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Productivity Maximizing of Cucumber (*Cucumis sativus* L.) Through Optimized Use of compost and compost tea under Different rates of Mineral Fertilizers

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DURING the growing summers of 2020 and 2021, two field experiments were conducted at the Sakha Agric. Res. Station farm in Kafr El-Sheikh, Egypt to improve cucumber plant "hybrid Prince" vegetative growth, yield, and quality by using of organic soil amendments (compost) and foliar spray (compost tea), under different levels of mineral fertilizers. Cucumber plants were treated with T1: control (100 % NPK), T2: 100 % NPK + compost, T3: 75 % NPK + compost, and T4: 50 % NPK + compost, T5: 100 % NPK + foliar spray with compost tea, T6: 75 % NPK + foliar spray with compost tea, and T7: 50 % NPK + foliar spray with compost tea in a completely randomized block design with three replicates. Over the control plant (T1), the application of a combination treatment with 100 % NPK + compost (T2) as soil amendments and 75 % NPK + foliar spray with compost tea (T6) as a foliar spray resulted in significant increases in vegetative growth (leaf area (cm^2), leaves dry matter %, and number of female flowers/plant), fruit length (cm), fruit diameter (cm), early and total fruit yield (t fed^{-1}), and this was reflected on increased total soluble solids, N, P and K % in leaves as well as chlorophyll content. So that, 100 % NPK + soil amendments with compost and 75 % NPK + foliar spray with compost tea treatment had a superior effect to improve yield and quality of the cucumber plant. As a result, 100 % NPK + soil amendments with compost and 75 % NPK + foliar spray with compost tea treatment were found to have a superior influence on cucumber plant output and quality.

Keywords: Cucumber, Organic fertilizers, Vegetative growth, Yield, Qualit.

1. Introduction

Cucumber (*Cucumis sativus* L.) is a common member of the Cucurbitaceae family (Thoa, 1998). It is considered one of the oldest vegetables grown, with historical records dating back 5,000 years (Wehner and Guner, 2004). Nowadays, the globe has focused its emphasis on lowering the use of synthetic fertilizers and chemicals in crop production to reduce environmental pollution and human health implications. In addition, fertilizer application rates in intensive agricultural systems in Egypt have expanded considerably, particularly in greenhouse vegetable production systems (Abdrabbo et al. 2019). The use of organic fertilizer and irrigation is rising as a result of higher yields and revenue; nevertheless, the highest fertilizer inputs can lead to significant deterioration in soil and groundwater quality, and the systems are plainly unsustainable (Bisht and Chauhan, 2020). Excess mineral fertilizer use in agriculture can result in nitrate buildup in plants. For example, nitrate accumulation in editable plants and a portion of the nitrate consumed may be converted to nitrite, which causes methaemoglobinemia, or to carcinogenic nitrosamines (Moloantoa et al. 2022).
According to https://fount.aucegypt.edu/cgi/viewcontent.cgi?article=1017&context=etds, **E**gypt produces a large amount of agricultural residues reached to 2.5 million ton $year^{-1}$ and animal waste reached to 63

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million ton year^{-1} and mismanagement of organic wastes has had a negative influence on public health and the environment. These organic wastes are high in plant nutrients and can be used as a soil conditioner and nutrition source for plants with correct management, such as composting (Hossain et al. 2016).

Compost addition was found to improve soil fertility in terms of organic C and N content, permeability, plant accessible water capacity, and air-filled porosity in addition to increasing crop production (Mamo, et al. 1998; Keener, et al. 2000). Rady et al. (2016) showed that the validity and viability of sustained agronomic performance of common bean utilizing locally accessible recycled organic materials for making the researched compost was proved by the benefit of compost as a partial alternative to chemical fertilizers. Afifi et al. (2018) concluded that organic fertilizing (compost), with 4 tons fed^{-1} resulted in high growth, yield, and its components as well as quality of snap bean.

Compost tea has long been used in agriculture as a source of organic matter and soil amendments that provide mineral fertilizers and other benefits to plants. Compost tea, in modern terminology, is a compost extract made from fermented compost with water (Litterick et al., 2004). Because compost tea is high in soluble nutrients, it can be used to soak seeds or seedlings before to planting. It can be sprayed on plant foliage or irrigated into the soil. Compost tea is also high in phytohormones and hormone regulators. It encourages microorganisms that have a direct or indirect beneficial influence on the plant rhizosphere, as well as improving the physical and chemical qualities of the soil and suppressing the pathogens that cause various plant illnesses (Abbasi et al. 2002, Biocycle 2004 and Meshref et al. 2010). Omara et al. (2022) found that rice plants treated with compost tea had higher vegetative growth and physiological features compared to control plants. In addition, Osman et al. (2022) discovered that combining phosphate solubilizing bacteria and compost tea has a positive effect on sugar beet growth and quality in salt-affected soils.

The goal of this study was to examine if organic soil amendments (compost) and foliar sprays (compost tea) could boost cucumber plant growth, productivity, and fruit quality under various mineral fertilizer levels in the 2020 and 2021 seasons.

