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Impact of Cyanobacteria Filtrate, Compost Tea and Different Rates of Nitrogen Fertilizer on Growth, Fruit Yield and Quality of Cantaloupe Plants

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

This work was carried out at Sakha Agricultural Research Station Farm during the summer seasons of 2013 and 2014 to evaluate the response of cantaloupe cultivars (Shahd El-Dokki) to spraying with cyanobacteria filtrate and compost tea either alone or mixed under different N levels (60, 120 and 240 kg N ha^{-1}). A split–split plot design with four replicates was used. Results indicated that foliar application with cyanobacteria filtrate + compost tea attained a highly significant response for increased vegetative growth characters with the highest plant height (159.8 and 162.6 cm $plant^{-1}$), number of leaves $plant^{-1}$ (72.9 and 75.3), number of branches $plant^{-1}$ (4.3 and 4.4), leaf area $plant^{-1}$ (68.1 and 70.3 cm^2), leaves fresh weight (437.9 and 448.5 g $plant^{-1}$), leaves dry weight (43.4 and 45.1 g $plant^{-1}$) compared to control (tap water) in both seasons, respectively. Furthermore, fruit yield and its components as well as leaf content of chlorophyll and chemical constituents gave a similar trend with application of N rate up to 240 kg N ha^{-1}.
Foliar application with cyanobacteria filtrate + compost tea with increasing N fertilization up to 240 kg N ha^{-1} appeared to be the most efficient treatment for more vigorous growth, fruit yield and its components.

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Keywords: Cyanobacteria filtrate; compost tea; cantaloupe plant; vegetative growth; fruit yield.

1. INTRODUCTION

Cantaloupe (*Cucumis melo* L.) is an annual plant, widespread in countries with temperate climate in Europe, Asia, and Africa. According to Food and Agriculture Organization (FAO), the world's total production of cantaloupe is 27×10^6 tons per year. Also, the world melon seeds' production is 782,205 tons and the cultivated area is 893,855 ha (FAO, 2013 Food and Agriculture Organization of the United Nations. Retrieved from www.faostat.fao.org [1]. In Egypt the total cultivated area was about 32118 hectare, which yielded 829779 tons (according to the statistics data of ministry of Agriculture, 2013).

Cantaloupe is a favorite and popular consuming crop in Egypt, it is a very good source of vitamins A, C and β- carotene and rich in bioactive compounds such as phenolics, flavonoids, carbohydrates and minerals as well as it can be used as fresh, dried and juice fruit.

Cyanobacteria filtrate represent the major microorganisms which contributed to soil fertility and activity of soil biota. These organisms play an important role in this system by providing a steady input of fixed nitrogen [2]. Also, cyanobacteria filtrate have been assumed to produce growth promoting substances like hormones, vitamins, amino acids or many other components that enhances seed germination and plant growth [3].

Compost tea is a liquid extract made by steeping composted material in water using a variety of preparation methods [4-5]. Compost tea has been brewed in large-scale mechanized systems for shorter periods of time and often supplemented with oxygen, nutrients, and microbial starter cultures to enhance the biological activity of the tea. Compost tea is manufactured and used on a wide range of crops such as vegetables, fruit, vines, cotton, cereals, and trees. 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 [6-7].

Chemical fertilizers enhance the growth of plants. Plants are made up of four main elements: carbon, hydrogen, oxygen, and nitrogen. Nitrogen is the most important fertilizer since nitrogen is present in proteins, DNA and other components. Thirty five percent of inorganic nitrogen applied to land is lost because farmers apply these inorganic sources in greater amounts than, that could be immediately assimilated by plants or soil [8].

The objective of the present study is to investigate the effect of compost tea and/or cyanobacteria filtrate spraying and different levels of N on the cantaloupe growth, fruit yield and its components.

