

DETERMINATION OF OPTIMAL DOSAGE APPLICATION OF COMPOST TEA FOR ENHANCED GROWTH AND YIELD OF SELECTED ARABLE CROPS.

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ABSTRACT

The study was conducted to determine the optimal compost tea dosage for improving growth and yield of selected arable crops. Five treatments were applied biweekly to Celosia, Cucumber, and Potato in a RCBD with three replications. Results showed significant differences ($P < 0.05$) in growth and yield, with treatment 1 (12.5 L compost tea + 12.5 L water) outperforming other treatments and the control. Highest values were recorded for number of leaves, plant height/vine length, stem girth, leaf biomass, leaf area, yield, and fruit diameter across the crops. Compost tea analysis revealed Ca as the dominant mineral (16.14 mg/kg), moderate N (0.27 mg/kg), and high microbial population (3.7×10^7 CFU/ml) dominated by *Bacillus* and *Pseudomonas spp.* The findings indicate that compost tea is effective, environmentally safe, reduces bulkiness associated with organic fertilizers, and caused no phytotoxic effects on the crops.

Keywords: Annual crops, Compost tea, Dosage, Growth, Yield.

INTRODUCTION

Compost tea is an affordable, sustainable and ecological method of effectively using nutrients from food waste that has been produced before and after consumption as well as vegetative waste from contemporary agriculture. It is an all-encompassing term for a nutrient- and microorganism-rich solution made by releasing compost nutrients and microbes into solution. It has recently been discovered that compost tea can inhibit a number of foliar diseases in addition to seed and root rot (Scheuerell and Mahaffee, 2004). The purpose of a compost tea can be tailored to its desired use. By improving the soil's ability to retain nutrients, the tea promotes plant growth. Fertilizer use can be reduced if the soil can hold onto its nutrients. A stronger, healthier plant results from increasing the nutrients available to the root system, compost tea helps lessen the harm that chemical-based fertilizers, pesticides, and herbicides do to the ecosystem's beneficial

microorganisms.

According to Ingham (2000), compost tea is often applied as a soil soaking or foliar spray. Compost tea contains nutrients that plants can absorb directly. Enhanced plant health from absorption of nutrients may lessen the requirement for additional chemical compounds to support plant growth (Ingham, 2005). The use of compost tea has also been shown to decrease several foliar diseases as well as seed and root rot (Scheuerell and Mahaffee 2002).

One of the primary determinants of crop quality in food production is the fertilization method (FAO, 2017). The soil's chemical and physical qualities are harmed, organic matter depletion increases, and soil textures change when poor fertilization methods are experienced (Abebe et al., 2017). Furthermore, these fertilizers might be costly and occasionally unavailable in the market. Given these realities, the public is becoming more and more worried about environmental risks, particularly those related to

health risks resulting from the careless use of agrochemicals and its high cost. Thus, many nations are considering organic agriculture as the most recognized cropping system among the possible methods of farming where compost is an integral component. However, utilizing compost on an expansive farm costs more than using inorganic fertilizer because it demands a lot of compost. Farmers are unable to determine the precise components of an organic fertilizer, the quantity of nutrients, and the right quantity of application required to address nutritional deficiencies. In light of this, the goal of this study is to determine the macro and micro nutrient, microbial load, ascertain the appropriate dosage of administration of compost tea for boosting the growth and output of specific annual crops, including sweet potatoes, cucumbers, and celosia.

2.0 Materials and Methods

2.1 Experimental Site

The Research Farm of Yaba College of Technology, Epe campus served as the site of the experiment. It is situated at latitude 6°35'N and longitude 3°59'E, with an elevation of 17 meters above sea level. The study area is renowned for growing vegetables, melons, maize and cassava, among other arable crops. With both rainy and dry season patterns, Epe has a tropical rain forest climate. The climate fluctuates with an opaque wet season and a slightly cloudy dry season. Rarely is the temperature lower than 67°F or higher than 94°F, it usually ranges between 73°F and 92°F.

2.2 Preparation of compost

The compost was prepared from organic materials such as weeds, chopped plant materials, both fresh and dried, cattle dung, poultry waste, ash and topsoil.

Site for the preparation of compost was under a shade. The compost was prepared based on the following steps:

- a. Four pits of 1m height were dug.
- b. Tillage of the soil was done to loosen it up.
- c. Fresh plant materials were cut to about 5cm length and bottom thickness of about 30cm, sprinkled with water.
- d. Dried plants such as leaves, as well as grasses were added up to 10cm to form the second layers.
- e. A partially decomposed cattle dung and poultry waste up to 2cm were added. The essence of this addition was to add nitrogen so as to stimulate micro-organisms, phosphate and other

nutrients.