2. Materials and Methods

2.1. Field trials

Field trials were conducted in the Sakha Agric. Res. Station farm in Kafr El-Sheikh, Egypt, during the summer seasons of 2020 and 2021. The coordinates are 31° 05' 20.43" N and 30° 56' 9.29" E, with a height of 6 m above sea level. The goal of this study was to study the effect of organic soil amendments (compost) and foliar spray (compost tea) could improve cucumber plant growth, productivity, and fruit quality under different levels of mineral fertilizers. The following treatments were employed in a totally randomized block design with three replicates as shown in Table 1:

Table 1. Treatments used in the experimental site.

Symbol	Treatment
T1	Control (100% NPK),
T2	100% NPK + soil amendments with compost at the rate of 5 ton fed^{-1},
T3	75% NPK + soil amendments with compost at the rate of 5 ton fed^{-1},
T4	50% NPK + soil amendments with compost at the rate of 5 ton fed^{-1}
T5	100% NPK + foliar spray with compost tea with the rate of 60 L fed^{-1} at 30, 45 days from sowing,
T6	75% NPK + foliar spray with compost tea with the rate of 60 L fed^{-1} at 30, 45 days from sowing,
T7	50% NPK + foliar spray with compost tea with the rate of 60 L fed^{-1} at 30, 45 days from sowing.

The Agricultural Microbiology Department of the Sakha Agricultural Research Station in Kafr El-Sheikh, Egypt, provided compost and compost tea, which the physicochemical properties are shown in Table 2.

The soil in plots (soil amendment treatments) was mixed with compost at a depth of 20 cm before sowing. Cucumber seeds (*Cucumis sativus* cv. Prince Hybrid) originated in Alflah Alrayid company for Agricultural Service, Cairo, Egypt. Each plot (20 m^2) was sown by hand on September 10th in 2020 and September 15th in 2021 at a rate of 3 seeds per hole with 50 cm spacing in double rows with 0.9 m and 1.5 separated by 1.5 m unplanted distances.

During soil tillage (physicochemical properties are shown in Table 1), 47.5 kg P_2O_5/fed as 150 kg calcium super phosphate (15.5% P_2O_5), was added as one dose, whereas 100 kg N/fed as 250 kg ammonium sulphate (20.5% N), and 48 kg K_2O/fed as 100 kg potassium sulphate (48% K_2O), were added at three equal portions, during soil preparation, after 3 and 6 weeks from sowing the seeds.

Table 2. Some physicochemical properties of soil and irrigation water used.

	Particle size distribution				Chemical properties			Macroelements (mg Kg^{-1})		
Season	**Clay**	**Silt**	**Sand**	**Texture**	**pH**	**EC ($dS\ m^{-1}$)**	**O.M ($g\ Kg^{-1}$)**	**N**	**P**	**K**
2020	47.15	35.50	17.35	Clayey	7.93	3.67	15.5	8.11	7.98	369.00
2021	47.10	35.35	17.55	Clayey	7.91	4.03	16.3	8.29	8.58	398.10

Compost	**pH**	**EC**	**O.M (%)**	**O.C (%)**	**C:N ratio**	**N (%)**	**P (%)**	**K (%)**
	6.88	4.93	39.23	22.10	17	1.49	1.18	1.37

Compost tea	**pH**	**EC**	Macro-elements (mg L^{-1})			Microelements (mg L^{-1})			
			N	**P**	**K**	**Fe**	**Zn**	**Mn**	**Cu**
	6.6	2.81	116	47	138	12.34	7.18	3.39	1.59

EC: Electrical conductivity; **O.M**: Organic matter; **O.C**: Organic carbon.

2.2. Measurements

2.2.1. Vegetative growth

The leaf area (cm^2) of the sixth leaf from the main stem's meristemic top. Using the L1-3000-Portable Area Meter, USA, the area of ten plants of each treatment was determined. The dry matter in the leaves (%) and the number of female flowers per plant were also determined.

2.2.2. Chemical constituents

Sparks et al. (2020), described methods for determining total nitrogen, phosphorus, and potassium in the dry matter of leaves, respectively. In the felid, total chlorophyll was evaluated using a Minolta chlorophyll metre SPAD-502, Japan.

2.2.3. Fruit yield

Early yield (t fed^{-1}): The early yield per feddan was calculated by weighing the fruits of the first eight harvests from each treatment. To compute total yield per feddan (t/fed^{-1}), all fruits gathered from each treatment during the harvesting time were weighted.

2.2.4. Fruit quality

The average fruit weight (g), average fruit length (cm), and fruit diameter (cm) were taken at random from each treatment through 8 pickings to determine fruit quality. In addition, total soluble solids (TSS %) in fruit juice were assessed using a hand refractometer in accordance with A.O.A.C. (2000).

2.2.5. Economics estimation

All different costs were computed according to Egyptian local market pricing (LE) for the 2020 and 2021 seasons based on market prices and inputs utilized in cultivation. The total seasonal return was calculated by multiplying the production from different treatments by the cucumber fruit market price in Egypt. Furthermore, net seasonal return was estimated by subtracting total seasonal return from cultivation costs. By dividing the whole seasonal return by the cultivation costs, the benefit cost ratio was established.

