobacteria have gained a lot of attention in recent years because of their potential applications in biotechnology. Cyanobacteria have been identified as a rich source of biologically active compounds with antibacterial and antifungal activities. It is a continually renewable biomass source that can release to the environment soluble organic substances as extracellular products also known as secondary metabolites, which can be mineralized by the microflora. These substances (vitamins, enzymes, carbohydrates, peptides, amino acids and growth promoters) were found to improve plant growth and productivity (Zulpa *et al*., 2003). Cyanobacteria represent the major microorganisms which contributed to soil fertility and activity of soil. These organisms play an important role in this system by providing a steady input of fixed nitrogen (Roger *et al.,* 1986). Anyway, many efforts were made to examine the influence of some cyanobacteria and compost tea as foliar spray and soil drench on vegetative growth and flowering habit, for some plants (Farrag *et al*., 2017; Mohsen *et al*., 2016). Ali and Mostafa (2009) investigated the effect of foliar spray or soil application methods of potassium humate and *Spirulina platensis* cyanobacterium individually or combined as bio-organic fertilizer on sesame yield and its attributes. They found that combined foliar application recorded the highest values of plant height, number of branches/ plant. A large proportion of the extra cellular nitrogenous materials are in the form of polypeptides and only a small fraction is in the form of free amino acids (Kannaiyan *et al*., 1997; Whitton, 2000). Positive effects on plants from cyanobacteria application to the soil can be observed through the secretion of plant growth regulators such as: auxins, gibberellins, and cytokinins that stimulate metabolic activities in the roots (Cocking, 2003). Phytohormones such as auxin could be an important factor contributing in increasing number of roots (Spaepen *et al*., 2007). Auxin long-distance signal from shoot to root regulates the inhibition of early root development by high rates of $NO_3$- supply in Arabidopsis seedlings (Forde, 2002). The foliar and soil applied liquid cyanobacteria fertilizer recorded higher root surface area compared to composted manure fertilizer on sandy soil (Sukor, 2013).

Compost tea is used in a wide range of applications including municipal parks, sports fields, schools and

botanical gardens as a viable alternative to conventional fertilizer programs. The use of compost tea is becoming interesting for applications in organic agriculture. It could be considered as an effective bio–organic fertilizer, consisting essential components required for cell division and elongation due to being enriched in macro and microelements, vitamins and phytohormones. Compost tea also produces plant hormones; mineralize plant available nutrients, fixes nitrogen and provides useful microorganisms that colonize leaf surfaces. Many investigators reported similar promotive effects for compost fertilizer on different plants such as *Plantago arenaria* (Hendawy, 2008), *Sanchezia nobilis* (Hegazi *et al*., 2008), *origanum majorana* (Edris *et al*., 2003) and on *Ruta graveolens* (El-Sherbeny *et al*., 2007). Pane *et al*. (2014) indicated that application of compost tea increased lettuce and kohlrabi commercial yields higher by 24 and 32%, respectively. Compost tea was used in integration with nitrogen-phosphorous-potassium, and it was found to increase the vegetative biomass and bioactive components production in the medicinal herb *Centella asiatica* (Siddiqui *et al*., 2011). Rashed *et al*., (2011) on *Achillea millefolium*, L. found that compost tea application significantly increased plant height, number of branches, number of inflorescences, fresh and dry weights. Similar findings were reported by Farrag *et al.*, (2017) on Cantaloupe, Abd-Alla *et al*., (2016) on *Cucumis melo*, Shalaby and Mehesen (2014) on soybean and Shalaby *et al*., (2011) on maize plants. Foliar spraying of compost tea has shown some potential for controlling a number of diseases, due to the presence of some microorganisms or their metabolites acted as plant growth promoting Rhizobacteria (PGPR) and / or as biocontrol agents as reported by Farrag *et al*., (2017); Brinton (1995). The production and application of compost tea is primarily focused on disease suppression, supplementing plant nutrients and increasing soil microbiology to improve soil structure, water percolation/retention, rooting depth and consequently improved plant growth as mentioned by Farrag *et al*., (2017); Naidu *et al*., (2010). The potential benefits of compost tea are substantial and particularly relevant to crop production in low-input agricultural systems. The described positive effects of compost-based treatments on plant growth and physiology has been largely associated to hormonal activity of compost tea, due to a specific group of dissolved molecules. Actually, some of these substances, with indefinite origins, including indoleacetic acid (Ertani *et al*., 2013), cytokinins (Zhang *et al*., 2013) and gibberellins (Pant *et al*., 2012), have been occasionally identified in highly bioactive teas. Application of bio-organic fertilizer compost tea as a foliar spray or soil drench has been demonstrated to improve plant growth, yield and nutritional quality, it was enhancing beneficial microbial communities and their effects on agricultural soils and plants improving mineral nutrient status of plants and inducing the production of plant defense compounds that may have beneficial bioactivities (Ingham, 2005; Scheuerell and Mahaffee, 2002).

Cyanobacteria are photosynthetic cosmopolitan prokaryotic organisms that have been isolated from aquatic (freshwater, brackish and marine), terrestrial (soil, lichen-associated and the surface of leaves), and different aquatic and terrestrial extreme environments (hot springs, high salinity, deserts) (Kaasalainen *et al*., 2012). In these environments, cyanobacteria face competitors and predators, including parasitic fungi, such as chytrids. The production of oligopeptides by Planktothrix spp. is believed to contribute to the defense against chytrid fungi (Rohrlack *et al*., 2013). Enhancement of the metabolic activity via exploiting cyanobacteria + compost tea with their high nutrient value was previously investigated by Emino and Warman (2004). Foliar application of cyanobacterial filtrate + compost tea with increasing nitrogen fertilization up to 240 kg N/ha appeared to be the most efficient treatment for more vigorous growth of cantaloupe and its components (Farrag *et al*., 2017).

Therefore, the present study aimed to investigate effects of the natural local rice straw compost tea, cyanobacterial filtrate and their mixture as foliar spraying and soil drench on growth, flowering quality and some biochemical traits of *Pelargonium zonal*e grown in pots trial.

## MATERIALS AND METHODS

**Plant materials:**

Tip stem cuttings of *Pelargonium zonale* with average length varied between 10 to 13 cm were planted on February 17$^{th}$ during two successive seasons of 2014/2015 and 2015/2016 in trays filled with mixed media composed of peatmoss and vermiculite (3: 1 v/v). Media treated with fungicide (Topsin M 70) 2g/L. On April 10$^{th}$, rooted cuttings were individually transplanted in 30 cm diameter plastic pots filled with peatmoss, sand and vermiculite (2: 2: 1 v/v). Transplants were pinched for about 7-10 cm from tip of the shoot. From May 3 $^{th}$, transplants were biologically fertilized four times with two weeks' intervals using certain treatments of cyanobacteria (C) and compost tea (T) individually and/or in their mixture as soil drench and foliar spraying.