- f. Wood ash which contains calcium and potassium was spread over the materials to regulating the ph.
- g. Green leguminous plants of about 15 – 20cm were added.
- h. Topsoil of about 2cm was spread to avoid the release of ammonia produced, temperature loss and plant nutrients increase in the pit.
- i. Adequate sprinkling of water was done on the whole pile.
- j. The steps from (e) to (j) were carried out until the pile was 1m high.
- k. Topsoil of about 5cm was used to cover the whole pit. Evaporation was prevented with the covering of the pile with dried banana leaves.
- l. A dried stick, with a pointed edge of about 2m long was inserted at the angle of the pile. This was done to check the moisture level and also act as a thermometer. After 2-3 days, decomposition started. When the stick was removed, it feels warm and moist. This stick was removed every 7 days to monitor warmth and moisture.
- m. Water is sprinkled every 3 – 5 days, depending on the weather condition.
- n. The pile was turned every 2 weeks to incorporate the different layers of the pile.
- o. After 4 months, the compost preparation was completed.

2.3 Compost tea preparation

1. The prepared compost was put in a jute bag 15% to 150 liters of water (water/volume).
2. The bag was hung in a plastic tank edge (Fig. 1) to ensure that the materials are properly immersed in the water. Such as a tea bag in a cup of hot water.
3. To allow for aeration, the water in the plastic was stirred at intervals using a wood.
4. Afterwards, the bag containing the solid compost was removed from the plastic container and returned to the compost pit.
5. The water in the plastic container turned caramel in colour.
6. The process was verified through the odour of the liquid (compost tea). The compost tea will produce a foul smell if the oxygen is not sufficient.



Fig 1: Compost in jute bag for compost tea preparation

2.4 Soil analysis, Preparation of Land and experimental Plots

Random samples of the soil were taken in the form of a zigzag, and each sample was gathered in a bucket. Using the quartering technique,

removal of the necessary amount of soil into a polythene bag was done. To estimate its different chemical qualities, a composite soil sample were collected and analyzed. Table 3 displays the findings.

The duration of the field experiment was 30 days for celosia, 60 days for cucumbers and 90 days for sweet potatoes (June-August, 2025). The soil was levelled and harrowed repeatedly to a fine tilt. Beds were constructed manually. Layout was created, as seen in figures 2 and 3.

2.5 Experimental Design and treatments

The total number of plots at each of the site was 15 and total area of the field was 10.0×10.0 m². The size of a plot was 1.88×2.4 m². The inter-block and inter-plot was at 0.5 m spacing. The experiment was laid out in randomized complete block design (RCBD) with five treatments and three replicates as in figure 2. The treatments were applied every two (2) weeks until maturity. The standard of mixture was 25 liters

T1 = 1:1 (12.5 liters of compost tea+12.5 liters of water)

T2 = 1: 2 (8.3 liters of compost tea+16.7 liters of water)

T3 = 1:3 (6.25liters of compost tea+18.75 liters of water)

T4 = 1:4 (5 liters of compost tea+20 liters of water)

T5 = Control (No application)

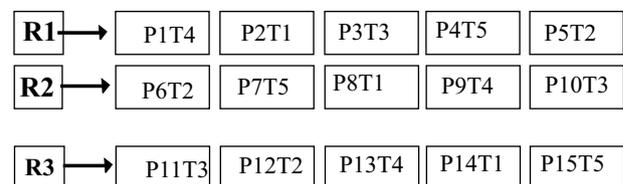


Figure 2: Field experimental Layout

2.6 Data Collection procedure

Four (4) stand of plants were randomly selected and tagged per plot for determination of growth and yield performance. The parameters determined were the number of leaves and vine length (cm) at 2, 4, 6 and 10 weeks after planting. Number of leaves were by visual counting, while vine length were determined using meter rule at the distance from the node close to the soil level to the terminal bud. At harvest, average weight of yield were taken using weighing scale as in Mayele and Abu, (2023).

2.7 Weed and water management

For the duration of the experiment, weeding was done on a regular basis with the primary goal of lowering crop competition with weeds. Due to rainfall breaks, the experiment location was manually irrigated every two (2) days while being continuously watched.