2.2.6. Statistical analyses

According to Duncan's multiple range test **(**Duncan, 1955), treatment means were compared using (MSTAT–C, 1986).

3. Results and Discussion

3.1. Vegetative growth

Table 3 shows that during the two growing seasons, organic soil amendments (compost) and foliar sprays (compost tea) improved leaf area, leaves dry matter %, and the number of female flowers on cucumber plants. Through both growth seasons, soil additions with compost at a rate of 5 ton fed^{-1} +100 % NPK treatment (T2) achieved significant increases in these parameters, followed by soil amendments with compost at a rate of 5 ton fed^{-1} + 50 % NPK treatment (T4). On the other hand, foliar spray with compost tea + 75 % NPK, showed the greatest increases among all foliar spray treatments, with 92.00, 23.00, and 36.67 at the first season (2020) and 86.67, 22.00, and 32.67 at the second season (2021), respectively, compared to 68.67, 17.33, and 22.00 at season 2020 and 61.33, 15.33, and 18.00 at season 2021 for control treatment.

Table 3. Effect of organic soil amendments (compost) and foliar spray (compost tea) on vegetative growth characters (leaf area, leaves dry matter, and the number of female flowers) of cucumber plants during 2020 and 2021 seasons.

Treatments	2020 season			2021 season		
	LA (cm^2)	LDM (%)	No. female flowers plant^{-1}	LA (cm^2)	LDM (%)	No. female flowers plant^{-1}
T1	68.67 ± 1.15 f	17.33 ± 0.58 e	22.00 ± 2.00 g	61.33 ± 1.15 f	15.33 ± 0.58 f	18.00 ± 2.00 e
T2	97.33 ± 1.15 a	27.00 ± 1.00 a	39.33 ± 0.58 a	92.00 ± 1.00 a	25.67 ± 1.15 a	35.33 ± 0.58 a
T3	81.67 ± 2.89 c	21.67 ± 0.58 c	33.67 ± 1.15 d	76.67 ± 2.89 c	20.33 ± 0.58 cd	29.67 ± 0.58 c
T4	95.33 ± 0.58 a	25.00 ± 1.00 b	38.00 ± 1.00 b	90.67 ± 1.15 a	23.33 ± 1.15 b	32.67 ± 3.21 b
T5	76.00 ± 1.73 d	19.67 ± 0.58 d	32.33 ± 0.58 e	72.00 ± 2.65 d	18.33 ± 0.58 de	28.00 ± 1.00 c
T6	92.00 ± 2.00 b	23.00 ± 1.00 c	36.67 ± 1.15 c	86.67 ± 2.89 b	22.00 ± 1.00 bc	32.67 ± 1.15 b
T7	71.33 ± 1.15 e	18.00 ± 1.00 e	28.67 ± 1.15 f	66.00 ± 1.00 e	16.33 ± 2.08 ef	24.67 ± 1.15 d
L.S.D 5%	2.47	1.52	1.32	3.10	2.10	2.08

By DMRT, the means in a column followed by a common letter are not statistically different at the 5% level. Values are means ± standard deviation (SD) from 3 replicates. **LA**: Leaf area; **LDM**: Leaves dry matter;**T1**: control (100% NPK), **T2**: 100% NPK + soil amendments with compost, **T3**: 75% NPK + soil amendments with compost, **T4**: 50% NPK + soil amendments with compost, **T5**: 100% NPK + foliar spray with compost tea, **T6**: 75% NPK + foliar spray with compost tea, and **T7**: 50% NPK + foliar spray with compost tea.

Compared to untreated (control), the highest leaves dry matter and number of female flowers observed for treated cucumber plants, which indicated higher nutrient uptake, ultimately gave rise to a higher leaf area. Maximum light interception was evidently caused by a larger leaf area that is required for optimum light interception, and leads to enhanced photosynthesis and transpiration, resulting in increased production/yield due to increased assimilate translocation to the storage organ, i.e., fruit (Law-Ogbomo and Osaigbovo, 2018). These are in agreement with those results obtained by Mahmoud et al., (2009) they indicated that 75% mineral N + 25% organic N treatments can improve plant growth and yield of cucumber. In addition, Abou-El-Hassan et al. (2014) indicated that using 100% and 125% compost with addition of plant growth promoting rihzobacteria or compost tea increased significantly the vegetative growth, nutritional content of cucumber plants and compared to recommended dose of mineral fertilizer treatment. Also, Sallam et al. (2021) reported that T2 treatment (30 kg poultry manure+ 3 kg mineral fertilizer), could improve vegetative growth of cucumber under greenhouse conditions.

3.2. Chemical constituents

Throughout the two study seasons, organic soil amendments and foliar spray treatments resulted in consistent increases in chlorophyll levels (SPAD units), N, P, and K % over the control treatment (Fig.1). T2 treatment (100 % NPK + soil amendments with compost at a rate of 5 ton fed^{-1}) had the greatest effect over the other treatments, with chlorophyll, N, P, and K % reaching 43.33, 4.83, 0.83, and 4.95 in 2020 season, and 41.33, 4.48, 0.79, and 4.82 in 2021 season, respectively. Whereas, among foliar spray treatments, T6 (75 % NPK + foliar spray with compost tea) had the greatest values, with chlorophyll, N, P, and K % reaching 38.67, 4.07, 0.70, and 4.07 in the 2020 season, and 36.67, 3.75, 0.65, and 3.97 in the 2021 season, respectively (Fig.1).

