Enhancing tomato productivity using compost, plant, and poultry litter teas in the Sudan Savanna Ecology of Nigeria

M.I. SHEHU[1], E. A. SHITTU[*1], M.A. HUSSAINI[1], B.M. AUWALU[1]

[1] *Department of Agronomy, Bayero University Kano, Kano State, Nigeria*

[2] *National Cereals Research Institute, Badeggi, Niger State, Nigeria*

[*] *Corresponding author seabraham.agr@buk.edu.ng*

Received 13/12/2025
Accepted 10/02/2026

Abstract

The global demand for safe, healthful food is accelerating the shift toward organic farming systems that enhance crop productivity while protecting the environment and mitigating climate change. To support this transition, a field experiment was conducted to assess the effects of plant, compost, and poultry litter teas on the growth, yield, and fruit quality of tomato (Solanum lycopersicum) during the 2017/2018 dry season in the Sudan Savanna agroecological zone of Nigeria. The experiment was replicated three times and laid out in a randomized complete block design, with three manure teas applied at 100, 200, and 300 ml m^{-2}, alongside inorganic fertilizer and a no-fertilizer control. The application of inorganic fertilizer consistently produced the highest values across all parameters, including plant height (51.1 cm), leaf area (65.0 cm^2), chlorophyll content (SPAD 94.5), and total yield (21,291 kg ha^{-1}). Among organic amendments, the application of 300 ml m^{-2} compost tea was the most effective, significantly enhancing key traits such as plant height (58.2 cm), leaf area (58.2 cm^2), chlorophyll content (SPAD 84.4), fruit yield (16,001 kg ha^{-1}), and earliness to flowering (28 days). It also improved physiological metrics, fruit size, and Brix content (3.7-3.8%). Plant tea followed closely, while poultry litter tea had moderate effects compared to the no-fertilizer (control) that consistently gave the least performance across all parameters. These results affirm compost tea's potential as a sustainable, nutrient-efficient alternative to inorganic fertilizer for enhancing dry-season tomato production in semi-arid regions.

Keywords: Organic nutrient solution, Compost tea, Tomato productivity, Nutrient management, Dry-season agriculture

INTRODUCTION

Although the Green Revolution significantly boosted global food production, it came with unintended environmental consequences such as greenhouse gas emissions, nutrient leaching, reduced soil organic carbon, and biodiversity loss (Kirchmann *et al.,* 2016; Kumar *et al.,* 2022). The Food and Agriculture Organization (FAO) projects that agricultural output must increase by 60% by 2050 to meet the food demands of the growing population (Searchinger *et al.,* 2014). This challenge calls for a shift from input-intensive farming to sustainable practices that maintain high productivity while reducing environmental footprints.

In Nigeria's Sudan Savanna, a region characterized by erratic rainfall, degraded soils, and increasing input costs conventional farming systems heavily reliant on inorganic fertilizers and synthetic pesticides have exacerbated land degradation, reduced soil fertility, and imposed economic burdens on resource-limited farmers (Gamage *et al.,* 2023). As an alternative, organic soil amendments like compost and manure teas are gaining traction for their potential to improve nutrient cycling, microbial activity, and crop resilience (Eudoxie and Martin, 2019; Tarashkar *et al.,* 2023; Shittu, 2024; Shittu *et al.,* 2024).

Manure teas, including those made from compost, plant residues, and poultry litter, offer a low-cost, biodegradable, and nutrient-rich input that can be locally produced and applied via fertigation or foliar spray (Ye *et al.,* 2022; Shittu *et al.,* 2024). Their rapid decomposition in water enhances nutrient bioavailability, potentially improving physiological growth traits, yield, and fruit quality in crops like tomato (Ramírez-Gottfried *et al.,* 2023; Wei *et al.,* 2022). Manure teas are broadly defined as aqueous extracts of animal manures. To be classified as 'teas,' they must be prepared through water-based extraction methods such as soaking or steeping, which distinguishes them from compost slurries or raw manure applications. These teas are typically diluted with water before application to regulate nutrient concentrations for safe plant use. However, the terms 'manure teas' and 'manure extracts' are often used interchangeably in practice, a mislabeling that can obscure their differences in composition and agronomic effects (Shittu, 2024; Shittu *et al.,* 2024).