Control plants, however, were sprayed with tap water. The transplants were fertilized with 3g/liter kirystalon (19-19-19) every month and the other practices were carried as recommended.

**Treatments:**

**Compost tea:**

For compost tea, composted rice straw inoculated with *Trichoderma viridi* and some plant growth promoting rhizobacteria (PGRP) such as *Azotobacter chroococcum, Azosperillum brasilense* and *Paenibacillus polymexa* was prepared according to Ghobrial *et al.*, (2009). Physical, chemical and biological characteristics of compost tea prepared under aerobic conditions were recorded in Table (A) based on data obtained by Sakha Agricultural Research Station, Biological Nitrogen Fixation Unit. One kilogram of the maturated compost was immersed in 10 L water to obtain tea compost. Crude compost tea was diluted 1: 5 (v/v) before application.

**Cyanobacteria:**

Mixed strains of cyanobacteria known as *Anabaena oryzae, Nostoc muscorum* and *N. calcicola* were kindly obtained from the stock culture collection of Biological Nitrogen Fixation Unit, Sakha Agric. Res. Station, Kafr El-Sheikh, Egypt. Nitrogen-fixing cyanobacteria have been cultured routinely in a modified Allen's BG-11 free-

nitrogen medium (Allen and Stainer, 1968). For the growth in the dark, 1% glucose was added to the medium. Flasks containing Allen's medium (pH 7) were inoculated with 20 ml of homogenized combined culture of the three tested Cyanobacteria strains to get 500 ml total volume. Cultures were incubated at 35°C for 20 days and illuminated on a 16 / 8 h light / dark cycle using fluorescent tubes with a light intensity of 3500 to 4500 lux at the surface of the vessels (Abdel-Raouf and El-Shafey, 2009). Cultures were manually stirred twice for a few minutes daily. Cultures were filtered by centrifugation at 5000 rpm for 10 min. The filtrate of cyanobacteria was diluted by adding 250 ml water to 750 ml filtrate before application. As stock culture, cyanobacteria were inoculated into nutrient agar media and incubated in dark for 3 days to activate their growth before maintaining at 4°C in the refrigerator. Cyanobacterial filtrate and/or compost tea was/were applied individually and combination between them in two ways: soil drench and foliar spraying four times with two weeks' interval, three weeks after transplanting. The experiments were carried out in three replicates, 6 pots each. Plants of the control treatment were sprayed with tap water.

**Table A. hysical, chemical and biological characteristics of compost tea prepared under aerobic conditions based on Sakha Agricultural Research Station, Biological Nitrogen Fixation Unit.**

| Character | Value | Character | Value |
|---|---|---|---|
| pH | 8.2 | Fe (ppm) | 176.9 |
| EC (dSm-1) | 3.5 | Mn (ppm) | 23.1 |
| Total N (ppm) | 148.5 | Zn (ppm) | 41.3 |
| Total P (%) | 0.11 | Cu (ppm) | 9.5 |
| $NH_4$–N (ppm) | 19.8 | Seed germination test (%)* | 91.2 |
| $NH_4$–N (ppm) | 69.9 | Total count of microorganisms (CFU $ml^{-1}$): | |
| $NO_3$–N (ppm) | 33.8 | Fungi | $1.3 \times 10^6$ |
| Total soluble–N (ppm) | 103.7 | Bacteria | $8.7 \times 10^7$ |
| Available P (ppm) | 19.8 | Actinomycetes | $1.2 \times 10^6$ |

***Seed germination test was carried out using *Eruca sativa* seeds after 72h.**

**Determinations:**

**Vegetative and flowering parameters:**

On November 2nd, some vegetative growth parameters such as plant height (cm), fresh and dry weights of aerial parts (shoots including stem and leaves), number of branches, stem diameter(cm), number of inflorescences/plant, number of florets/ inflorescence, Inflorescences diameter (cm), fresh weight of inflorescences/plant(g), peduncle length(cm), flowering duration(days), aerial parts dry matter %, root length (cm) of the longest root, as well as fresh and dry weights of roots, roots number and roots dry matter% were measured. To indicate biomass formations, fresh and dried weights (g) of roots and the aerial parts (shoots including stem and leaves) of the plants using hot air oven at 70ºC for a time till showed a constant weight ranged from 4 to 7 days were determined at the same time span. Specimens were let to cool before further weighted. Difference between the two weights per gram was recorded as moisture and percentage of the dry matter was resulted and calculated as follows:

**Dry matter (%) = (dry weight / fresh weigh) * 100**

**Biochemical tests:**

On the other hand, chlorophyll contents (a and b) of plant leaves (mg/g f.w) were estimated according to Moran (1982). A known weight of leaves was taken and extracted their chlorophyll contents by immersing in 5 mL of N, N-dimethyl-formamide in the dark. Absorbance was measured at 647 and 664 nm using spectrephotometer (Jenway 6105 UV-VIS). Readings were used to calculate chlorophyll a and b based on the following equations:

**Chl. a = 12.46 (A664)-2.49 (A647) µg $mL^{-1}$**

**Chl. b = - 5.6 (A664) + 23.26 (A647) µg $ml^{-1}$**

Total carbohydrate contents (mg/g d.w) were determined in the leaves as described by Herbert *et al.*, (1971). Percentage of nitrogen was determined using microkjeldahle digestion-distillation method as reported by Piper (1947). Total phosphorus (%) was determined calorimetrically at 725 µm using acid solution of the digested sample based on the methods described by Troug and Meyer (1939). Digested solutions of the samples were also used for determination of total potassium as percentage using flame-photometric method (Brown and Lilliland, 1946).

**Statistical analysis:**

Data were subjected to statistical analysis of variance (ANOVA) test. A complete randomized block design was applied and Duncan's multiple range tests were used for comparing means (Snedecor and Cochran, 1980).

## RESULTS AND DISCUSSION

**Effect of bio organic fertilizers on some vegetative growth traits:**

Data revealed applicability of cyanobacteria, compost tea and their combination as foliar spraying and as soil drench on some vegetative and growth parameters of *Pelargonium zonale* are represented in Table (1).

It showed significant increases of all tested parameters due to the investigated treatments and application methods during both seasons compared with control plants. Superiority effects for enhancing all parameters were detected due to the combination between cyanobacteria and compost tea. For the individual treatments, compost tea was found to be the most efficient compared with cyanobacteria. Data confirmed also that foliar spraying was the most suitable technique with high magnitude of all tested traits compared to soil drench during both seasons.

The tallest plants reached 60 and 63.30 cm due to the dual treatment as foliar spraying compared with 33.70 and 31.30 cm for control plants during both seasons, respectively. Such superiority was also attained to obtain 10.50 and 11.30 branches per plant compared to 5.00 and 5.80 for control treatment during both season, respectively. Similar attitude was observed for the other traits, indicating about double values of the mix treatment compared with control plants, not only as foliar spraying but also as soil drench. To test formation of the biomass, aerial parts dry matter due to all treatments was recalculated and averages data of both seasons based on fresh and dry weights were plotted in Fig. (1).