Similarly, Masarirambi et al. (2010) found that lettuce plants treated with organic fertilizers had higher macro and micronutrient content than those cultivated with conventional fertilizers. These results could be attributed to the beneficial effects of compost and compost tea, which boost the availability of macro and micronutrients in plant-available form. This results are confirmed in cucumber plants (Hamma et al. 2012; Singh et al. 2018; Law-Ogbomo and Osaigbovo 2018; Sallam et al. 2021).

3.3. Total soluble sugar and fruit yield

Organic soil amendments and foliar spray treatments consistently increased total soluble sugar, early yeild, and total yield above the control treatment across the two study seasons (Table 4). Total soluble sugar (%), early yield, and total yield (t fed^{-1}) were higher in the T2 treatment (100 % NPK + soil amendments with compost at a rate of 5 ton fed^{-1}) reaching 4.95 , 5, and 16.03 in the 2020 season, and 4.78 , 4.81, and 15.29 in the 2021 season, respectively. On the other hand, T6 (75 % NPK + foliar spray with compost tea) had the highest values among foliar spray treatments, with total soluble

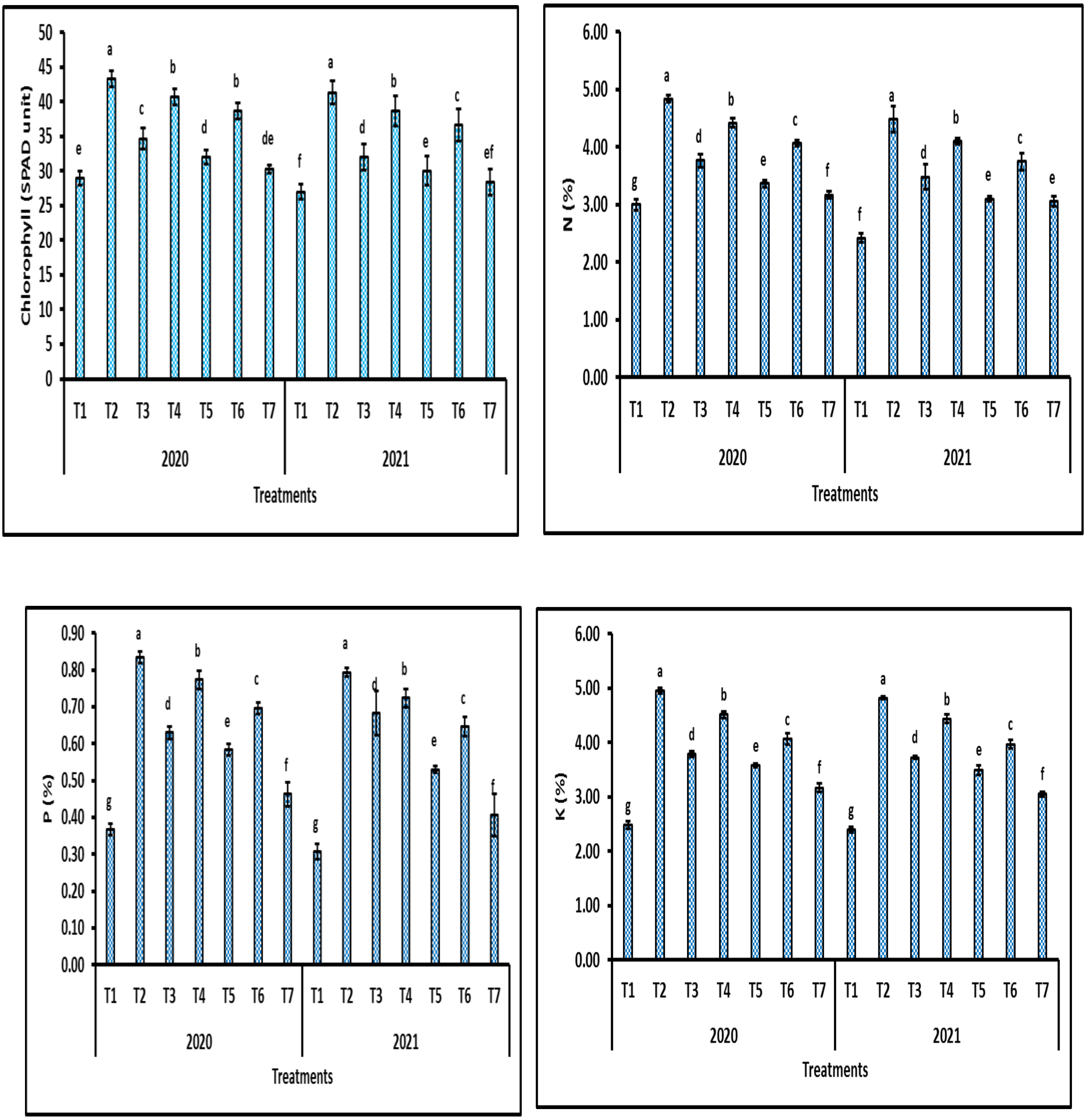

Fig. 1: Effect of organic soil amendments (compost) and foliar spray (compost tea) on chemical constituents characters (chlorophyll (SPAD units), N, P, and K %) of cucumber plants during 2020 and 2021 seasons. By DMRT, the means in a column followed by a common letter are not statistically different at the 5% level. Values are means ± standard deviation (SD) from 3 replicates. T1: control (100% NPK), T2: 100% NPK + soil amendments with compost, T3: 75% NPK + soil amendments with compost, T4: 50% NPK + soil amendments with compost, T5: 100% NPK + foliar spray with compost tea, T6: 75% NPK + foliar spray with compost tea, and T7: 50% NPK + foliar spray with compost tea.

Table 4. Effect of organic soil amendments (compost) and foliar spray (compost tea) on total soluble sugar and fruit yield (early and total) of cucumber plants during 2020 and 2021 seasons.

Treatments	2020 season			2021 season		
	TSS (%)	Early yield (t fed^{-1})	Total yield (t fed^{-1})	TSS (%)	Early yield (t fed^{-1})	Total yield (t fed^{-1})
T1	3.70 ± 0.13 e	3.14 ± 0.03 d	10.44 ± 0.07 g	3.58 ± 0.16 e	2.51 ± 0.18 d	9.42 ± 0.38 d
T2	4.95 ± 0.05 a	5.00 ± 0.08 a	16.03 ± 0.10 a	4.78 ± 0.06 a	4.81 ± 0.16 a	15.29 ± 0.16 a
T3	4.45 ± 0.05 c	4.44 ± 0.31 b	13.76 ± 0.05 d	4.28 ± 0.08 c	4.21 ± 0.31 b	12.54 ± 0.27 abc
T4	4.82 ± 0.08 a	4.94 ± 0.05 a	15.47 ± 0.09 b	4.68 ± 0.06 ab	4.68 ± 0.08 a	14.62 ± 0.34 ab
T5	4.22 ± 0.06 d	4.22 ± 0.10 b	12.37 ± 0.29 e	4.08 ± 0.03 d	4.02 ± 0.08 b	8.10 ± 5.86 cd
T6	4.65 ± 0.10 b	4.89 ± 0.05 a	14.44 ± 0.10 c	4.55 ± 0.05 b	4.63 ± 0.04 a	13.86 ± 0.56 ab