2.8 Statistical Analysis

The data collected from various parameters were subjected to analysis of variance (ANOVA) using SPSS (V.24) and means were compared at $P \leq 0.05$ as in Hidaka *et al.*, (2013). The results were displayed in tabular form.

3.0 Result and Discussion

3.1 Mineral composition of compost tea (Macro nutrient)

Table 1 indicates the macro-nutrients presents in the compost tea. The most significant macronutrient is nitrogen. It is needed in sufficient proportions since it is a necessary component of all proteins and enzymes (Street & Kidder, 1997), a crucial component of chlorophyll (Nursu'aidah *et al.*, 2014), and metabolic activities in energy transformation. For a liquid foliar or soil drench, a concentration of 0.27% as present in the compost tea produced, denotes a moderate nitrogen level. This quantity is adequate to supplement current soil nitrogen levels without being unduly high. Additionally, it can encourage the growth of lush green foliage in annual crops like tomatoes, lettuce, and maize. This is especially important for crops whose yield is influenced by leaf production.

Energy transfer (ATP), root development, and flowering/fruitlet processes all depend on phosphorus. To get a high crop production, phosphate is applied exogenously (Huang *et al.*, 2011). This compost tea with 5.20 mg/kg phosphorus content is advantageous, particularly in the early planting and reproductive stages. It will promote early seedlings and root establishment. In crops like tomatoes and cucumbers, it also promotes flowering and the development of seeds and fruits.

Enzyme activation in plant, water control, photosynthesis, and disease resistance are all significantly impacted by potassium. According to Jiang *et al.* (2018), potassium is essential for physiological functions such ATP synthesis, nutrition and water absorption, and growth in challenging conditions. Potassium, with a composition of 12.35 mg/kg as presented in table 1, is sufficient to satisfy the physiological requirements of annual crops during the stages of peak development and fruiting. Additionally, it can enhance the fruit quality of crops like okra and pepper.

Table 1 shows the calcium content of the compost (16.14 Mg/kg). Plant cell division, food absorption regulation, and cell wall formation all depend on calcium (Brady *et al.*, 2008). In the rapidly expanding tissues of annual crops, this level promotes consistent cell wall production, which is essential. Keeps diseases like pepper

and tomato blossom-end rot at bay. Enhances the structural integrity of green plants like lettuce and spinach as well.

Since magnesium is the main atom in chlorophyll, photosynthesis cannot occur without it (Ding *et al.*, 2008). Even if the value is low at 2.51 Mg/kg present in the compost, consistent application, especially when combined with other food sources, provides sufficient support. Photosynthetic activity and leaf greenness are important for annual crops like cucumbers and amaranths.

Table 1: Macro-Nutrient in compost tea

Macro-Nutrient	Value
Calcium (Ca) Mg/kg	16.14
Nitrogen (N) %	0.27
Phosphorous (P)	5.20
Mg/kg Potassium (K)	12.35
Mg/kg Magnesium	2.51

Source: Laboratory experiment, 2025

3.2 Mineral composition of compost tea (Micro nutrient)

Table 2 presents the micro-nutrients presents in the compost tea produced. Iron is necessary for plants to synthesize chlorophyll, maintain the structure of their chloroplasts, and perform other processes like respiration, photosynthetic activity, and DNA synthesis. Additionally, iron and the prosthetic group components of several enzymes trigger a variety of metabolic pathways (Rout & Sahoo, 2015). The compost tea's 7.41 mg/kg of iron is essential for photosynthesis and chlorophyll synthesis, both of which are necessary for robust leaf development and early vegetative growth. Adequate iron guarantees robust foliage for annual crops, particularly green vegetables and grains, which is crucial for the quick synthesis of carbohydrates and the buildup of biomass.

Zinc is essential for defense against plant diseases, cell membrane integrity, protein synthesis, pollen development, and increasing the amount of chlorophyll and antioxidants in plant tissue, according to a review by Rudani *et al.* (2018). Compost tea containing 1.53 mg/kg of zinc will contribute to early maturity and consistent development, two important goals in the production of annual crops.

Gad and Hasan (2013) assert that copper is a necessary heavy metal that plays an active role in photosynthesis. One of the most important natural resources is soil, and too much copper can degrade it. Even though the value of 0.12 mg/kg is low as presented in table 2, copper can promote reproductive growth, which is important for fruiting crops like peppers, tomatoes, and okra.