However, scientific evaluations comparing the efficacy of different manure teas under semi-arid conditions remain limited, especially for tomato production, a crop of high economic importance in Nigeria. From a theoretical standpoint, this study is underpinned by the Agroecological Theory, which promotes the use of biologically-based inputs to foster sustainable and climate-resilient farming systems (Altieri *et al.,* 2018). It also draws on the Nutrient Cycling Framework, which posits that plant productivity is closely tied to the efficiency of organic and inorganic nutrient sources in the soil–plant continuum (Cui *et al.,* 2022).

Therefore, the objective of this research is to evaluate the response of tomato to plant, compost, and poultry litter teas under dry-season conditions in the Sudan Savanna of Nigeria. Specifically, it aimed to assess the effects of these manure teas on physiological growth parameters, yield components, and fruit quality traits, with a view toward identifying effective and sustainable alternatives to inorganic fertilizer.

https://doi.org/10.5281/zenodo.18557515

MATERIALS AND METHODS

Field trials were conducted at two locations in the Sudan Savanna region of Nigeria: the Teaching and Research Farm of Bayero University, Kano (11°58.861'N, 8°31.177'E), and a community-based farm in Tafa Village, Jigawa State (12.450°N, 10.040°E). The experiment involved three manure teas (Compost, Plant, and Poultry Litter) applied at three rates (100, 200, and 300 ml m^{-2}), along with two controls (no fertilizer and recommended inorganic fertilizer). Treatments were arranged in a randomized complete block design (RCBD) with three replicates, totaling 33 plots per site. Each plot consisted of six rows (5 m long, 60 cm apart), with the two central rows excluding 50 cm at each end, used as net plots for harvest and yield assessments.

Soil samples were collected from both sites prior to planting using a zigzag pattern and an auger at a 0–30 cm depth. Physical and chemical properties were analyzed: particle size by hydrometer method, pH in water using a pH meter, organic carbon via the Walkley-Black method, total nitrogen by macro-Kjeldahl, available phosphorus using Bray and Kurtz I, and exchangeable bases via the ammonium saturation method.

Compost was produced using the Passively Aerated Windrow Method, maintaining a 30:1 carbon-to-nitrogen ratio with manure and maize stalks/grasses. The mixture was composted for six weeks in a polythene-covered pile (2 m high, 80 cm wide) with a perforated pipe for aeration. Fresh poultry litter was collected from beneath battery cages at the university poultry unit. Compost and poultry litter teas were prepared according to Ingham (2005). Ten kilograms of material were placed in jute bags, suspended in containers with 20 L of water, and supplemented with 1 L of molasses. The mixtures were stirred twice daily for the first week and once weekly for the next two weeks. After 21 days, the teas were diluted 2:1 (water:tea) before application.

Plant tea was made from 15 kg of shredded cowpea, cassava, and pumpkin leaves and branches, combined with 5 kg of cow dung and 0.5 kg of ash in a container filled to 200 L with water. The mixture was stirred daily for a week and then weekly for two more weeks, then diluted 2:1 before use. All teas were analyzed for nitrogen, phosphorus, and potassium content. Nitrogen was measured using the Kjeldahl method, phosphorus by Bray and Kurtz I, and potassium by the ammonium saturation technique.

Manure teas were applied weekly from three to eight Weeks After Transplanting (WAT). Inorganic fertilizer treatments followed the recommended rate of 125 kg N ha^{-1}, 50 kg P_2O_5 ha^{-1}, and 50 kg K_2O ha^{-1}. NPK 15:15:15 was applied at transplanting (50 kg each of N, P_2O_5, and K_2O), and the remaining 75 kg N ha^{-1} was supplied via urea at 3 and 8 WAT. The tomato variety used was UC 82B, an open-pollinated, determinate cultivar maturing 70–80 days after transplanting. It is adapted to dry-season cultivation and resistant to *Verticillium dahlia* and *Fusarium oxysporum*, with a spreading growth habit.