T7	4.12 ± 0.03 d	3.84 ± 0.07 c	11.55 ± 0.39 f	4.02 ± 0.03 d	3.61 ± 0.07 c	10.72 ± 0.24 bcd
L.S.D 5%	0.14	0.25	0.37	0.16	0.29	0.39

By DMRT, the means in a column followed by a common letter are not statistically different at the 5% level. Values are means ± standard deviation (SD) from 3 replicates. **T1**: control (100% NPK), **T2**: 100% NPK + soil amendments with compost, **T3**: 75% NPK + soil amendments with compost, **T4**: 50% NPK + soil amendments with compost, **T5**: 100% NPK + foliar spray with compost tea, **T6**: 75% NPK + foliar spray with compost tea, and **T7**: 50% NPK + foliar spray with compost tea.

sugar (%), early yield, and total yield (t fed^{-1}) reaching 4.65 , 4.89, and 14.44 in the 2020 season, and 4.55, 4.63, and 13.86 in the 2021 season, respectively (Table 4).

Abou-El-Hassan et al. (2014) showed that addition of compost tea to produce good yield of cucumber plants under sandy soil. Similarly, spray of fruit trees with compounds containing amino acids, plant phytohormones, humate, N, P, K and some microelements contribute in improving tree growth and yield **(**Eissa, 2003).

Abou-El-Hassan et al. (2014) demonstrated that adding compost tea to sandy soil resulted in a high yield of cucumber plants. Spraying fruit trees with substances including amino acids, plant phytohormones, humate, N, P, K, and some microelements, for example, helps to improve tree development and yield **(**Eissa, 2003). Furthermore, our findings matched those of a field experiment done to assess the impact of compost fertilizer combined with chemical fertilizer on different crops and production (El-Akhdar et al. 2018, Abdel-Rahman1 and Darwesh 2020, Elbaalawy et al. 2020, Omara et al. 2022).

3.4. Fruit quality

Organic soil amendments, foliar spray treatments, and their combinations with various levels of mineral fertilizers significantly boosted cucumber plant fruit quality (average fruit weight (g), average fruit length (cm), and fruit diameter (cm), as shown in Table 5. T2 treatment (100 % NPK + soil amendments with compost) produced the biggest and most significant gains above the control (T1) treatment. Average fruit weight, average fruit length, and average fruit diameter were 163.33 g, 15.17 cm, and 4.13 cm in the first growing season (2020), and 155.00 g, 14.63 cm, and 3.90 cm in the second growing season, respectively (Table 5). These findings could be explained as a result of the beneficial effects of compost and compost tea, which contain many macro and micro nutrients in available form, natural hormones, vitamins, and antioxidants that are available to plants and thus reflect on plant growth and composition **(**Abbasi et al., 2002, Biocycle, 2004, and Meshref et al., 2010), resulting in an increase in total yield of cucumber plants.