2. MATERIALS AND METHODS

This work was carried out at Sakha Agricultural Research Station farm during two summer seasons of 2013 and 2014 (Latitude 31°, 4 N and Longitude 30°, 56 E). Two field experiments were conducted to clarify the effects of compost tea and /or cyanobacteria filtrate spraying under different nitrogen levels, on vegetative growth characters, fruit yield and its components of cantaloupe. Some characteristics of the experimental soil are presented in Table 1, which obtained from Physics and Chemical Lab., Sakha Agric. Res. Station, Kafr El-Sheikh, Egypt.

Each experiment included twelve treatments representing the combinations between three N levels (60, 120 and 240 kg N ha^{-1}) and four bio-organic fertilizer treatments, *i.e.*, 1) control (tap water), 2) spraying with Cyanobacteria filtrate, 3)

Table 1. Some characteristics of the experimental soil

Season	Mechanical analysis (%)			Texture	pH*	EC** dSm^{-1}	OM** %	Available elements (ppm)		
	Sand	Silt	Clay					N	P	K
1st	21.65	25.14	53.21	Clayey	8.05	2.1	1.70	22	6.1	280
2nd	24.72	26.11	49.17	Clayey	8.21	2.4	1.60	19	5.8	214

* *1:2.5 soil: water suspension* ** *Soil past extract*

compost tea and 4) Cyanobacteria filtrate + compost tea. The experiments were conducted using split-split plot system in a randomized complete block design, with four replicates. The main plots were allocated for the bio-organic fertilizer treatments, whereas, the sub plots were devoted for the N levels. Each sub – plot contained 4 rows, 4 m in long and 1.2 m width, comprising an area of 19.2 m^2. Cantaloupe cultivar (Shahd El-Dokki) was sown on 5th and 10th of May in the first and second seasons, respectively. Spacing between plants within rows was 40cm, and sowing was done on one side of row. Plants were thinned to one plant per hill after three weeks of planting. Ammonium sulphate (20.5% N) was the N source and the required amounts of the fertilizer were side banded at two equal portion at 30 and 45 days from seed sowing. The other recommended agricultural practices were used such as calcium super-phosphate (15% P_2O_5) and potassium sulphate (48% K_2O).

Composted rice straw tea inoculated with *Trichoderma viridi, Azotobacter chroococcum, Azospirillum brasilense* and *Paenibacillus polymexa* was prepared according to [9]. One kilogram of the mature acted compost was immersed in 10 L water to obtain compost tea and crude concentration of compost tea was diluted 1:5 with rate 45 L ha^{-1} before application.

Cyanobacteria filtrate, mixed strains of cyanobacteria known as *Anabaena oryzae*, *Nostoc muscorum* and *N. calcicola* were 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 [10]. 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 28-30℃ 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 [11]. Cultures were manually stirred twice for a few minutes daily. After that, cyanobacteria of exponentially growing cultures were separated from their culture medium by centrifugation (14000 rpm for 10 min). The filtrate of cyanobacteria was diluted 1:200 with rate 2.4 L ha^{-1} before application.

Cyanobacteria filtrate and/or compost tea was foliar sprayed three times at 20, 35 and 50 days after sowing. Plants of the control treatment were sprayed with tap water.

Table 2. Main characteristics of compost tea produced by aerated method and some additives

Character	Value
pH	8.20
EC (dSm^{-1})	3.51
Total N (ppm)	148.50
Total P (%)	0.11
NH_4–N (ppm)	69.9
NO_3–N (ppm)	33.80
Total soluble–N (ppm)	103.7
Available P (ppm)	19.80
DTPA extractable Fe (ppm)	176.90
DTPA extractable Mn (ppm)	23.10
DTPA extractable Zn (ppm)	41.30
DTPA extractable Cu (ppm)	9.50
E_4/E_6 ratio	3.12
Seed germination test (%)	91.20
Total count of bacteria (CFU ml^{-1})	8.7×10^7
Total count of fungi (CFU ml^{-1})	1.3×10^6
Total count of actinobacteria (CFU ml^{-1})	1.2×10^6