**Table 1. Effect of cyanobacteria, compost tea and their combinations as foliar spraying and as soil drench on some vegetative growth traits of *Pelargonium zonale*, during 2014/2015 and 2015/2016 seasons.**

| Treatments / Traits | Control | Bio organic fertilizers | | | | | |
|---|---|---|---|---|---|---|---|
| | | Foliar spraying | | | Soil drench | | |
| | | C | T | C+T | C | T | C+T |
| | | | | 2014/2015 | | | |
| Plant height (cm) | 33.70 d | 44.40 bc | 48.20 b | 60.00 a | 40.10 c | 45.00 bc | 48.80 b |
| Fresh weight of aerial parts(g) | 91.80 f | 187.30 c | 242.70 b | 266.40 a | 122.00 e | 156.60 d | 188.80 c |
| Dry weight of aerial parts(g) | 9.70 e | 28.30 c | 37.70 b | 53.50 a | 18.60 d | 28.50 c | 40.70 b |
| No .of branches/plant | 5.00 c | 7.80 b | 8.30 b | 10.50 a | 7.00 b | 7.70 b | 10.00 a |
| Stem diameter (cm) | 0.88 e | 1.55 b | 1.59 b | 1.88 a | 1.01d | 1.33 c | 1.38 c |
| | | | | 2015/2016 | | | |
| Plant height (cm) | 31.30 e | 49.00 c | 52.30 b | 63.30 a | 42.00 d | 49.20 c | 51.00 bc |
| Fresh weight of aerial parts(g) | 88.70 e | 177.10 c | 212.00 b | 241.80 a | 128.00 d | 170.10 c | 207.20 b |
| Dry weight of aerial parts(g) | 8.90 e | 26.80 c | 29.80 bc | 46.40 a | 20.20 d | 27.00 bc | 35.80 b |
| No .of branches/plant | 5.80 c | 8.80 b | 8.20 b | 11.30 a | 8.00 b | 8.00 b | 10.80 a |
| Stem diameter (cm) | 1.04 e | 1.65c | 1.84 b | 2.06 a | 1.50 d | 1.51d | 1.73 bc |

**In the same row, means followed by the same letter are not significantly different at 0.05 levels. C: Cyanobacteria, T: Compost tea and C+T: Combination between them.**

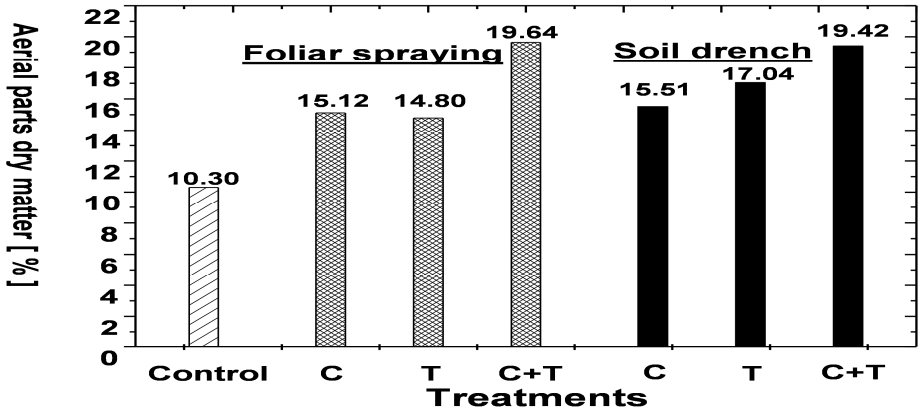


**Fig. 1. Effect of cyanobacteria, compost tea and their combinations as foliar spraying and as soil drench on aerial parts dry matter of *Pelargonium zonale* as averages data during both growing seasons.**

It confirmed supremacy of all treatments for enhancing formation of great amounts of biomass compared to the untreated plants. Due to use the mix treatment, dried matter reached 19.64 % as foliar spraying and 19.42 % as soil drench compared with 10.30 % for control treatment. However, comparable non-significant dry matter data due to use of cyanobacteria (15.12 and 15.51 %) or compost tea (14.80 and 17.04 %) in both applied techniques were obtained, respectively, indicating about one fold and half increase compared to control treatment. The improving effects of compost tea might be attributed to the direct action of compost tea on the development of N– fixing root nodules (Ghobrial *et al.*, (2009). These results were in agreement with those obtained by Farrag *et al*., (2017) on *Cucumis melo*, Mohsen *et al*., (2016) on *Lactuca sativa*, Ali (2012) and Chaned *et al*., (2011) on pelargonium species and Mehesen *et al*., (2009) on cantaloup plants. Cyanobacteria represent the major microorganisms which contributed to soil fertility and activity of soil. These organisms play an important role in this system by providing a steady input of fixed nitrogen Roger *et al*., (1986). Ezz EL-Din and Hendawy (2010) indicated that compost tea significantly increased plant height, fresh and dry weight of aerial parts and number of branches on *Borago Officinalis* plant. Also Hegazi *et al*., (2008) found similar results on *Sanchezia nobilis*.

**Effect on some flowering traits:**

For indicating effect of such treatments on some flowering traits, Data were recorded in Table (2).

On contrary to the vegetative and growth parameters, it was to noticed that the findings due to soil drench application technique reached remarkable values of flowering traits compared to foliar spraying.

A gradual and significant increment in number of inflorescences/plant was observed due to the use of the mix treatment (C+T) either as foliar spraying or as soil drench during both seasons was obtained. This treatment gave significantly the highest records of 8.5 and 8.0 inflorescences/plant, respectively, towards 4.0 inflorescences/plant for control treatment in the first season; the corresponding values were 9.0 and 8.7 respectively, against 4.6 for untreated plants in the second one. The increase in inflorescences per plant with application of cyanobacteria and compost tea individually or in combination treatment may be due to cyanobacteria producing growth promoting hormones such as gibberellin like, cytokines like and auxin like compounds (Aly *et al*., 2008). Abdel-Raouf *et al.*, (2012) revealed that cyanobacteria were found to produce and release bioactive

extracellular substances that may influence plant growth and development. These have been reported to be plant growth regulators, vitamins, amino acids, polypeptides, antibacterial or antifungal, substances that phytopathogen biocontrol and polymers, especially exopolysaccharides that improve soil structure and enzyme activity.

Data indicted also that, number of florets/ inflorescence was also increased due to the superior treatment (C+T) in both methods during both seasons compared with control plants and the individual treatments. It reached 42.20 and 40.00 as soil drench and 41.10 and 39.00 as foliar spraying at the first and second seasons, respectively. However, the least values of 18.50 and 17.10 in both seasons, respectively were recorded by control treatment.