Abou-El-Hassan et al. (2014), showed that use the compost as organic fertilizer that has many advantages compared to inorganic fertilizer particularly in sandy soil such as conditioning effect, raising the cation exchange capacity, contributes to soil aggregation, favors tillage operations (plasticity and cohesion), increases water retention, greater stability temperature, improves nutrient availability, which are essentially required to plant growth. In addition, compost as an organic fertilizer has many advantages over inorganic fertilizers, according to Abou-El-Hassan et al. (2014), such as conditioning effect, increasing cation exchange capacity, contributing to soil aggregation, favoring tillage operations, increasing water retention, greater temperature stability, and improving nutrient availability, which are all essential for plant growth.

These results are confirmed in potato plants (Abdel Mouty et al. 2001), pea plants (EL-Etr et al. 2004), snap bean (Hafez and Mahmoud 2004), red lettuce plants (Masarirambi et al. 2010), cucumber (Law-Ogbomo and Osaigbovo 2018; Sallam et al. 2021).

Table 5. Effect of organic soil amendments (compost) and foliar spray (compost tea) on fruit quality (average fruit weight (g), average fruit length (cm), and fruit diameter (cm)) of cucumber plants during 2020 and 2021 seasons.

Treatments	2020 season			2021 season		
	Aver. Fruit weight (g)	Aver. Fruit length (cm)	Aver. Fruit diameter (cm)	Aver. Fruit weight (g)	Aver. Fruit length (cm)	Aver. Fruit diameter (cm)
T1	113.33 ± 5.77 f	10.93 ± 0.12 e	2.83 ± 0.06 g	105.00 ± 5.00 e	10.17 ± 0.29 e	2.40 ± 0.10 f
T2	163.33 ± 2.89 a	15.17 ± 0.29 a	4.13 ± 0.15 a	155.00 ± 5.00 a	14.63 ± 0.35 a	3.90 ± 0.10 a
T3	145.00 ± 5.00 c	12.70 ± 0.36 c	3.57 ± 0.06 d	138.33 ± 7.64 c	12.27 ± 0.46 c	3.37 ± 0.06 c
T4	158.33 ± 2.89 ab	14.87 ± 0.12 a	3.93 ± 0.06 b	150.00 ± 5.00 ab	14.03 ± 0.55 a	3.80 ± 0.10 a
T5	133.33 ± 5.77 d	11.83 ± 0.76 d	3.17 ± 0.06 e	125.00 ± 5.00 d	11.33 ± 0.29 d	3.07 ± 0.06 d
T6	151.67 ± 2.89 bc	13.53 ± 0.50 b	3.77 ± 0.06 c	141.67 ± 2.89 bc	13.27 ± 0.46 b	3.67 ± 0.06 b
T7	125.00 ± 5.00 e	11.10 ± 0.17 de	3.00 ± 0.10 f	118.33 ± 7.64 d	10.87 ± 0.23 d	2.87 ± 0.06 e
L.S.D 5%	7.60	0.74	0.16	10.77	0.63	0.12

By DMRT, the means in a column followed by a common letter are not statistically different at the 5% level. Values are means ± standard deviation (SD) from 3 replicates. **T1**: control (100% NPK), **T2**: 100% NPK + soil amendments with compost, **T3**: 75% NPK + soil amendments with compost, **T4**: 50% NPK + soil amendments with compost, **T5**: 100% NPK + foliar spray with compost tea, **T6**: 75% NPK + foliar spray with compost tea, and **T7**: 50% NPK + foliar spray with compost tea.

3.5 Economics estimation

Due to the use of different treatments of soil amendments and foliar spray under varied amounts of mineral fertilizers, the economics of cucumber production vary greatly (Table 6). The total cost of cucumber cultivation differed amongst the treatments. During the 2020 and 2021 seasons, the combined application of 100 % NPK + soil amendments with compost (T2) treatment produced the highest overall seasonal return, 56105 and 53515 LE fed^{-1}, respectively.

Similar findings was observed in net seasonal return, which arranged as follows: T2 > T4 > T6 > T3 > T5 > T7 > T1. Concerning benefit cost ratio (Table 5), the maximum values was recorded at T6 treatment (75% NPK + foliar spray with compost tea), which attained 3.32 in 2020 season, and 3.19 in 2021 season, compared to control and other studied treatments, respectively.

Table 6. Values of total seasonal costs (LE Fed^{-1}), total seasonal return (LE Fed^{-1}), net seasonal return (LE Fed^{-1}) and benefit cost ratio for cucumber plants during 2020 and 2021 seasons.