2.1 Observations on Growth and Yield Parameters

1. Chlorophyll content of leaves was measured by the SPAD–501, a portable leaf chlorophyll meter (Minolta, Marquard and Timpton, 1987) on the recently fully expanded leaf.
2. Vegetative traits, *i.e.,* plant height (cm), number of leaves $plant^{-1}$, number of branches $plant^{-1}$, leaf area $plant^{-1}$ (cm^2) as well as fresh and dry weight of leaves (g $plant^{-1}$).
3. After harvest, fruit and its components, were determined as number of fruit $plot^{-1}$, early yield $plot^{-1}$, total fruit yield $plot^{-1}$, average fruit weight (g), fruit length and diameter (cm), total soluble solids (TSS %), Seed weight $fruit^{-1}$ (g) and fruit hardness ($lb/inch^2$).

Seeds samples were oven dried, crushed and digested using sulphuric + perchloric acids method, according to [12]. Total nitrogen, phosphorus and potassium were determined in

the dry matter according to the methods described by [13-15], respectively. All obtained data was statistically analyzed using [16], and revised L.S.D. test was used to compare the differences among treatment means [17].

3. RESULTS AND DISCUSSION

3.1 Vegetative Growth Characters

3.1.1 Effect of foliar application of bio-organic fertilizer

Data presented in Table 3 showed that growth parameters were significantly affected by spraying with cyanobacteria filtrate + compost tea in both growing seasons, the foliar application of cyanobacteria filtrate + compost tea gave the highest plant height (cm) (159.8 and 162.6), number of leaves plant^{-1} (72.9 and 75.3), number of branches plant^{-1} (4.3 and 4.4), leaf area / plant (cm^2) (68.1 and 70.3), leaves fresh weight (g plant^{-1}) (437.9 and 448.5), leaves dry weight (g plant^{-1}) (43.4 and 45.1) and chlorophyll content (44.6 and 47.0), seed index (weight of 100 seeds) and total nitrogen, phosphorus and potassium of seeds (%) in both seasons, as compared to untreated plants (control). On the other hand, spraying with cyanobacteria filtrate only produced the lowest values of each character studied. The improving effects of compost tea may be attributed to the direct action of compost tea on the development of N–fixing root nodules [18]. Therefore, results obtained herein indicate enhancement of metabolic activity via exploiting compost tea with their high nutritional value [19]. 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 of cherry tomato. In the same line, [20-22] stated that spraying plants with compost tea resulted in more vigorous symbiotic N_2–fixation and vegetative growth compared with the untreated ones. 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 exert phytopathogen biocontrol and polymers, especially exopolysaccharides that improve soil structure and exoenzyme activity [23].

3.1.2 Effect of nitrogen levels

Data presented in Table 3 showed that in all growth parameters were significantly affected by increasing rate of nitrogen fertilization in both growing seasons, the highest nitrogen fertilization rate gave the highest plant height (cm) (155.7 and 158.3), number of leaves plant^{-1} (71.4 and 74.0) and number of branches plant^{-1} (4.3 and 4.3), leaf area plant^{-1} (cm^2) (67.6 and 70.1), leaves fresh weight (g plant^{-1}) (410.4 and 420.7), leaves dry weight (g plant^{-1}) (42.3 and 44.0) as well as the largest chlorophyll content (43.4 and 46.3), in the first and second seasons, respectively. Whereas 60 kg N ha^{-1} rate produce the lowest value of each character. The positive results of the added N effects could be related to two reasons [24]. Found that many, not all, non-heterocyst cyanobacteria can fix N_2 and convert it into an available from of ammonia required for the plant growth. The nitrogen content in cyanobacteria extract may amount up to 10% of their dry weight and is quantitatively the third most important element essential for fixing amino acids and proteins.