Seeds were sown on raised beds (120 cm wide, 25 cm high) in lines spaced 15 cm apart, covered gently, and mulched with straw until germination. The straw was removed after germination, and standard nursery management practices were followed for six weeks. Vigorous seedlings were transplanted into field plots at 0.6 m × 0.75 m spacing (intra- and inter-row, respectively). Each plot was tagged and labeled according to its treatment. Routine agronomic practices including weeding, pest and disease control were carried out as needed. Harvesting occurred at physiological maturity when fruit color began changing to red.

Data collection and analysis

Data were collected from randomly tagged plants within the net plots and included measurements of leaf area index, crop growth rate, relative growth rate, net assimilation rate, total dry matter per plant, mean fruit weight per plant, total number of marketable fruits per plant, fruit yield per hectare, and Brix content. Standard agronomic and laboratory procedures were used. Data were analyzed using analysis of variance in the JMP statistical software, and treatment means were separated using the Student-Newman-Keuls (SNK) test.

RESULTS AND DISCUSSION

Plant height (cm)

The influence of plant, compost, and poultry litter teas on tomato plant height at different growth stages of 4, 6, and 8 weeks after transplanting (WAT), and at harvest at two locations (BUK and Tafa), during the 2017/2018 dry season is shown in Table 1. Inorganic fertilizer consistently resulted in the tallest plants across all sampling stages and sites, peaking at 49.6 cm in BUK and 51.1

Table 1: Influence of Plant, Compost and Poultry litter Teas on Plant height of Tomato at BUK and Tafa during 2017/2018 dry season

Treatment	Weeks after transplanting (WAT)							
	4		6		8		Harvest	
	BUK	Tafa	BUK	Tafa	BUK	Tafa	BUK	Tafa
Inorganic fertilizer	16.4 a	16.7 a	28.1 a	30.1 a	39.4 a	40.2 a	49.6 a	51.1 a
Poultry Litter Tea (ml m^{-2})								
100	13.8 cd	14.6 d	7.8 cd	20.2 e	26.2 e	28.6 e	33.7 e	32.7 e
200	15.2 b	15.6 c	16.2 d	24.6 cd	27.8 de	29.2 d	34.8 de	34.6 de
300	15.8 b	13.0 de	19.4 c	26.2 bc	31.6 bc	32.7 c	41.2 b	38.2 c
Compost Tea (ml m^{-2})								
100	15.7 b	15.1 bc	18.6 c	23.0 d	28.0 d	32.4 c	37.0 cd	37.8 c
200	13.3 c	13.5 de	18.6 c	26.0 bc	29.6 cd	34.6 b	37.9 c	32.8 e
300	15.8 b	15.6 bc	22.5 b	27.4 b	32.8 b	35.5 b	42.7 b	39.2 bc
Plant Tea (ml m^{-2})								
100	14.4 c	16.2 b	16.2 d	20.4 e	29.4 cd	31.0 cd	36.2 d	36.8 cd
200	15.2 bc	11.1 e	18.4 c	24.2 d	28.8 d	28.4 e	36.4 d	36.4 d
300	16.2 ab	16.0 b	21.8 b	25.2 c	30.9 c	34.8 b	42.2 b	43.5 b
No fertilizer	11.5 e	15.0 cd	14.5 f	17.6 f	20.1 f	25.4 f	26.8 f	27.2 f
SE±	1.42	1.73	2.03	1.57	2.48	2.86	3.67	2.51

Means followed by the same letters are not significantly different at 5% of probability using SNK.

cm in Tafa at harvest. The rapid and balanced nutrient availability from synthetic fertilizers likely contributed to strong shoot elongation and cell expansion. Similar trends were reported by (Odueme *et al.*, 2019) who found that mineral fertilizer application significantly enhances vegetative growth and stem elongation in tomato.

Among organic liquid fertilizers, the application of compost tea at 300 ml m^{-2} achieved the greatest plant height, reaching 42.7 cm (BUK) and 39.2 cm (Tafa) at harvest. Height gains were especially noticeable from 6 WAT onward, suggesting a delayed but sustained nutrient release pattern. Compost tea's nutrient-rich composition, combined with microbial stimulation and improved soil structure, likely contributed to these outcomes (Ahmed *et al.,* 2023). These findings align with trials showing compost tea enhances root absorption efficiency and shoot growth over time.