The photosystem II (PSII) water splitting protein is thought to contain manganese as a structural element. As stated by Diedrick (2010) and Millaleo *et al.* (2010), manganese was used to store and transport electrons to the center of the chlorophyll process. Its addition in compost tea helps to ensure balanced micronutrient nutrition during crucial growth phases, despite the low concentration of 0.09 mg/kg in table 2.

Table 2: Micro-Nutrient in compost tea

Micro-Nutrient	Value
Iron (Fe) mg/kg	7.41
Zinc (Zn) mg/kg	1.53
Copper (Cu) mg/kg	0.12
Manganese (Mn) mg/kg	0.09

Source: Laboratory experiment, 2025

3.3 Microbial load analysis of compost tea

The compost tea has a remarkably high microbial population, especially at the 10⁶ dilution with 3.7 x 10⁷ CFU/ml. This indicates a high concentration of advantageous microorganisms that can colonize the rhizosphere and plant surfaces. Compost tea contains beneficial bacteria including *Bacillus* and *Pseudomonas spp.* that increase nutrient availability and create phytohormones, which helps annual crops grow more quickly and healthily (Dubeikovskiy, Mordukhova, Kochetkov, Polikarpova & Boronin, 1993)

Pathogenic organisms may be competitively excluded from plant surfaces due to the high microbial population; this is referred to as competitive exclusion. Frequent application can improve nutrient cycling, particularly phosphate solubilisation and nitrogen fixation, by balancing the soil microorganisms.

Table 3: Microbial load of Compost Tea

S/N	Dilutions	Count per plate	Cfu/ml
1.	10 ₄	77	7.7X10 ₄
2.	10 ₆	37	3.7X10 ₇

Source: Laboratory experiment, 2025

3.4 Effect of treatment on the number of leaves at 2, 4 and 6 WAP

Table 3 shows the effect of different compost tea treatments on number of leaves in celosia, cucumber and potato at 2, 4, 6 and 8 weeks after planting (WAP). The result revealed a significant difference (P < 0.05) across treatments. At 2 WAP, the highest leaf number for celosia, cucumber, and potato was obtained under T₁ (6.00 ± 0.44, 7.35 ± 0.07 and 21.43 ± 0.47), while the lowest values were observed in T₅ (3.67 ± 0.44, 5.02 ± 0.07 and 5.33 ± 0.47). Similarly, at 6 WAP, T₁ produced the highest leaf numbers

across the three crops (30.67 ± 6.12; 53.88 ± 0.40 and 54.86 ± 0.35), while T₅ had the lowest values (12.00 ± 6.12; 22.24 ± 0.40 and 26.23 ± 0.35).

The results indicate that compost tea application significantly enhanced leaf production compared to the control. This agrees with earlier findings that organic soil amendments improve plant growth by supplying essential nutrients and enhancing microbial activity (Adebayo *et al.*, 2021). The superior performance of T₁ could be attributed to the higher concentration of compost tea, which likely increased the availability of macronutrients such as nitrogen, a key element for vegetative growth (Mishra and Sarkar, 2022). Previous studies have shown that organic liquid fertilizers like compost tea improve chlorophyll content and photosynthetic efficiency, leading to higher leaf proliferation (Amanullah and Khalid, 2018). The declining trend in leaf number with decreasing compost tea concentration (from T₁ to T₅) corroborates the report of Yusuf *et al.*, (2019), who observed similar responses in leafy vegetables treated with varying levels of organic fertilizers. This suggests that optimum compost tea concentration is essential for maximizing vegetative growth in crops.