3.1.3 Effect of bio-organic fertilizer spraying and nitrogen levels interaction

Data in Table 4 showed that the interaction between bio-organic fertilizer spraying and nitrogen levels significantly affected vegetative growth characters in both seasons. Foliar application of cyanobacteria filtrate + compost tea combined with N fertilizer at the rate of 240 kg N ha^{-1} increased plant height, number of leaves plant^{-1}, number of branches plant^{-1}, leaf area Plant^{-1}, leaves fresh weight, leaves dry weight and chlorophyll content compared with those of the cyanobacteria extract combined with N fertilizer at the rate of 60 kg N ha^{-1} in both seasons. Compost tea was the most promise bio-products recently programs as plant pest, disease and fertility as described by [25]. The present results are in accordance with those reported by [26] which the results of chlorophyll a indicated that amount of pigment in the cell increased by the exponential growth phases, particularly the content was highest at the mid to late exponential phase.

In pot culture, the amount of chlorophyll increased proportionally with biomass or growth curve of culture of rice seedlings with algae *Nostoc* extracts increased root, epicotyle and hypocotyle growth, number of roots and plant fresh and dry weights [27-30].

Table 3. Effect of bio-organic fertilizer and nitrogen fertilizer levels on vegetative characters on cantaloupe plants in 2013 and 2014 seasons

Treatments	Plant height (cm)		No. of leaves plant^{-1}		No. of branches plant^{-1}		Leave area plant^{-1} (cm^2)		Leaves fresh weight (g)		Leaves dry weight (g)		Chlorophyll content SPAD unit	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Cyano. filtrate	144.4 c	146.2 c	60.8 c	64.5 c	3.5	3.8 b	62.0 c	64.0 c	320.6 d	330.5 d	36.0 c	37.8 c	37.8 c	40.5 c
Compost-tea	150.3 b	153.0 b	66.4 b	68.5 b	4.0	4.1 ab	65.5 b	68.0 b	340.3 c	348.0 c	38.3 b	40.1 b	40.9 b	43.0 b
Cyano. F. + Comp.-tea	159.8 a	162.6 a	72.9 a	75.3 a	4.3	4.4 a	68.1 a	70.3 a	437.9 a	448.5 a	43.4 a	45.1 a	44.6 a	47.0 a
Control	145.3 c	148.0 c	62.8 c	64.5 c	3.5	3.7 b	60.8 c	63.0 c	352.8 b	365.4 b	36.9 bc	38.3 c	38.3 c	41.0 c
F-test	**	**	**	**	NS	**	**	**	**	**	**	**	**	**
25	142.1 c	144.4 c	56.6 c	58.8 c	3.2 b	3.4 b	58.6 c	60.8 c	281.0 c	290.8 c	33.3 c	35.2 c	35.8 c	38.3 c
50	152.1 b	154.6 b	69.1 b	71.9 b	4.0 a	4.3 a	66.6 b	68.2 b	397.3 b	407.8 b	40.4 b	41.8 b	41.9 b	44.1 b
100	155.7 a	158.3 a	71.4 a	74.0 a	4.3 a	4.3 a	67.6 a	70.1 a	410.4 a	420.7 a	42.3 a	44.0 a	43.4 a	46.3 a
F-test	**	**	**	**	**	**	**	**	**	**	**	**	**	**

Values having a similar alphabetical letter, within a comparable group of means, are not significantly different, using revised L.S.D. test at 0.05 level

Table 4. Effect of bio- organic fertilizer and nitrogen fertilizer levels interaction on vegetative characters on cantaloupe plants in 2013 and 2014 seasons