Plant tea at 300 ml m^{-2} also performed well, with plant heights of 42.2 cm (BUK) and 43.5 cm (Tafa) at harvest. The mixture of cowpea, cassava, and pumpkin leaves may have provided moderate macronutrients and plant-growth-promoting compounds. This supports observations by (Mbuyisa *et al.*, 2024), who noted that leaf-based foliar teas can increase stem growth and leaf mass due to enhanced cytokinin activity and trace mineral input.

Poultry litter tea showed moderate results, with the 300 ml m^{-2} treatment producing 41.2 cm (BUK) and 38.2 cm (Tafa) at harvest. While richer in nitrogen than plant tea, its nutrient uptake may have been delayed or constrained due to its relatively lower microbial stimulatory effect or potential salt content (Chen *et al.,* 2024). Nonetheless, it consistently outperformed the control. The control (no fertilizer) yielded the shortest plants, with heights of 26.8 cm (BUK) and 27.2 cm (Tafa) at harvest, indicating nutrient deficiency and limited vegetative development.

Number of leaves per plant

Table 2 presents the effects of plant, compost, and poultry litter teas on the number of tomato leaves per plant of tomato at various growth stages (4, 6, and 8 weeks after transplanting [WAT], and at harvest) at BUK and Tafa during the 2017/2018 dry season.

The application of inorganic fertilizer consistently produced the highest number of leaves across all stages and locations, ranging from 12–13 leaves at 4 WAT to 48–54 leaves at harvest, indicating its superior ability to stimulate early and sustained vegetative growth. These results align with conventional knowledge that synthetic fertilizers offer immediate nutrient availability for rapid plant development.

Compost tea at 300 ml m^{-2} outperformed all organic treatments, particularly by 8 WAT and at harvest, where it resulted in 34–36 leaves at 8 WAT and 43–40 leaves at harvest in BUK and Tafa, respectively. These values are second only to those of inorganic fertilizer, underscoring compost tea's ability to support vigorous foliage development, especially at higher concentrations. This finding corroborates reports by Bali *et al.* (2021), who observed improved leaf formation and canopy expansion due to enhanced microbial activity and nutrient solubilization associated with compost tea.

Plant tea at 300 ml m^{-2} also produced competitive leaf numbers, particularly at later stages (35 leaves at 8 WAT and 40 at harvest in Tafa), suggesting its potential to improve vegetative performance, albeit slightly less effectively than compost tea. The moderate performance may stem from slower nutrient release and lower nutrient density compared to compost-based extracts.

Poultry litter tea on the other hand, showed modest gains in leaf production, with 300 ml m^{-2} yielding 30–34 leaves at 8 WAT and 38–28 leaves at harvest, placing it below both compost and plant teas in effectiveness. Despite poultry litter's nutrient richness, its relatively lower solubility and potential salt content may have limited its effectiveness in this context.

The control consistently recorded the lowest number of leaves, with values ranging from 5–9 at 4 WAT to 20–24 at harvest, affirming the essential role of nutrient supplementation for optimal tomato development. These results are consistent with findings by Wei *et al.* (2022), which highlight the limitations of nutrient-deficient soils in sustaining vegetative growth. Thus, the number of leaves is a key indicator of vegetative vigor, photosynthetic capacity, and overall plant health

Overall, compost tea at 300 ml m^{-2} demonstrated the strongest potential among organic treatments for enhancing leaf production, closely approximating the performance of inorganic fertilizer. Its superior nutrient profile

Table 2: Influence of Plant, Compost and Poultry litter Teas on Number of Leaves of Tomato at BUK and Tafa during 2017/2018 dry season