Table 1: Effect of treatment on the number of leaves at 2, 4 and 6 WAP

Crop	Treatment	No. of Leaves (2 weeks)	No. of Leaves (4 weeks)	No. of Leaves (6 weeks)
Celosia	T ₁	6.00±0.44 ^a	8.67±1.09 ^{bc}	30.67±6.12 ^a
	T ₂	5.33±0.44 ^{ab}	8.00±1.09 ^{bc}	29.00±6.12 ^{ab}
	T ₃	5.00±0.44 ^{bc}	7.33±1.09 ^{bc}	20.67±6.12 ^{ab}
	T ₄	4.67±0.44 ^{bc}	6.00±1.09 ^c	15.33±6.12 ^{ab}
	T ₅	3.67±0.44 ^c	5.00±1.09 ^c	12.00±6.12 ^{ab}
Cucumber	T ₁	7.35±0.07 ^a	31.35±0.24 ^d	53.88±0.40 ^d
	T ₂	7.04±0.07 ^a	29.24±0.24 ^d	50.24±0.40 ^d
	T ₃	6.98±0.07 ^b	25.34±0.24 ^d	45.77±0.40 ^b
	T ₄	6.95±0.07 ^b	24.44±0.24 ^d	43.24±0.40 ^b
	T ₅	5.02±0.07 ^c	11.45±0.24 ^d	22.24±0.40 ^b
Potato	T ₁	21.43 ± 0.47 ^a	34.33 ± 0.83 ^d	54.86 ± 0.35 ^d
	T ₂	16.66 ± 0.47 ^b	31.33 ± 0.83 ^d	49.98 ± 0.35 ^b
	T ₃	12.13 ± 0.47 ^c	30.50 ± 0.83 ^d	34.86 ± 0.35 ^b
	T ₄	10.22 ± 0.47 ^b	27.00 ± 0.83 ^d	33.53 ± 0.35 ^d
	T ₅	5.33 ± 0.47 ^d	22.24 ± 0.83 ^d	26.23 ± 0.35 ^d

Values represent least square means ± standard error. LS-means were separated using Tukey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P=0.05. T₁ = 1:1 (12.5 liters of compost tea+12.5 liters of water), T₂ = 1:2 (8.3 liters of compost tea+16.7 liters of water), T₃ = 1:3 (6.25 liters of compost tea+18.75 liters of water), T₄ = 1:4 (5 liters of compost tea+20 liters of water), T₅ = Control (No application).

3.5 Effect of treatment on the plant height/vine length at 2, 4 and 6 WAP

The effect of compost tea on plant height and vine length followed a similar trend to leaf number. T₁ consistently produced the tallest plants, with cucumber having the value (202.24 ± 4.25 cm) at 6 WAP compared to (109.77 ± 4.25 cm) in the control. Celosia and potato also showed significant (P < 0.05) height increases under T₁ (11.20 ± 1.81 cm and 53.56 ± 0.52 cm, respectively) compared to T₅ (6.10 ± 1.81 cm and 24.58 ± 0.52 cm), indicating that liquid organic fertilizer positively affects cell elongation and vegetative vigor. These findings agree with Yusuf *et al.*, (2019), who reported that liquid organic fertilizers enhance root development and nutrient uptake, leading to improved plant above-ground

vegetative growth.

Table 2: Effect of treatment on the plant height/vine length at 2, 4 and 6 WAP

Crop	Treatment	Plant height / Vine length (2 weeks)	Plant height / Vine length (4 weeks)	Plant height / Vine length (6 weeks)
Celosia	T ₁	5.00±0.50 ^a	9.00±1.08 ^a	11.20±1.81 ^a
	T ₂	4.97±0.50 ^a	8.00±1.09 ^{ab}	10.40±1.81 ^a
	T ₃	3.70±0.50 ^{ab}	6.67±1.08 ^b	8.47±1.81 ^a
	T ₄	3.37±0.50 ^{ab}	6.50±1.08 ^b	7.97±1.81 ^a
	T ₅	2.57±0.50 ^b	2.27±1.08 ^c	6.10±1.81 ^a
Cucumber	T ₁	29.56±1.14 ^a	43.56±1.77 ^a	202.24±4.25 ^a
	T ₂	27.24±1.14 ^a	42.65±1.77 ^a	197.25±4.25 ^{ab}
	T ₃	25.46±1.14 ^{ab}	38.45±1.77 ^{ab}	186.21±4.25 ^b
	T ₄	23.48±1.14 ^{ab}	37.66±1.77 ^{ab}	180.24±4.25 ^b
	T ₅	11.24±1.14 ^b	20.14±1.77 ^b	109.77±4.25 ^b
Potato	T ₁	10.23 ± 0.20 ^a	36.86 ± 0.58 ^a	53.56 ± 0.52 ^a
	T ₂	9.88 ± 0.20 ^a	33.55 ± 0.58 ^a	50.55 ± 0.52 ^a
	T ₃	7.66 ± 0.20 ^b	26.26 ± 0.58 ^b	32.46 ± 0.52 ^b
	T ₄	7.44 ± 0.20 ^b	24.73 ± 0.58 ^b	31.70 ± 0.52 ^b
	T ₅	4.43 ± 0.20 ^c	14.16 ± 0.58 ^c	24.58 ± 0.52 ^b

Values represent least square means ± standard error. LS-means were separated using Tukey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P=0.05. T₁= 1:1 (12.5 liters of compost tea+12.5 liters of water), T₂= 1:2 (8.3 liters of compost tea+16.7 liters of water), T₃= 1:3 (6.25 liters of compost tea+18.75 liters of water), T₄= 1:4 (5 liters of compost tea+20 liters of water), T₅= Control (No application).