Treatment	N levels	Plant height (cm)		No. of leaves plant^{-1}		No. of branches plant^{-1}		Leave area plant^{-1} (cm^2)		Leaves fresh weight (g)		Leaves dry weight (g)		Chlorophyll content SPAD unit	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Cyano. filtrate	25	137.8 h	140.0 h	47.8 i	50.8 g	2.7 f	3.0 f	56.5 j	58.3 i	200.6 i	209.7 h	29.9 i	31.4 h	33.0 j	35.5 h
	50	146.5 ef	148.0 ef	66.3 e	71.0 d	3.7 c-e	4.0 c-e	63.0 f	65.0 f	375.8 f	385.4 e	38.7 e	40.4 e	39.3 f	41.8 e
	100	149.0 e	150.5 e	68.3 d	71.8 d	4.0b-d	4.3b-d	66.5 e	68.8 e	385.3 e	396.5 d	39.2 de	41.5 d	41.0 e	44.3 d
Compost-tea	25	141.3 g	143.3 g	55.3 h	57.0 f	3.3 ef	3.5 ef	58.0 i	60.8 h	219.5 h	226.8 g	31.3 h	33.5 g	35.3 i	37.8 g
	50	152.3 d	155.0 d	70.0 d	72.0 d	4.3 bc	4.5 a-c	68.5 d	70.8 d	397.9 d	406.5 c	39.8 d	41.7 d	42.8 d	44.5 d
	100	157.5 c	160.8 c	74.0 c	76.5 c	4.5 ab	4.5 a-c	70.0 c	72.5 c	403.4 c	410.7 c	43.8 c	45.2 c	44.8 c	46.8 c
Cyano. filtrate +	25	144.0 fg	146.5 f	60.5 g	62.8 e	3.3 ef	3.5 ef	59.3 h	61.0 h	351.0 g	361.5 f	35.3 g	37.4 f	36.8 h	38.8 f
Comp. -tea	50	164.5 b	167.5 b	77.5 b	80.0 b	4.5 ab	4.8 ab	71.6 b	74.0 b	462.6 b	473.9 b	45.9 b	46.8 b	47.3 b	49.3 b
	100	171.0 a	173.8 a	80.8 a	83.3 a	5.0 a	5.0 a	73.3 a	76.0 a	500.1 a	510.2 a	49.2 a	51.2 a	49.8 a	53.0 a
Control	25	145.3 f	148.0 ef	62.8 f	64.5 e	3.5 de	3.8 de	60.8 g	63.0 g	352.8 g	365.4 f	36.9 f	38.3 f	38.3 g	41.0 e
	50	145.3 f	148.0 ef	62.8 f	64.5 e	3.5 de	3.8 de	60.8 g	63.0 g	352.8 g	365.4 f	36.9 f	38.3 f	38.3 g	41.0 e
	100	145.3 f	148.0 ef	62.8 f	64.5 e	3.5 de	3.8 de	60.8 g	63.0 g	352.8 g	365.4 f	36.9 f	38.3 f	38.3 g	41.0 e
F-test		**	**	**	**	**	**	**	**	**	**	**	**	**	**

Values having a similar alphabetical letter, within a comparable group of means, are not significantly different, using revised L.S.D. test at 0.05 level

Table 5. Effect of bio-organic fertilizer and nitrogen fertilizer levels on yield and its components on cantaloupe plants in 2013 and 2014 seasons

Treatments	No. of fruits plot^{-1}		Early yield Kg plot^{-1}		Total yield Kg plot^{-1}		Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)		T.S.S (%)		Fruit firmness (lb/inch^2)		Seed weight (g) fruit^{-1}	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Cyano. filtrate	66.1 c	68.3 d	32.0 d	34.3 d	123.2	131.5 d	1850 c	1912.5 c	26.7 b	26.6 c	9.2 c	9.3 c	8.0	8.5 c	5.5 c	5.7 c	12.2 c	15.4 d
Compost-tea	70.8 b	73.9 b	36.2 b	39.3 b	139.3	151.4 b	1954.2 b	2041.7 b	27.7 a b	27.3 b	9.6 b	9.8 b	8.8	9.5 b	5.8 b	5.9 b	16.5 b	17.0 b
Cyano. filtrate + Comp.-tea	76.6 a	79.9 a	44.2 a	48.4 a	156.4	171.1 a	2033.3 a	2120.8 a	28.7 a	28.3 a	9.9 a	10.2 a	9.6	10.0 a	6.2 a	6.5 a	17.9 a	18.3 a
Control	67.8 c	71.0 c	34.3 c	36.9 c	127.0	136.7 c	1875 c	1925.0 c	27.4 b	27.0 bc	9.2 c	9.3 c	8.3	8.8 c	5.6 bc	5.8 c	15.7 c	16.1 c
F-test	**	**	**	**	NS	*	**	**	**	**	**	**	NS	*	**	**	**	**
25	61.8 c	64.7 c	25.2 c	27.5 c	110.4 c	120.2 c	1781.3 c	1859.4 c	26.0 c	26.4 c	9.0 c	9.2 c	7.5 c	8.0 c	5.3 b	5.4 c	14.4 c	14.8 c
50	73.5 b	76.6 b	41.5 b	44.6 b	146.3 b	157.1 b	1984.4 b	2043.8 b	27.8 b	28.1 b	9.6 b	9.8 b	9.0 b	9.6 b	6.0 a	6.2 b	17.0 b	17.3 b
100	75.6 a	78.6 a	43.3 a	47.1 a	152.6 a	165.7 a	2018.8 a	2096.9 a	28.1 a	28.4 a	9.8 a	10.1 a	9.4 a	9.9 a	6.1 a	6.3 a	17.6 a	17.9 a
F-test	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**