Treatment	Weeks after transplanting (WAT)							
	4		6		8		Harvest	
	BUK	Tafa	BUK	Tafa	BUK	Tafa	BUK	Tafa
Inorganic fertilizer	12 a	13 a	25 a	32 a	41 a	50 a	48 a	54 a
Poultry Litter Tea (ml m^{-2})								
100	6 de	7 d	12 e	16 f	23 c	29 d	32 e	33 e
200	8 c	7 d	10 e	17 c	24 de	28 e	31 e	35 d
300	7 d	8 c	14 d	19 cd	30 c	34 bc	38 c	28 c
Compost Tea (ml m^{-2})								
100	7 d	7 d	12 e	17 e	23 e	30 c	34 d	36 cd
200	8 c	8 c	13 de	18 d	25 d	31 c	28 f	36 cd
300	8 c	10 b	18 b	22 b	34 b	36 b	43 b	40 b
Plant Tea (ml m^{-2})								
100	7 d	7 d	12 e	17 c	25 d	32 c	34 d	35 d
200	7 d	7 d	13 de	17 c	24 de	30 c	35 d	36 d
300	9 b	9 bc	16 c	20 c	35 b	35 b	39 c	40 b
No fertilizer	5 e	5 e	9 f	11 g	18 f	20 f	20 g	24 f
SE±	0.63	0.55	0.72	0.38	0.49	0.76	0.98	0.81

Means followed by the same letters are not significantly different at 5% of probability using SNK.

and microbial stimulation capabilities likely contributed to increased nutrient uptake and chlorophyll content, leading to enhanced leaf initiation and expansion. This supports its recommendation as a sustainable input for promoting vegetative growth in tomato, particularly under the semi-arid conditions of the Sudan Savanna. The findings are further supported by recent literature showing that compost teas improve canopy architecture and nutrient assimilation in vegetable crops (Ramírez-Gottfried *et al*., 2023; Eudoxie and Martin, 2019).

Leaf area (cm²)

The influence of plant, compost, and poultry litter teas on leaf area (cm²) of tomato plants at BUK and Tafa across four sampling stages (4, 6, 8 WAT, and at harvest) during the 2017/2018 dry season is shown in Table 3. Results reveals that the application of inorganic fertilizer significantly produced the highest leaf area values at all stages and across both sites, peaking at 65 cm² at harvest in Tafa and 58.7 cm² at BUK. This result reflects the rapid availability and balanced supply of essential nutrients, especially nitrogen and potassium, which directly promote expansive leaf growth. Similar findings have been reported by Maida *et al*. (2021), who noted that synthetic fertilizer regimes significantly increase canopy size and photosynthetic surface in tomato.

Compost tea at 300 ml m^{-2} emerged as the most effective organic input, especially at harvest, achieving 49.9 cm² and 58.2 cm² in BUK and Tafa, respectively. These values were consistently higher than those from other organic treatments across all sampling periods, affirming compost tea's superior nutrient release and microbial stimulation capacity. This aligns with observations by Jafari *et al*. (2020), who found compost tea application to enhance cell division and leaf expansion due to increased phytohormone and mineral availability. Plant tea at 300 ml m^{-2} also showed strong performance, producing leaf areas of 45.4 cm² (BUK) and 57.3 cm² (Tafa) at harvest, closely matching the results of compost tea. The significant leaf area expansion with plant tea may be linked to the presence of bioactive compounds and trace minerals from leguminous and leafy materials, which improve vegetative vigor over time (Zehra *et al.,* 2022).

Poultry litter tea at 300 ml m^{-2} showed moderate effects, resulting in 42.2-58.0 cm² at harvest, which were lower than those of compost and plant teas but still substantially higher than the control. This reflects its relatively rich nutrient profile, albeit with limitations in microbial activity or solubility, as previously reported by Al-Mahdawi and Abbas (2019). The control treatment consistently had the smallest leaf areas, with values as low as 18.4 cm² (BUK) and 20.3 cm² (Tafa) at 4 WAT, and only reaching 29.5-33.3 cm² at harvest. These results highlight the critical need for nutrient supplementation to achieve optimal leaf development in tomatoes, especially under dry-season conditions.