3.6 Effect of treatment on leaf area at 2, 4 and 6 WAP

Leaf area developed with increasing compost tea concentration. At 6 WAP, T₁ recorded the largest leaf areas for all crops: 25.49±4.95 cm² in celosia, 32.25±6.14 cm² in cucumber, and 57.24±0.58 cm² in potato, while T₅ had the least values (7.65±4.95 cm², 16.23±6.14 cm², and 28.88±0.58 cm², respectively).. Larger leaf area enhances light interception and photosynthetic efficiency, crucial for biomass production and yield (Amanullah and Khalid, 2018). Similar studies by Iwuagwu *et al.*, (2020) emphasized that liquid organic fertilizers improve leaf expansion by providing readily available nutrients and beneficial soil microbes.

Table 3: Effect of treatment on leaf area at 2, 4 and 6 WAP

Crop	Treatment	Leaf area (2 weeks)	Leaf area (4 weeks)	Leaf area (6 weeks)
Celosia	T ₁	1.94±0.37 ^a	13.23±1.87 ^a	25.49±4.95 ^a
	T ₂	1.79±0.37 ^{ab}	10.20±1.08 ^{ab}	23.07±4.95 ^a
	T ₃	1.56±0.37 ^{bc}	8.22±1.87 ^{ab}	18.87±4.95 ^{ab}
	T ₄	0.98±0.37 ^{bc}	6.80±1.87 ^{ab}	11.91±4.95 ^{bc}
	T ₅	0.38±0.37 ^c	4.58±1.87 ^b	7.65±4.95 ^c
Cucumber	T ₁	17.56±1.53 ^a	20.24±3.52 ^a	32.25±6.14 ^a
	T ₂	17.22±1.53 ^a	19.88±3.52 ^a	27.24±6.14 ^a
	T ₃	15.42±1.53 ^b	17.88±3.52 ^b	23.24±6.14 ^b
	T ₄	15.11±1.53 ^b	17.24±3.52 ^b	22.42±6.14 ^b
	T ₅	8.88±1.53 ^c	13.22±3.52 ^b	16.23±6.14 ^b
Potato	T ₁	29.43 ± 0.20 ^a	46.03 ± 0.56 ^a	57.24 ± 0.58 ^a
	T ₂	25.48 ± 0.20 ^a	40.22 ± 0.56 ^a	47.96 ± 0.58 ^b
	T ₃	15.10 ± 0.20 ^b	30.53 ± 0.58 ^b	40.48 ± 0.58 ^b
	T ₄	12.03 ± 0.20 ^b	29.22 ± 0.58 ^b	36.55 ± 0.58 ^c
	T ₅	0.13 ± 0.20 ^c	21.60 ± 0.58 ^c	28.88 ± 0.58 ^c

Values represent least square means ± standard error. LS-means were separated using Tukey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P=0.05. T₁= 1:1 (12.5 liters of compost tea+12.5 liters of water), T₂= 1:2 (8.3 liters of compost tea+16.7 liters of water), T₃= 1:3 (6.25 liters of compost tea+18.75 liters of water), T₄= 1:4 (5 liters of compost tea+20 liters of water), T₅= Control (No application).

3.7 Effect of treatment on stem girth at 2, 4 and 6 WAP

Stem girth increased significantly (P < 0.05) under compost tea treatments, with T₁ consistently recording the highest values. At 6

WAP, cucumber plants under T₁ had the thickest stems (25.44±2.32 mm) compared to (13.33±2.32 mm) in the control. Similar patterns were observed in celosia (1.94±0.087 vs 1.37±0.087) and potato (1.08±0.02 vs 0.50±0.02). Thicker stems support enhanced water and nutrient transport, providing structural support for reproductive growth under high nutrient demand (Mishra and Sarkar, 2022). Similar improvements in stem girth under organic fertilizer treatments were reported by Yusuf *et al.*, (2019), linking it to better plant vigor and resilience.