Table 6. Effect of bio-organic fertilizer and nitrogen fertilizer levels on chemical constituents of cantaloupe fruits in 2013 and 2014 seasons

Treatments	100 seed weight (g)		N %		P %		K %	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Cyano. filtrate	11.1 c	11.0 c	4.7	4.5 b	0.3 c	0.4 c	3.8 b	3.8 c
Compost-tea	11.7 ab	11.9 b	4.8	4.8 ab	0.4 b	0.4 b	3.9 b	4.0 b
Cyano. filtrate + Comp.-tea	12.2 a	12.5 a	4.9	5.0 a	0.4 a	0.4 a	4.2 a	4.3 a
Control	11.5 bc	11.7 b	4.6	4.7 ab	0.3 c	0.3 c	3.9 b	4.0 b
F-test	**	**	NS	**	**	**	**	**
25	10.9 c	10.9 c	4.4 b	4.5 b	0.3 c	0.3 c	3.5 b	3.6 c
50	11.9 b	11.9 b	4.8 a	4.9 a	0.4 b	0.4 b	4.2 a	4.2 b
100	12.2 a	12.4 a	5.1 a	5.0 a	0.4 a	0.4 a	4.2 a	4.2 a
F-test	**	**	**	**	**	**	**	**

Values having a similar alphabetical letter, within a comparable group of means, are not significantly different, using revised L.S.D test at 0.05 level

Table 7. Effect of bio-organic fertilizer and nitrogen fertilizer levels interaction on yield and its components on cantaloupe plants in 2013 and 2014 seasons