**Table 2. Effect of cyanobacteria, compost tea and their combinations as foliar spraying and as soil drench on some flowering traits of *Pelargonium zonale,* during 2014/2015 and 2015/2016 seasons.**

| Treatments / Traits | Control | Bio organic fertilizers | | | | | |
|---|---|---|---|---|---|---|---|
| | | Foliar spray | | | Soil drench | | |
| | | C | T | C+T | C | T | C+T |
| | | | | 2014/2015 | | | |
| No .of inflorescences/plant | 4.00 d | 6.00 c | 6.30 c | 8.00 a | 7.00 b | 7.30 b | 8.50 a |
| No. of florets/ inflorescence | 18.50 e | 30.20 d | 34.50 c | 41.10 a | 36.30 bc | 38.30 b | 42.20 a |
| Inflorescences diameter (cm) | 7.70 d | 9.10 c | 10.80 b | 11.10 b | 11.00 b | 11.10 b | 12.60 a |
| Fresh weight of inflorescences/plant (g) | 28.20 e | 36.00 d | 41.00 c | 50.00 b | 37.70 d | 44.00 c | 58.80 a |
| Peduncle length(cm) | 7.60 e | 9.10d | 11.80 c | 15.60 a | 12.40 bc | 13.00 b | 16.00 a |
| Flowering duration(days) | 5.00 c | 7.00 b | 7.30 b | 10.00 a | 7. 70 b | 8.00 b | 10.40 a |
| | | | | 2015/2016 | | | |
| No .of inflorescences/plant | 4.60 e | 6.20 d | 7.70 c | 8.70 a | 8.00 b | 8.40 ab | 9.00 a |
| No. of florets/ inflorescence | 17.10 d | 32.80 c | 33.70 c | 39.00 a | 36.40 b | 36.80 b | 40.00 a |
| Inflorescences diameter (cm) | 8.40 c | 10.60 b | 10.80 b | 11.80 a | 11.00 ab | 11.30 ab | 12.00 a |
| Fresh weight of inflorescences/plant (g) | 23.50 e | 28.00 d | 36.60 c | 41.00 b | 29.20 d | 35.20 c | 44.00 a |
| Peduncle length(cm) | 7.00 d | 11.10 c | 13.60 bc | 16.70 a | 11.50 c | 14.80 b | 17.10 a |
| Flowering duration(days) | 4.80 d | 6.40 c | 6.70 c | 9.40 a | 8.30 b | 9.00 ab | 10.00 a |

**In the same row, means followed by the same letter are not significantly different at 0.05 levels. C: Cyanobacteria, T: Compost tea and C+T: Combination between them.**

Diameter of the inflorescence was also clearly increased due to the superior treatment. The recorded values were 12.60 and 12.00 cm as soil drench, and 11.10 and 11.80 as foliar spraying, while the lower values of 7.70 and 8.40 cm were for control plants in both seasons, respectively.

Effectiveness of the superior mix treatment was also extended to enhance fresh weight of the inflorescence per plant, especially as soil drench more than foliar spraying. The highest significant value of fresh weight was obtained from the treatment of (C+T) as drench soil with 58.80 and 44.00 g, followed by 50.00 and 41.00g as foliar spraying. However, the lower values of 28.20 and 23.50 g were recorded for control treatment in the first and second seasons, respectively.

Similarly, significant longer peduncle length due to the superior treatment (C+T) compared to control in both seasons was obtained. The highest records resulted from combination between cyanobacteria and compost tea in both methods as 16.00 and 15.60 cm for soil drench and foliar spray, respectively in the first season and gave 17.10 and 16.70 cm in the second one.

For flower duration, high magnitudes due to the superior treatment (C+T) by both techniques in both seasons were also reached, followed by compost tea and cyanobacteria. However, untreated plants recorded the least values. Compost tea contains a considerable amount of soluble mineral nutrients that are readily available for plant uptake and promote crop growth and yield (Hargreaves *et al*., 2009 and Welke, 2005). Compost tea significantly increased flowers of *Borago officinalis* plant (Ezz EL-Din and Hendawy 2010).

Here, it could be summarized that, both application techniques played important roles during plant life, so further mix application method including soil drench and foliar spraying is required in the future studies to guarantee enhancement of both vegetative and flowering traits.

**Effect on some root traits:**

For root growth parameters, data presented in Table (3) showed the superiority of all treatments for enhancing root length compared with control treatment (17.70 and 19.40 cm) in both seasons and both application methods. Similar magnitudes were also obtained for enhancing root number, fresh and dry weights of the roots with superiority of foliar spraying method. A somewhat similar trend was obtained concerning fresh, dry weight and number of roots as aforementioned in root length character. The foliar and soil applied liquid cyanobacteria fertilizer recorded higher root surface area compared to composted manure fertilizer in sandy soil (Sukor, 2013). Naidu *et al*., (2010) stated that the application and production of compost tea is primarily supplementing plant nutrients and increasing soil microbiology to improve soil structure, water percolation/retention, rooting depth and consequently improved plant growth. This finding in agreement with Hegazi *et al*., (2008) who indicated that compost and compost tea supplemented with PGRP could be used safety and recommended for obtaining good growth of vegetative and root traits as well as chemical constitutes. Cyanobacteria have positive effects on plant growth and can produce phytohormones such as auxins which could increase hormone levels inside the plant (Long *et al*.,2003). Phytohormones such as auxin could be an important factor contributing in increasing numbers of roots (Spaepen *et al*.,

2007). Data indicated also formation of more root dried biomass due to application of both compost tea and cyanobacteria either soil drench soil or foliar spray method as compared with untreated plants. The highest root dried matter value of 24.82 and 29.82 % was obtained for the treatment of compost tea coupled with cyanobacteria as soil drench method at the first and second seasons. It was followed by the treatment of mix cyanobacteria and compost tea (C+T) as foliar spraying at the first and second seasons with non- significant differences between themselves in the first season only, while the control treatment gave the least values of 14.11 and 19.54 % for both seasons, respectively.

**Table 3. Effect of cyanobacteria, compost tea and their combinations as foliar spraying and as soil drench on some root growth traits of *Pelargonium zonale*, during 2014/2015 and 2015/2016 seasons.**

| Treatments / Traits | Control | Bio organic fertilizers | | | | | |
|---|---|---|---|---|---|---|---|
| | | Foliar spray | | | Soil drench | | |
| | | C | T | C+T | C | T | C+T |
| | | First season of 2014/2015 | | | | | |
| Root length(cm) | 17.70 d | 20.50 c | 22.00 c | 22.20 c | 27.00 b | 28.00 b | 37.80 a |
| Roots (f.w) g) | 20.20 d | 26.80 c | 28.40 c | 30.00 c | 39.70 b | 41.80 b | 55.60 a |
| Roots( d.w) (g) | 2.85e | 5.60 d | 6.11 cd | 7.00 c | 9.00 b | 9.90 b | 13.80 a |
| Roots number | 8.30 e | 15.40 d | 17.0 cd | 19.20 c | 23.50 b | 25.20 ab | 28.30 a |
| Root dry matter(%) | 14.11 | 20.90 | 21.51 | 23.33 | 22.67 | 23.68 | 24.82 |
| | | Second season of 2015/2016 | | | | | |
| Root length(cm) | 19.40 d | 23.60 c | 25.00 c | 25.70 c | 31.70 b | 33.40 b | 42.70 a |
| Roots (f.w) g) | 24.40 d | 31.00 c | 33.50 c | 38.10 c | 47.10 b | 50.00 b | 61.70 a |
| Roots( d.w) (g) | 4.77e | 7.00d | 8.10d | 10.24c | 12.2b | 13.10 b | 18.40a |
| Roots number | 11.70 d | 18.50 c | 20.00 c | 20.80 c | 20.30 b | 22.00 ab | 27.60 a |
| Root dry matter(%) | 19.54 | 23.33 | 24.17 | 26.87 | 25.90 | 26.20 | 29.82 |