Table 4: Effect of treatment on stem girth at 2, 4 and 6 WAP

Crop	Treatment	Stem girth (2 weeks)	Stem girth (4 weeks)	Stem girth (6 weeks)
Celosia	T ₁	0.47±0.40 ^a	1.70±0.087 ^a	1.94±0.087 ^a
	T ₂	0.40±0.40 ^{ab}	1.57±0.087 ^{ab}	1.86±0.087 ^{ab}
	T ₃	0.37±0.40 ^{ab}	1.30±0.087 ^{bc}	1.63±0.087 ^{bc}
	T ₄	0.37±0.40 ^{ab}	1.27±0.087 ^c	1.45±0.087 ^c
	T ₅	0.30±0.40 ^c	1.20±0.087 ^c	1.37±0.087 ^c
Cucumber	T ₁	11.21±0.53 ^a	15.23±1.88 ^a	25.44±2.32 ^a
	T ₂	10.22±0.53 ^a	13.45±1.88 ^a	23.45±2.32 ^a
	T ₃	8.26±0.53 ^{ab}	10.24±1.88 ^b	22.22±2.32 ^{ab}
	T ₄	7.36±0.53 ^b	9.55±1.88 ^b	19.65±2.32 ^b
	T ₅	4.65±0.53 ^b	7.59±1.88 ^b	13.33±2.32 ^c
Potato	T ₁	0.53 ± 0.02 ^a	0.73 ± 0.03 ^a	1.08 ± 0.02 ^a
	T ₂	0.53 ± 0.02 ^a	0.60 ± 0.03 ^a	1.01 ± 0.02 ^a
	T ₃	0.43 ± 0.02 ^b	0.54 ± 0.03 ^b	0.73 ± 0.02 ^b
	T ₄	0.42 ± 0.02 ^b	0.50 ± 0.03 ^b	0.66 ± 0.02 ^b
	T ₅	0.30 ± 0.02 ^c	0.46 ± 0.03 ^c	0.50 ± 0.02 ^c

Values represent least square means ± standard error. LS-means were separated using Tukey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P=0.05. T₁= 1:1 (12.5 liters of compost tea+12.5 liters of water), T₂= 1:2 (8.3 liters of compost tea+16.7 liters of water), T₃= 1:3 (6.25 liters of compost tea+18.75 liters of water), T₄= 1:4 (5 liters of compost tea+20 liters of water), T₅= Control (No application).

3.8 Effect of treatment on the leaf weight of celosia

Compost tea significantly (P < 0.05) increased leaf biomass in celosia, with T₁ producing 186.24 g/plot (240 g/ha), while T₅ recorded only 50.24 g/plot (175 g/ha). Higher leaf weight reflects both greater leaf number and larger leaf size, indicating increased assimilate production, supporting reproductive processes and overall yield potential (Adebayo *et al.*, 2021). This agrees with Amanullah and Khalid (2018), who reported improved biomass accumulation under organic fertilizer regimes due to sustained nutrient release and enhanced soil health.

Table 5: Effect of treatment on the leaf weight of celosia

Treatment	Leaf weight (g/plot)	Leaf weight (g/ha)
T ₁	186.24±0.03 ^a	240±0.00 ^a
T ₂	154.66±0.03 ^{ab}	235±0.00 ^b
T ₃	131.26±0.03 ^{bc}	200±0.00 ^c
T ₄	120.35±0.03 ^c	195±0.00 ^d
T ₅	50.24±0.03 ^d	175±0.00 ^c

Values represent least square means ± standard error. LS-means were separated using Tukey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at

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P=0.05.. T₁= 1:1 (12.5 liters of compost tea+12.5 liters of water), T₂ = 1: 2 (8.3 liters of compost tea+16.7 liters of water), T₃ = 1:3 (6.25liters of compost tea+18.75 liters of water), T₄= 1:4 (5 liters of compost tea+20 liters of water), T₅ = Control (No application).

3.9 Effect of treatment on the yield parameters of cucumber

Yield components of cucumber responded strongly to compost tea treatments. T₁ produced the highest number of flowers (38.87±0.03), fruits (32.56±5.43), fruit weight (225.24±1.87 kg/plot), and fruit diameter (40.22±0.55 cm). In contrast, T₅ consistently recorded the lowest values for all parameters (number of flowers (18.06±0.03), fruits (13.19±5.43), fruit weight (77.24±1.87 kg/plot), and fruit diameter (17.55±0.55 cm)). This highlights the role of compost tea in enhancing both vegetative and reproductive growth stages. These findings align with Iwuagwu *et al.*, (2020), who attributed improved fruiting under organic fertilizer treatments to better nutrient availability, hormonal stimulation, and enhanced photosynthetic activities resulting in increased flowering and fruit set. The present findings confirm that optimal compost tea concentration promotes not only plant growth but also yield quality and quantity.