Treatment	Total seasonal costs (LE Fed^{-1})	Total seasonal return (LE Fed^{-1})	Net seasonal return (LE Fed^{-1})	Benefit Cost Ratio
		2020		
T1	15570	36540	20970	2.34
T2	19070	56105	37035	2.94
T3	18502.5	48160	29657.5	2.60
T4	17935	54145	36210	3.01
T5	15750	43295	27545	2.74
T6	15182.5	50540	35357.5	3.32
T7	14615	40425	25810	2.76
		2021		
T1	15570	32970	17400	2.11
T2	19070	53515	34445	2.80
T3	18502.5	43890	25387.5	2.37
T4	17935	51170	33235	2.85
T5	15750	28350	13167.5	1.8
T6	15182.5	48510	33327.5	3.19
T7	14615	37520	22905	2.56

T1: control (100% NPK), **T2**: 100% NPK + soil amendments with compost, **T3**: 75% NPK + soil amendments with compost, **T4**: 50% NPK + soil amendments with compost, **T5**: 100% NPK + foliar spray with compost tea, **T6**: 75% NPK + foliar spray with compost tea, and **T7**: 50% NPK + foliar spray with compost tea. Total seasonal costs according to the Egyptian local market price (LE); Chemical fertilizer (2270 LE fed^{-1} as 100% NPK); Compost (3500 LE); Compost tea (180 LE fed^{-1}); Seeds (6000 seeds fed^{-1}, 5000 LE); Soil preparation costs (800 LE); Labour wages and irrigation **(**2500 LE**);** Land rent for summer season (5000 LE) and seeds yield (3500 LE ton^{-1}).

4. Conclusion

Organic soil amendments (compost) and foliar sprays (compost tea) applied to cucumber plants demonstrated excellent and encouraging effects on their growth. According to the findings, 100 % NPK + soil amendments with compost and 75 % NPK + foliar spray with compost tea had a superior effect on vegetative growth characters and some chemical compounds of cucumber fruits, resulting in a higher total yield with the best quality of cucumber fruits. Under the experimental conditions, it is possible to conclude that the mixture is a more effective treatment for cucumber yield and quality than the other treatments.

5. Conflicts of interest

The authors declare that they have no competing interests.

6. Formatting of funding sources

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8. References

A.O.A.C. (2000). Official Methods of Analysis, the association of official agriculture chemists, 10th ed., Washington D.C., U.S.A.

Abbasi, P.A., Al-Dahmani, J., Sahin, F., Hoitink, H.A.J., Miller, S.A. (2002). Effect of compost amendments on disease severity and yield of tomato in conventional and organic production systems. Plant Dis., 86, 156-161.

Abdel-Mouty, M.M., Ali, A.H., Rizk, F.A. (2001). Potato yield as affected by the interaction between bio and organic fertilizers. Egypt J. Appl. Sci., 16(6): 267-286.

Abdelrahman, H.M., Darwesh, D.R. (2020). Effect of integrated fertilization with inorganic, organic fertilizers in presence of *Enterobacter ludwigii* local strain on growth, yield and fruit quality of Anna Apple Trees. Environment, Biodiversity and Soil Security, 4, 345-360.

Abdrabbo, M.A.A., Negm, A., Fath, H.E., Javadi, A. (2019). Greenhouse management and best practice in Egypt. *Int. Water Technol. Assoc*, *9*, 118-201.

Abou-El-Hassan, S., Abdrabbo, M.A., Desoky, A.H. (2014). Enhancing Organic Production of Cucumber by using Plant Growth Promoting Rhizobacteria and Compost Tea under Sandy Soil Condition. Research J. Agric. Bio. Sci., 10(2), 162-169

Afifi, S.T., Shalata, A.A.A., Kiera, R.M. (2018). Effect of compost rates and spraying with some biostimulant substances on growth, yield and quality of snap bean. *Journal of Plant Production*, *9*(7), 601-607.

Biocycle, (2004). Bulding a knowledge base for compost tea. J. Composting and Organic Recycling, June, 1-2.

Bisht, N., Chauhan, P.S. (2020). Excessive and disproportionate use of chemicals cause soil contamination and nutritional stress. *Soil Contamination-Threats and Sustainable Solutions*, 1-10.

Duncan, D.B. (1955). Multiple Range and Multiple F Tests. Biometrics, 11, 1–42.

Eissa, Fawzia, M. (2003). Effect of biostimulants on vegetative growth, yield and fruit quality of "Kelsey" Plum. Egypt. J. Appl. Sci., 18, 716-735.

El-Akhdar, I., Omara, A.E.D., Abdel-Rahman, M.A. (2018). Intergradation of different fertilizers for sustainable agriculture enhanced growth and yield of wheat (*Triticum aestivum* L.). Environment, Biodiversity and Soil Security, 2, 11-23.

Elbaalawy, A.M., Tantawy, M.F., El-Noamany, N.E. (2020). Maximizing Productivity of Peanut (Arachis hypogaea L.) Plants in Sandy Soils Using Environmental Safe Fertilizers. Environment, Biodiversity and Soil Security, 4, 167-179.

EL-Etr, W.T., Ali, L.K., EL-Khatib, M. (2004). Comparative effects of bio-compost and compost on growth yield and nutrients content of pea and wheat plants grown on sandy soils. Egyptian Journal of Agricultural Research, 82(2): 73-94.