**In the same row, means followed by the same letter are not significantly different at 0.05 levels. C: Cyanobacteria, T: Compost tea and C+T: Combination between them.**

To test formation of the biomass, root dry matter due to all treatments was recalculated and averages data of both seasons based on fresh and dry weights were plotted in Fig. (2).

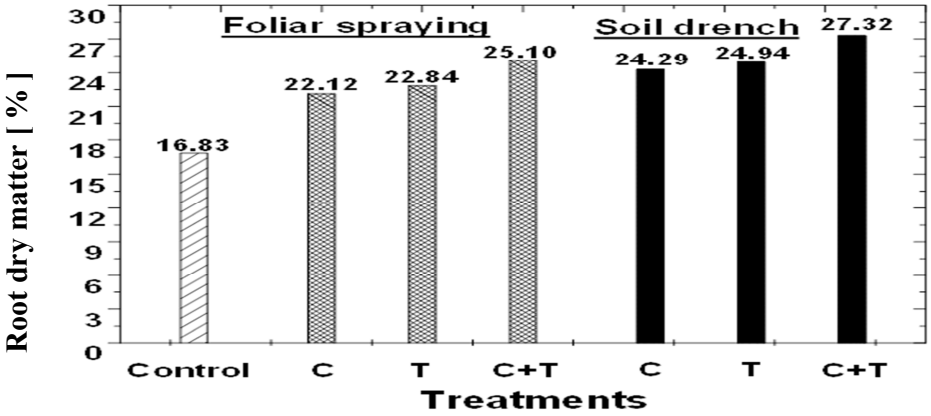


**Fig. 2. Effect of cyanobacteria, compost tea and their combinations as foliar spraying and as soil drench on root dry matter of *Pelargonium zonale* as averages data during both growing seasons.**

It confirmed the great efficacies of all tested treatments for enhancing formation of dried biomass compared to the untreated plants (control). Due to use of the mix treatment, dried matter reached 25.10 % as foliar spraying and 27.32 % as soil drench compared with 16.83 % for control. However, root dry matter data due to use of the individual treatment of compost tea in both applied techniques were increased more than cyanobacteria, especially as soil drench. The improving effects of compost tea might be attributed to the direct action of compost tea on the development of N– fixing root nodules according to Ghobrial *et al.*, (2009).

**Effect on some biochemical constituents**:

**Chlorophyll (a) and (b):**

Data presented in Table (4) showed that the highest values were obtained from the treatment of treating plants with combination of cyanobacteria and compost tea (C+T) as soil drench during the two seasons as in the first season gave 1.03 mg/g (f.w.), and the corresponding values in the second season were 1.11mg/g (f.w.), whereas the control treatment gave the least values of 0.79 and 0.81 mg/g (f.w.), respectively in the first and second seasons. Similar results were obtained by Pane *et al*., (2014) on lettuce and kohlrabi, Hegazi *et al*., (2008) on *Sanchezia nobilis*.

**Table 4. Effect of cyanobacteria, compost tea and their combinations as foliar spraying and as soil drench on chlorophyll (a), (b), total carbohydrates, N, P and K of *Pelargonium zonale*, during 2014/2015 and 2015/2016 seasons.**

| Treatments / Traits | Control | Bio organic fertilizers | | | | | |
|---|---|---|---|---|---|---|---|
| | | Foliar spray | | | Soil drench | | |
| | | C | T | C+T | C | T | C+T |
| | | | | 2014/2015 | | | |
| Chl. (a) (mg/g f.w.) | 0.79 f | 0.86 e | 0.87 d | 0.90 c | 0.92 c | 0.96 b | 1.03 a |
| Chl. (b) (mg/gf.w.) | 0.41 e | 0.49 d | 0.538 c | 0.58 b | 0.53 c | 0.58 b | 0.60 a |
| Total carbohydrates (mg/g d.w.) | 22.30 d | 26.00 c | 26.50 c | 30.10 b | 30.30 b | 31.80 b | 35.10 a |
| N% | 2.02 d | 2.32 c | 2.57 b | 2.98 a | 2.60 b | 2.68 b | 3.07 a |
| P% | 0.18 f | 0.21 e | 0.25 d | 0.30 ab | 0.27 c | 0.28 b | 0.31 a |
| K% | 1.17 d | 1.40 c | 1.42 c | 1.68 b | 1.59 b | 1.61 b | 1.90 a |
| | | | | 2015/2016 | | | |
| Chl. (a) (mg/g f.w.) | 0.81 f | 0.88 e | 0.89 d | 0.92 c | 0.93 c | 0.98 b | 0.11 a |
| Chl. (b) (mg/gf.w.) | 0.44 e | 0.48 d | 0.49 d | 0.56 b | 0.53 c | 0.56 b | 0.61 a |
| Total carbohydrates (mg/g d.w.) | 20.40 d | 28.70 c | 28.80 c | 33.30 ab | 29.00 b | 29.80 b | 36.00 a |
| N% | 2.11 d | 2.61 c | 2.68 c | 3.27 a | 3.00 b | 3.08 b | 3.32 a |
| P% | 0.19 f | 0.22 e | 0.25 d | 0.34 ab | 0.28 c | 0.33 b | 0.34 a |
| K% | 1.08 d | 1.44 c | 1.50 c | 1.73 b | 1.74 b | 1.77 b | 1.98 a |

**In the same row, means followed by the same letter are not significantly different at 0.05 levels. C: Cyanobacteria, T: Compost tea and C+T: Combination between them.**

A somewhat similar trend was obtained concerning chlorophyll (b) as the highest record was for the treatment of cyanobacteria +compost tea as soil drench in both seasons as gave 0.61, and 0.61 mg/g (f.w.) against 0. 46 and 0.44 mg/g (f.w.) for control treatments in the first and second seasons, respectively. These results are parallel with those obtained by Mohsen *et al*., (2016) on *Lactuca sativa*.