Table 6: Effect of treatment on the yield parameters of cucumber

Treatment	No. of flowers	No. of fruit	Fruit weight (kg/plot)	Fruit diameter (cm)
T ₁	38.87±0.03 ^a	32.56±5.43 ^a	225.24±1.87 ^a	40.22±0.55 ^a
T ₂	36.84±0.03 ^b	28.88±5.43 ^{ab}	200.56±1.87 ^{ab}	37.25±0.55 ^{ab}
T ₃	25.43±0.03 ^b	18.90±5.43 ^c	184.56±1.87 ^b	31.22±0.55 ^b
T ₄	24.32±0.03 ^b	18.44±5.43 ^c	182.22±1.87 ^b	30.54±0.55 ^b
T ₅	18.06±0.03 ^c	13.19±5.43 ^d	77.24±1.87 ^c	17.55±0.55 ^c

Values represent least square means ± standard error. LS-means were separated using Tukey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P=0.05. T₁ = 1:1 (12.5 liters of compost tea+12.5 liters of water), T₂ = 1: 2 (8.3 liters of compost tea+16.7 liters of water), T₃ = 1:3 (6.25liters of compost tea+18.75 liters of water), T₄= 1:4 (5 liters of compost tea+20 liters of water), T₅ = Control (No application).

3.10 Effect of treatment on the yield parameters of potato

Potato tuber number and weight followed the same trend as cucumber and celosia, with T₁ producing the highest values (8.77±1.33 tubers; 16.54±11.93 kg/plot) and T₅ the lowest values (4.00±1.33 tubers; 7.05±11.93 kg/plot). These results indicate that compost tea not only improves vegetative growth but also facilitates efficient translocation of assimilates from vegetative tissues to developing tubers, resulting in better tuber yield (Yusuf *et al.*, 2019).

Table 7: Effect of treatment on the yield parameters of potato

Treatment	No. of tubers	Tuber weight (kg/plot)
T ₁	8.77 ± 1.33 ^a	16.54 ± 11.93 ^a
T ₂	6.86 ± 1.33 ^b	14.44 ± 11.93 ^b
T ₃	6.15 ± 1.33 ^b	13.88 ± 11.93 ^b
T ₄	5.87 ± 1.33 ^c	10.11 ± 11.93 ^c
T ₅	4.00 ± 1.33 ^d	7.05 ± 11.93 ^c

Values represent least square means ± standard error. LS-means were separated using Tukey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P=0.05.. T₁= 1:1 (12.5 liters of compost tea+12.5 liters of water), T₂ = 1: 2 (8.3 liters of compost tea+16.7 liters of water), T₃ = 1:3 (6.25liters of compost tea+18.75 liters of water), T₄= 1:4 (5 liters of compost tea+20 liters of water), T₅ = Control (No application).

Overall, compost tea at a 1:1 concentration (T₁) consistently produced superior outcomes across all growth and yield parameters. Higher leaf numbers, larger leaf areas, thicker stems, and improved reproductive traits collectively contributed to better crop performance. These results strengthen the importance of organic liquid fertilizers as sustainable alternatives to chemical inputs, promoting soil health, crop vigor, and food security.

4.0 Conclusion

The findings of this study clearly shows that compost tea significantly promotes the growth and yield of annual crops such as celosia, cucumber, and sweet potato when applied at the right dosage. Across all growth parameters measured; leaf number, plant height, leaf area, stem girth, leaf biomass, and yield components. Plants treated with compost tea performed better than the control, with the 1:1 mixture (T₁) consistently producing the best results. This highlights the importance of compost tea not only as an affordable and sustainable alternative to inorganic fertilizers but also as an effective means of improving soil fertility, nutrient uptake, and crop productivity. The gradual decline in performance from T₁ to T₄ further underscores the need for optimum concentration in maximizing plant growth benefits. Beyond growth enhancement, the use of compost tea contributes to environmental sustainability by reducing dependence on chemical fertilizers, promoting healthier soils, and lowering production costs for farmers.

Therefore, it can be concluded that a 1:1 application rate of compost tea is the most effective dosage for enhancing the vegetative growth and yield of selected annual crops under the conditions of this study. Future research should, however, explore its long-term effects on soil health, crop quality, and economic returns across different agro-ecological zones to strengthen its adoption in sustainable crop production systems.

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