Treatments		No. of fruits plot^{-1}		Early yield Kg plot^{-1}		Total yield Kg plot^{-1}		Fruit weight (g)		Fruit length (g)		Fruit diameter (cm)		T.S.S (%)		Fruit firmness (lb/inch^2)		Seed weight (g) fruit^{-1}	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Cyano. extract	25	56.0 i	59.0 i	18.6 j	21.2 j	93.1 j	102.6 i	1662.5 j	1737.5 h	24.8 h	25.0 h	8.8 g	9.0 f	6.8 i	7.0 g	5.0 f	5.1 i	12.9 i	13.1 i
	50	70.5 e	72.5 ef	38.0 f	40.1 f	135.7 f	143.2 e	1925.0 f	1975.0 e	27.2 e	27.4 ef	9.4 de	9.4 de	8.4 f	9.2 d	5.8 de	5.9 e	16.0 f	16.1 f
	100	71.8 de	73.5 e	39.4 e	41.7 e	140.8 e	148.8 e	1962.5 e	2025.0 d	27.7 d	27.9 de	9.5 d	9.7 cd	8.8 e	9.3 d	5.9 cd	6.0 d	16.9 e	17.0 e
Compost-tea	25	60.3 h	63.3 h	21.2 i	23.4 i	106.2 i	117.2 h	1762.5 i	1875.0 g	25.8 g	26.5 g	9.1 f	9.3 ef	7.3 h	8.1 f	5.2 f	5.4 h	14.2 h	14.8 h
	50	74.0 d	78.0 d	42.0 d	45.6 d	149.8 d	162.8 d	2025.0 d	2087.5 c	28.0 cd	28.2 cd	9.7 c	9.9 c	9.3 d	9.9 c	6.0 bc	6.2 c	17.4 d	17.8 d
	100	78.0 c	80.5 c	45.3 c	48.7 c	161.8 c	174.1 c	2075.0 c	2162.5 b	28.1 c	28.5 c	10.0 b	10.3 b	9.8 c	10.4 d	6.2 b	6.3 b	18.0 c	18.4 c
Cyano. extract +	25	63.3 g	65.5 g	26.5 h	28.6 h	115.4 h	124.5 g	1825.0 h	1900.0fg	26.5 f	26.9 fg	9.1 f	9.3 e	7.8 g	8.3 f	5.5 e	5.6 g	14.8 g	15.3 g
Comp.-tea	50	81.8 b	85.0 b	51.8 b	55.8 b	172.7 b	185.9 b	2112.5 b	2187.5 b	28.9 b	29.4 b	10.1 b	10.4 b	10.1 b	10.2 b	6.6 a	6.8 a	19.2 b	19.4 b
	100	84.8 a	89.3 a	54.3 a	60.9 a	180.9 a	203.1 a	2162.5 a	2275.0 a	29.4 a	29.9 a	10.7 a	11.0 a	10.9 a	11.1 a	6.5 a	6.9 a	19.8 a	20.3 a
Control	25	67.8 f	71.0 f	34.3 g	36.9 g	127.0 g	136.7 f	1875.0 g	1925.0 f	27.0 e	27.4 ef	9.2 ef	9.4 e	8.3 f	8.8 e	5.6 e	5.8 f	15.7 f	16.1 f
	50	67.8 f	71.0 f	34.3 g	36.9 g	127.0 g	136.7 f	1875.0 g	1925.0 f	27.0 e	27.4 ef	9.2 ef	9.4 e	8.3 f	8.8 e	5.6 e	5.8 f	15.7 f	16.1 f
	100	67.8 f	71.0 f	34.3 g	36.9 g	127.0 g	136.7 f	1875.0 g	1925.0 f	27.0 e	27.4 ef	9.2 ef	9.4 e	8.3 f	8.8 e	5.6 e	5.8 f	15.7 f	16.1 f
F-test		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**

Values having a similar alphabetical letter, within a comparable group of means, are not significantly different, using revised L.S.D. test at 0.05 level

Table 8. Effect of bio-organic fertilizer and nitrogen fertilizer levels on chemical constituents of cantaloupe fruits in 2013 and 2014 seasons

Treatments		100 seed weight (g)		N%		P%		K%	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd
Cyano. extract	25	9.9 h	9.6 f	4.2 e	4.2 g	0.3 g	0.3 e	3.2 f	3.3 j
	50	11.6 e	11.3 de	4.8 bc	4.8 de	0.4 c-f	0.4 cd	4.1 cd	4.1 e
	100	11.8 de	12.1 c	5.0 ab	4.8 c-e	0.4 b-e	0.4 bc	4.2 bc	4.1 f
Compost-tea	25	10.8 g	11.1 e	4.4 de	4.4 fg	0.3 fg	0.3 de	3.8 f	3.5 i
	50	12.1 cd	12.1 c	4.9 bc	5.0 b-d	0.4 a-d	0.4 a-c	4.3 ab	4.2 d
	100	12.3 bc	12.6 b	5.0 a-c	5.4 bc	0.4 a-c	0.4 a-c	4.5 b-d	4.3 c
Cyano. extract + Comp.-tea	25	11.2 f	11.4 de	4.5 de	4.5 ef	0.3 e-g	0.3 de	3.6 e	3.8 h
	50	12.5 b	12.9 ab	5.0 ab	5.1 b	0.4 ab	0.4 ab	4.5 a	4.5 b
	100	12.9 a	13.1 a	5.3 a	5.4 a	0.4 a	0.5 a	4.5 a	4.6 a
Control	25	11.5 ef	11.7 d	4.6 cd	4.7 de	0.4 d- g	0.4 c-e	3.9 d	4.0 g
	50	11.5 ef	11.7 d	4.6 cd	4.7 de	0.4 d-g	0.4 c-e	3.9 d	4.0 g
	100	11.5 ef	11.7 d	4.6 cd	4.7 de	0.4 d-g	0.4 c-e	3.9 d	4.0 g
F-test		**	**	**	**	**	**	**	**