**Total carbohydrates:**

For total carbohydrates, all treatments caused increasing of total carbohydrates content in the leaves against untreated plants during the two seasons. The highest values were obtained from the treatment of application of (C+T) in both seasons as gave 35.1 and 36.00 mg/g (d.w.) against 22.3and 20.40 mg/g (d.w.) for the control treatment in the first and second seasons, respectively. The increase in total carbohydrates content resulted from application of the different bio organic fertilization levels may be directly or indirectly due to the activation of the anabolic processes of carbohydrates metabolism, leading to more chlorophyll contents, which participate directly in carbohydrate metabolism. So, the application of cyanobacteria or compost tea individually or combination in both methods increased chlorophyll (a) and chlorophyll (b) content as compared with untreated plants.

**Nitrogen (N) %:**

The highest N % values were resulted due to the (C+T) treatment as soil drench or as foliar spray. The treatment of (C+T) as soil drench gave 3.07 and 3.32%in the first and second seasons. Moreover, the treatment of (C+T) as foliar spray gave 3.07 and 3.32%in both seasons, respectively with non–significant differences between themselves in both seasons. On the other hand, control plants gave the least values of 2.02 and 2.11% in both seasons, respectively.

**Phosphorus (P) %:**

For P %, the highest records were noticed using cyanobacteria coupled with compost tea either as drench soil or foliar spray in both seasons as gave 0.31 and 0.30 % in the first season, respectively. The corresponding values in the second season were 0.34 and 0.34 %, with non – significant differences between themselves, while the control gave the least values of 0.18 and 0.19 % respectively in the first and second seasons.

**Potassium (K) %:**

It is clear to mention that the significantly highest values were obtained from the treatment of (C+T) as soil drench as gave 1.90 and 1.98 % during the two seasons respectively. However, the control treatment gave the least values of 1.17 and 1.08% in the first and second seasons, respectively.

The enhancement of N, P, K, chlorophyll (a), (b) and total carbohydrates contents could be resulted from the increase in the uptake of the nutrients through the root system, which became more capable of absorbing more amounts of nutrients. The increase in nitrogen percentage in the leaves as a result of using cyanobacteria and compost tea may be due to the properties of cyanobacterial extracts which influence the availability of nitrogen to be taken up by the plants. In accordance with the present results, many workers reported the ability of cyanobacteria to liberate high amounts of their nitrogenous substances into the medium. A large proportion of the extracellular nitrogenous materials are in the form of polypeptides and only a small fraction is in the form of free amino acids (Kannaiyan *et al*., 1997; Whitton, 2000). These results are supported by the findings of other workers as Farrag *et al*., (2017) and Abd-Alla *et al*., (2016) on *Cucumis melo*, Mohsen *et al*., (2016) on *Lactuca sativa* and Chand *et al*., (2011) on geranium plants who indicated that combination application of vermicomposting, bio fertilizer and inorganic fertilizers increased N, P and K %. Likewise, Hegazi *et al*., (2008) on *Sanchezia nobilis* found similar results.

Data presented in this investigation showed clearly positive relations between the increases of total chlorophyll content induced by application of cyanobacteria with compost tea and the enhanced photosynthesis rate observed in all vegetative growth parameters which reflected in

flowering traits. In these conditions, plants can over-induce carbohydrates synthesis and store precious energy for the following vegetative development.

The reason might be due to the properties of cyanobacteria, which can promot plants by producing growth promoting hormones such as gibberellin, cytokinin and auxin compounds. These substances increased root and shoot growth (Aly *et al.*, 2008; Venkataraman, 1993). The compounds can be assimilated by plants and enhance their growth. Abdel-Raouf *et al.*, (2012) stated that cyanobacteria were found to be plant growth regulators, vitamins, amino acids, polypeptides, antibacterial or antifungal, substances that exert phytopathogen biocontrol and polymers, especially exopolysaccharides that improve soil structure and enzyme activity.

The improving effects of compost tea may be attributed to the direct action of compost tea on the development of N– fixing root nodules (Ghobrial *et al.*, 2009). Therefore, activated compost tea could be considered as an effective bio–organic fertilizer, consisting of essential components required for cell division and elongation due to being enriched in macro– and microelements, vitamins and phytohormones to increase growth with their high nutritional value (Emino and Warman, 2004). Naidu *et al*., (2013) reported that microbial-enriched compost tea inciting a global physiological response in treated muskmelon plants, including increases in chlorophyll content, caused stimulation of flowering, growth, yield and quality. Compost tea stimulatory effects may be also ascribed to its humic component (Nardi *et al*., 2002).

Therefore, application of cyanobacteria and compost tea as mix treatment either a soil drench or as foliar spraying methods resulted in highly significant increased growth performance of pelargonium plant.

## CONCLUSION

Application of bio organic fertilizers is a global approach to reduce chemical inputs pollution and on the other hand to increase the quantity and quality of plant products in line with sustainable agriculture. Therefore, results obtained in the presented work indicated enhancement of metabolic activity via exploiting cyanobacteria coupled with compost tea as mix treatment which led a good growth performance and long flowering duration. Moreover, it has a great impact on sustainable agricultural systems**.** They may determine a more efficient growth of the plants, reducing dependence from external inputs, such as pesticides and fertilizers. Therefore, advances on this topic could increase the potential for diffusion and practical applications of such bio organic fertilizers. However, since underlying mechanisms of action are still largely unknown, further studies on ornamental plants are still necessary**.**

## REFERENCES

Abd-Alla, M. A.; A. A. Mehesen and M. E. Shalaby (2016). Effect of compost, compost tea and chemical fertilization on growth, productivity and fruit quality of Cantaloupe plants. Egy. J. Plant Pro. Res., 4 (4): 111- 128.

Abdel-Raouf, N. and N. M. El-Shafey (2009). Harmful effects of endosulfan treatment on cyanobacterial distribution and some macromolecules of soybean plant. African J. Biotech., 8(22):6277-6281.

Abdel-Raouf, N.; A. A. Al-Homaidan and I.B.M. Ibraheem (2012). Agricultural importance of algae. African. J. Biotech., 11(54): 11648-11658.

Ali, A.S. (2012). Ecological studies on cyanobacteria in soils of Sharkia Governorate. LAMBERT Academic Publishing GmbH and Co. KG. http://www. amazon.com/ Ecological- studies-cyanobacteria sharkia governorate /dp / 3848441152.

Ali, L.K. M. and S. S.M. Mostafa (2009). Evaluation of potassium humate and *Spirulina platensis* as bio-organic fertilizer for sesame plants grown under salinity stress. Egypt. J. Agric. Res., 87(1): 369-388.

Allen, M.M and R.Y. Stainer (1968). Growth and division of some unicellular blue-green algae. J. G. Microbiol., 51(2):199-202.

Aly, M. H. A.; A. A. M. Abd El-All and S.S.M. Mostafa (2008). Enhancement of sugar beet seed germination, plant growth, performance and biochemical compounds as contributed by algal extracellular products. J. Agric. Sci., Mansoura Univ., 33(12):8429-8448.

Brinton, W. (1995). The control of plant pathogenic fungi by use of compost tea. Biodynamics, 197:12–15.