Hafez, M.M., Mahmoud, A.R. (2004). Response of snap bean *Phaseolus vulgaris* L. to nitrogen fertilizer source. Annals of Agric. Sci., Mashtohor, 42(1): 261-270.

Hamma, I., Ibrahim, U., Haruna, M. (2012). Effect of poultry manure on the growth and yield of cucumber (*Cucumis sativum* L.) in Samaru, Zaria. Niger. J. Agric. Food Environ., 8, 94–98.

Hossain, M.Z., von Fragstein, P., Heß, J. and Heß, J. (2016). Plant origin wastes as soil conditioner and organic fertilizer: a review. *J. Agric. & Environ. Sci*, *16*(7), 1362-1371.

Keener, H.M., Dick, W.A., Hoitmk, H.A. (2000). Composting and beneficial utilization of composted by-products materials. In USA. Land application of agricultural, industrial and municipal by-products, SSS a Book series No. 6: 315-341.

Law-Ogbomo, K.E., Osaigbovo, A.U. (2018). Growth and yield responses of cucumber (*Cucumis sativum* L.) to different nitrogen levels of goat manure in the humid ultisols environment. Not. Sci. Biol. 2018, 10, 228–232.

Litterick, A.M., Harrier, L., Wallace, P., Waston, C.A., Wood, M. (2004). The role of uncomposted materials, compost, manures and compost extracts in reducing pests and diseases incidence and severity in sustainable temperate agricultural and horticultural crop production. Plant Science, 23(6): 453-479.

Mahmoud, E., Abd EL-Kader, N., Robin, P., Akkal-Corfini, N., Abd El-Rahman, L. (2009). Effects of different organic and inorganic fertilizers on cucumber yield and some soil properties. *World Journal of Agricultural Sciences*, *5*(4), pp.408-414.

Mamo, M., Rosen, C.J., Hallbach, T.R., Moncrief, J.F. (1998). Corn yield and nitrogen uptake in sandy soils amended with municipal solid waste compost. J. Pro. Agri., 11: 469-475.

Masarirambi, M.T., Hlawe, M.M., Oseni, O.T., Sibiya, T.E. (2010). Effects of organic fertilizers on growth, yield, quality and sensory evaluation of red lettuce (*Lactuca sativa* L.) Veneza Roxa. Agric. Biol. J. N. America, 1(6), 1319-1324.

Meshref, H.A., Rabie, M.H., El-Ghamry, A.M., El-Agamy, M.A. (2010). Maximizing utilization of compost addition using foliar compost extract and humic substances in alluvial soil. J. Soil Sci. and Agric. Engineering, Mansoura Univ., 1(9), 957-971.

Moloantoa, K.M., Khetsha, Z.P., Van Heerden, E., Castillo, J.C., Cason, E.D. (2022). Nitrate Water Contamination from Industrial Activities and Complete Denitrification as a Remediation Option. *Water*, *14*(5), 799.

Omara, A.E., Hadifa, A., Ali, D.F. (2022). The Integration Efficacy between Beneficial Bacteria and Compost Tea on Soil Biological Activities, Growth and Yield of Rice Under Drought Stress Conditions. Journal of Agricultural Chemistry and Biotechnology, 13(4), pp.39-49.

Osman, H.S., Rady, A., Awadalla, A., Omara, A.E.D., Hafez, E.M. (2022). Improving the antioxidants system, growth, and sugar beet quality subjected to long-term osmotic stress by phosphate solubilizing bacteria and compost tea. International Journal of Plant Production, 16(1), pp.119-135.

Rady, M.M., Semida, W.M., Hemida, K.A., Abdelhamid, M.T. (2016). The effect of compost on growth and yield of *Phaseolus vulgaris* plants grown under saline soil. *International Journal of Recycling of Organic Waste in Agriculture*, *5*(4), pp.311-321.

Sallam, B.N., Lu, T., Yu, H., Li, Q., Sarfraz, Z., Iqbal, M.S., Khan, S., Wang, H., Liu, P., Jiang, W. (2021). Productivity enhancement of cucumber (*Cucumis sativus* L.) through optimized use of poultry manure and mineral fertilizers under greenhouse cultivation. Horticulturae, 7(8), p.256.

Singh, M.C., Kachwaya, D.S., Kalsi, K. (2018). Soilless cucumber cultivation under protective structures in relation to irrigation coupled fertigation management, economic viability and potential benefits-a review. Int. J. Curr. Microbiol. Appl. Sci., 7, 2451–2468.

Sparks, D.L., Page, A.L., Helmke, P.A., Loeppert, R.H., editors. Methods of soil analysis, part 3: Chemical methods. John Wiley & Sons; 2020 Jan 22.

Thoa, D.K. (1998). Cucumber seed multiplication and characterization. AVRDC/ARC Training Thailand.

Wehner, T.C., Guner, N. (2004). Growth stage, flowering pattern, yield and harvest date prediction of four types of cucumber tested at 10 planting dates. Proc. xxvi IHC. Advances in Vegetable Breeding, J.D. Mc Creight and E.J. Ryder, (Ed.) Acta. Hort., 637, ISHS.