Values having a similar alphabetical letter, within a comparable group of means, are not significantly different, using revised L.S.D. test at 0.05 level

3.2 Fruit Yield and its Components

3.2.1 Effect of foliar application of bio-organic fertilizer

Data in Tables 5 and 6 showed that foliar application of cyanobacteria filtrate with compost tea, highly significantly, increased number of fruit plot^{-1}, early and total yield plot^{-1}, average fruit weight, fruit length and diameter, total soluble solids, fruit hardness, weight of 100-seeds and seeds nitrogen, phosphorus and potassium content over those obtained from control treatment, in both seasons.

Therefore, results obtained herein indicate enhancement of the metabolic activity via exploiting cyanobacteria filtrate + compost tea with their high nutrient value [19]. Therefore, activated compost tea 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 microelemenets, vitamins and phytohormones. Similar findings were reported by [18] on soybean and [21] on maize and [17,31] on soybean and [22] on Cucumber Plant. Foliar spraying of compost tea has shown some potential for controlling a number of diseases, due to the presence of some microorganisms or there metabolites acted as Plant Growth Promoting Rhizobacteria (PGPR) and / or as biocontrol agents [32].

Also, the presence of abundant microorganisms in compost and compost tea, besides their rule in nutrient and soil cycle and soil fertility, they provide and increased the expression of natural defensive mechanisms of plants against various types of pathogen [33].

3.2.2 Effect of nitrogen levels

Data recorded in Tables 5 and 6 indicated that nitrogen fertilization with 240 kg N ha^{-1} significantly increased number of fruit plot^{-1}, early and total yield plot^{-1}, average fruit weight, fruit length and diameter, total soluble solids, fruit hardness, weight of 100-seeds and seeds nitrogen, phosphorus and potassium content than those of the other fertilized treatments, in both seasons. The obtained increment in the fruit yield as a result of N application might be directly attributed to the increase of number of fruit number plot^{-1} and average fruit weight. These results seemed to be in accordance with those reported by [28] stated that pretreatment of *Vicia faba* with the extract of *Anabaena variabilis* induced an increase in germination percentage, root growth, seedling dry weight and soluble proteins as compared with untreated seeds. The stimulation effect of cyanobacteria on plant growth and seed yield might reflect on seed quality leading to an increase in germination percentage and subsequent seedling criteria [20].

3.2.3 Effect of bio-organic fertilizer spraying and nitrogen levels interaction

Tables 7 and 8 showed the comparisons among the various treatments combinations of bio-organic fertilizer spraying and nitrogen levels on fruit yield and its components of cantaloupe plants.

The comparisons among the mean values of each character indicated that foliar spray with cyanobacteria filtrate + compost tea + 240 kg N. ha^{-1} resulted in highly significant increases in number of fruit plot^{-1}, early and total yield plot^{-1}, average fruit weight, fruit length and diameter, total soluble solids and fruit hardness compared with those of all treatment combination which were treated with only one factor (Table 5) and the control treatment (without bio-organic fertilizer). Apparently, the using of bio-organic fertilizer and nitrogen levels application growth of cantaloupe plants which are reflected on the increased of total fruit yield and its components. These results are in the same line with those obtained by [34,20,35,36].

4. CONCLUSION

From our results, it could be suggested that using foliar spraying three times at 20, 35 and 50 days after sowing with cyanobacteria filtrate + compost tea under application of N rate up to 240 kg N ha^{-1} could be used for maximizing vegetative growth, fruit yield and its components of Cantaloupe (*Cucumis melo* L.) plants.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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