Brown, J.D. and O.C. Lilliland (1946). Rapid determination of potassium and sodium in plant material and soil extracts by flame photometry. Proc. Amer. Soc. Hort. Sci., 48: 341-346.

Chand, S.; A. Pandey; M. Anwar and D. D. Parta (2011). Influence of integrated supply of vermicompost, biofertilizer and inorganic fertilizer on productivity and quality of rose scented geranium *(Plergonium* species). Indian Journal of Natural Products and Resources., 2(3):375-382.

Cocking, E. C. (2003). Endophytic colonisation of plant roots by nitrogen-fixing bacteria. Plant and Soil., 252 :169-175.

Edris, A.E.; A. Shalaby and H.M. Fadel (2003). Effect of organic agriculture practices on the volatile aroma components of some essential oil plants growing in Egypt. 11: Sweet marjoram (*Origanum marjorana*) essential oil. Flavour and Fragrance J., 18: 345-351.

El-Sherbeny, S.E.; M.Y. Khalil; M.S. Hussein and M. S. Aly (2007). Effect of sowing date and application of foliar fertilizers on the yield and chemical composition of rue (*Ruta graveolens* L.) herb. Herba Polonica., 54(1): 47-56.

Emino, E. R and P. R. Warman (2004). Biological assay for compost. Sci. Fertilization.,12(4): 342–348.

Ertani, A.; D. Pizzeghello; A. Baglieri; V. Cadili; F. Tambone; M. Gennari and S. Nardi (2013). Humic-like substances from agro-industrial residues affect growth and nitrose assimilation in maize (*Zea mays* L.) plantlets. J. Geochem. Explor., 129:103-111.

Ezz-El-Din, A. A and S.F. Hendawy, (2010). Effect of dry yeast and compost tea on growth and oil content of *Borago officinalis* plant. Research. Journal of Agric and Biologal.Sci., 6:424-430.

Farrag, D.K.; A. A. Mehesen; M. H. Kasem and O. A. Alaa El-Dein (2017). Impact of cyanobacteria filtrate, compost tea and different rates of nitrogen fertilizer on growth, fruit yield and quality of cantaloupe plants. Microbiology Research Journal International., 18(1): 1-10.

Forde, B. G. (2002). Nitrate transporters in plants: structure, function and regulation. Biochimica et Biophysica Acta.,1465:219–235.

Ghobrial, W. N; A. A. Mehesen ; J. M. Abass; M.E. Shalaby and A.F. Omar (2009). Potential impacts of rhizobium and compost tea enhanced with rhizobacteria for enhancing protection of faba bean against broad bean mottle virus (BBMV). J. Agric. Res. Kafrelsheikh Univ., 35(1):20–38.

Hargreaves, J.C; M.S. Adl and Ph. R. Warman (2009). Are compost teas an effective nutrient amendment in cultivation of strawberries? Soil and plant tissue effects. J. Sci. Food Agric., 89:390-397.

Hegazi, M. A.; S. M.Z. EL-Bably and A. A. Mehesen (2008). Effect of compost and compost tea on rhizosphere microflora, growth and chemical composition of *Sanchezia nobilis*, Hook. f. J. Agric. Res. Kafr EL-Sheikh Univ.,34(4)1126-1143.

Hendawy, S.F. (2008). Comparative study of organic and mineral fertilization on *Plantago arenaria* plant. J. of Appl. Sci. Res., 4: 500-506. Rice Crops. J. Appl. Phycol., 9: 167–174.

Herbert, D.; J. Philipps and R.E. Strange (1971). Determination of total carbohydrates. Methods in Microbiology, 5(8): 290-344.

Ingham, E. R. (2005). The Compost Tea Brewing Manual, Latest Methods and Research. 5th ed., Soil Food Web Inc., Corvallis, Oregon, USA.

Kaasalainen, U.; D. P. Fewer; J. Jokela; M. Wahlsten; K. Sivonen and J. Rikkinen (2012). Cyanobacteria produce a high variety of hepatotoxic peptides in lichen symbiosis. Proc. Natl. Acad. Sci. USA, 109: 5886–5891.

Kannaiyan, S.; S. J. Aruna; S. M. P. Kumari and D. O. Hall (1997). Immobilized cyanobacteria as a bio fertilizer for rice crops. J. Appl. Phycol., 9: 167–174.

Lawrence; Ebrahim (2002). "*Pelargonium zonale* (L) L'Hérit.", PlantZAfrica, South African National Biodiversity Institute, retrieved 2015-01-23 .

Long, H. H.; N. Furuya; D. Kurose; M. Takeshita; and Y. Takanami (2003). Isolation of endophytic bacteria from *Solanum* sp and their antibacterial activity against plant pathogenic bacteria. Journal of the Faculty of Agriculture Kyushu University., 48: 21-28.

Mehesen, A. A.; M.E. Shalaby and M. A. Abd Alla (2009). Effect of some natural bio fertilizers substitutes of peat moss on rhizosphere microflora and growth promotion of cantaloupe seedlings. Minufiya J. Agric. Res., 34(2):737– 754.

Mohsen, A. A. M.; A. S. A. Salama and F. M. A. El-Saadony (2016). The effect of foliar spray with cyanobacteria extracts on growth, yield and quality of lettuce plants (*Lactuca sativa* L.) Middle East Journal of Agriculture.,5(1):90-96.

Moran, R. (1982). Formula for determination of chlorophyllous pigment extracted with N. N dimethyl formamide. Plant Physiol., 69:1376-1381.

Naidu, Y.; S. Meon and Y. Siddiqui (2013). Foliar application of microbial- enriched compost tea enhances growth, yield and quality of muskmelon (*Cucumis melo*, L.) cultivated under fertigation system. Sci. Hort., 159:33-40

Naidu, Y.; S. Meon; J. Kadir and Y. Siddiqui (2010). Microbial starter for the enhancement of biological activity of compos tea. Int. J. Agric. Biol.,56(8) 12:51.

Nardi, S.; D. Pizzeghello; A. Muscolo and A. Vianello (2002). Physiological effects of humic substances on higer plants. Soil Biol. Biochem., 34:1527-36.

Pane, C.; A.M. Palese; G. Celano and M. Zaccardlli (2014). Effects of Compost tea treatments on productivity of lettuce and kohlrabi systems under organic cropping management. Official Journal of the Italian Society for Agronomy.,9(3): 596.

Pant, P.; T. J.K. Radovich; N.V. Hue and R.E. Paull (2012). Biochemical properties of compost tea associated with compost quality and effects on *Pak choi* growth. Sci. Hort., 148:138-46.

PFAF, (2014). Plants for a future. http://www.pfaf.org.

Piper, C.S. (1947). Soil and Plant Analysis. The University of Adelaide, Adelaide, Australia.

Rashed, N.M.; A. A. Mehesen and A.A. Abdel-Kader (2011): Response of *Achillea millefolium*, L. to bio-organic fertilization under clay soil condition., Alex. J. Agric. Res., 56 (2):65-76.

Roger, P.A.; A. Tirol; S. Ardales and I. Watanabe (1986). Chemical composition of cultures and natural samples of N2 –fixing blue –green algae from rice fields. Biol. Fertil., Soils, 2:131-146.

Rohrlack, T.; Christiansen, G. and R. Kurmayer (2013). Putative antiparasite defensive system involving ribosomal and nonribosomal oligopeptides in cyanobacteria of the genus Planktothrix. Appl. Environ. Microbiol., 79, 2642–2647.

Scheuerell, S. and W. Mahafee (2002). Compost tea; principles and prospects for plant disease control. Compost Science and Utilization., 10(4):313–338.

Shalaby, M. E. and A. A. Mehesen (2014). Effect of inoculation with Cyanobacteria and bradyrhizobia on N2- fixation and productivity of soybean plants. J. Biol. Chem. Environ. Sci., 9(2):1-20.

Shalaby, M. E; S.M. El–Moghazy; E.A. Abdelrasoul and A.A. Mehesen (2011). Effect of some plant growth promoters on controlling late wilt disease and enhancing nutritive value of maize plants. Egypt. J. of Appl. Sci., 26(11):369–385.

Siddiqui,Y; T.M. Islam; Y. Naidu and S . Meon (2011). The conjunctive use of compost tea and inorganic fertilizer on the growth, yield and terpenoid content of *Centella asiatica,* L. Urban. Sci. Hort., 130:289-95.

Snedecor, G.W. and W. G. Cochran (1980). Statistical Methods.7th ed. Iowa State Univ., Press, Ames., Iowa, U.S.A.

Spaepen, S.; J. Vanderleyden and R. Remans (2007). Indole-3-acetic acid in microbial and microorganism plant signaling. FEMS Microbiol. Rev., 31: 425-448.

Sukor, A. (2013). Effects of cyanobacterial fertilizers compared to commonly-used organic fertilizers on nitrogen availability, lettuce growth, and nitrogen use efficiency on different soil textures. M.Sc. Thesis, Colorado State University, Fort Collins, Colorado. U.S.A.

Troug, E. and A.H. Meyer (1939). Improvement in denies colorimetric method for phosphorus and arsenic 1st Eng. Chem. Anal. Ed., 1: 136-139.

Venkataraman, G. S (1993). Blue-green algae (Cyanobacteria):45-76 In:S. N. Tata, A. M. Wadhwani and M. S. Mehdi(Eds.), Biological Nitrogen Fixation. Indian Council Agric. Res., New Delhi.

Welke, S.E. (2005). The effect of compost extract on the yield of strawberries and the severity of *Botrytis cinerea*. Journal of Sustainable Agriculture., 25: 57 – 68.

Whitton, B. A; (2012). The Ecology of Cyanobactefia: Their Diversity in Time and Space. Kluwer Academic, Netherlands Soils and Rice-Fields. p. 233-255 in B. A.

Zhang, H; S.N. Tan; W.S. Wong; C.Y.L Ng; C.H. Teo; L. Ge; X. Chen; and W.H. Yong (2013). Mass spectrometric evidence for the occurrence of plant growth promoting cytokinins in vermicompost tea. Biol. Fert. Soils, 50:401.

Zulpa, G.; M.C. Zaccaro; F. Boccazzi; J.L. Parada and M. Storni (2003). Bioactivity of intra and extracellular substances from cyanobacteria and lactic acid bacteria on "wood blue stain" fungi. Biol. Control., 27: 345-358.

## تأثير مستخلص الطحالب الزرقاء المخضرة وشاى الكمبوست علي بعض صفات النمو والتزهير والخصائص البيوكيميائية لنباتات الخبيزة الأفرنجي

**ساميه زهير البابلي [١] ، أحلام على محيسن [٢] و مصطفى السيد شلبى [٣]**

**[١]قسم قسم نباتات الزينة وتنسيق الحدائق- معهد بحوث البساتين –مركز البحوث الزراعية - سخا - مصر**

**[٢]معهد بحوث الأراضى والمياه والبيئة - مركز البحوث الزراعية – سخا – مصر**

**[٣]قسم النبات الزراعى - فرع الميكروبيولوجيا الزراعية – كلية الزراعة – جامعة كفر الشيخ – مصر**

تم دراسة تأثير مستخلص الطحالب الخضراء المزرقة وشاى كمبوست قش الأرز على بعض مقاييس نمو وتزهير وبعض الخصائص البيوكيميائية لنباتات البلارجونيوم. وقد إستخدمت المعاملات إضافة للتربة ورشا على المجموع الخضرى خلال موسمين متتاليين فى تجارب الأصص. وقد أثبتت النتائج تحسن معنوى في مقاييس النمو الخضرى المختبرة مثل ارتفاع النباتات والاوزان الطازجة والجافة وعدد الأفرع وقطر الساق للأجزاء الخضرية نتيجة لكل المعاملات, مع تفوق نسبى للمعاملة بالخليط رشا على المجموع الخضرى. ونتيجة للمعاملة بالخليط, فقد وصل متوسط نسبة الكتلة الحية الجافة للأجزاء الخضرية خلال موسمى النمو إلى ١٩.٦٤ % رشا على المجموع الخضرى و١٩.٤٢% إضافة للتربة مقارنة بـ ١٠.٥٠ % للكنترول. وبالمثل, زادت أطوال وأعداد والأوزان الطازجة والجافة للجذور نتيجة استخدام كل المعاملات خاصة المعاملة بالخليط لكن إضافة للتربة خلال موسمى النمو مقارنة بالكنترول. ونتيجة للمعاملة بالخليط, فقد وصل متوسط نسبة الكتلة الحية الجافة للجذور خلال موسمى النمو إلى ٢٥.١٠ % رشا على المجموع الخضرى و ٢٧.٣٢ % إضافة للتربة مقارنة بـ ١٦.٨٣ % للكنترول. أى أن مقاييس النمو الخضرى زادت بالرش على المجموع الخضرى وتحسن مقاييس الجذور بوضوح بالإضافة للتربة. كما أدت المعاملات إلى زيادة معنوية فى عدد النورات لكل نبات وعدد الزهيرات لكل نورة وقطر النورات و طول الحامل النوري ووزنه الطازج ومدة بقاء الأزهار حية علاوة على ذلك, فقد أثبتت النتائج زيادة معنوية فى محتوى الأوراق من كلوروفيل (أ) وكلوروفيل (ب) والكربوهيدرات الكلية والنسبة المئوية للنيتروجين والفوسفور والبوتاسيوم. وعليه فإنه يوصى بالمعاملة بخليط من مستخلص الطحالب الخضراء المزرقة وشاى الكمبوست إضافة للتربة و/أو رشا على المجموع الخضرى بعد ثلاث اسابيع من زراعة عقل نباتات البلارجونيوم وتكرر أربع مرات بين المعاملة والأخرة أسبوعين تحت نفس الظروف التجريبية للدراسة المقدمة.