Thus, leaf area is a vital indicator of photosynthetic efficiency and a proxy for overall crop vigor and biomass production. Overall, compost tea at 300 ml m^{-2} proved the most effective organic treatment for promoting leaf area expansion, followed closely by plant tea, particularly at later growth stages. These findings support the broader consensus that liquid organic amendments can substitute or complement synthetic fertilizers when applied at adequate concentrations and frequencies. The positive effects may be attributed to enhanced root uptake of nutrients, stimulation of beneficial rhizosphere microorganisms, and improved physiological functions in treated plants.

Chlorophyll content (SPAD)

Table 4 presents the influence of plant, compost, and poultry litter teas on the chlorophyll content (measured in SPAD units) of tomato leaves at BUK and Tafa during the 2017/2018 dry season. Results indicates that application of inorganic fertilizer significantly produced the highest SPAD readings across all sampling stages and locations, ranging from 65.2-73.4 at BUK and 62.6-93.7 at Tafa, with a peak of 94.5 at 8 WAT in Tafa. These values reflect the superior and rapid nitrogen availability in mineral fertilizers, which directly supports chlorophyll biosynthesis and leaf greenness. Similar outcomes were reported by Adeniyi *et al*. (2021), who observed enhanced chlorophyll development and photosynthetic capacity in tomatoes under inorganic fertilization.

Table 3: Influence of Plant, Compost and Poultry Litter Teas on Leave area (cm²) of Tomato at BUK and Tafa during 2017/2018 dry season

Treatment	Weeks after transplanting (WAT)							
	4		6		8		Harvest	
	BUK	Tafa	BUK	Tafa	BUK	Tafa	BUK	Tafa
Inorganic fertilizer	24.8 a	29.6 a	40.9 a	40.7 a	52.5 a	62.4 a	58.7 a	65 a
Poultry Litter Tea (ml m⁻²)								
100	21.7	25.0	26.5 f	30.4 d	31.6 f	43.2	35.6	54.1 d
200	20.5	25.6	30.3	31.3 cd	32.8 ef	45.0	33.8	56.3
300	20.5	27.6	34.9	34.4 c	38.4	48.6	42.2	58.0
Compost Tea (ml m⁻²)								
100	19.1 d	26.0 c	29.3 e	32.4 c	34.9 de	45.1 e	35.4 f	53.2 de
200	22.8 b	25.0 d	28.6 e	32.6 c	35.5 d	47.5 d	37.2 ef	54.0 d
300	24.5 e	28.0 b	35.7 bc	35.2 b	40.3 bc	52.4 b	49.9 b	58.2 b
Plant Tea (ml m⁻²)								
100	21.3 bc	25.2 d	36.2 b	31.4 cd	34.2 de	44.1 f	36.2 ef	52.4
200	21.0 bc	26.1 c	31.8 d	32.1 c	33.7	46.6 de	35.6	53.5 de
300	20.2 c	27.5 bc	36.5 b	35.3 b	41.6	48.6	45.4	57.3
No fertilizer	18.4 c	20.3 c	23.8 g	25.3 e	27.8 g	28.4	29. 5 h	33.3 f
SE±	2.81	3.67	2.98	3.53	2.10	2.882	3.08	3.67

Means followed by the same letters are not significantly different at 5% of probability using SNK.

Compost tea at 300 ml m^{-2} showed the highest SPAD values among organic treatments, reaching 75.4 at BUK and 84.4 at Tafa at harvest, and maintaining a consistently high chlorophyll index across growth stages. This suggests a strong capacity for sustained nitrogen release and improved leaf physiology. Studies by Khan *et al.* (2023) support this, indicating that compost teas enriched with microbial and humic substances can improve nitrogen assimilation and chlorophyll retention in crops.

Plant tea at 300 ml m^{-2} also produced high SPAD readings, notably 79.5–89.1 at 8 WAT, and 66.6–82.5 at harvest, closely mirroring compost tea performance. The presence of bioactive plant compounds may contribute to the stimulation of chlorophyll synthesis and maintenance of photosynthetic pigments, as observed in studies on foliar bio stimulants (Ramzan *et al.*, 2022).

Poultry litter tea at 300 ml m^{-2} had moderate effects, with SPAD values peaking at 75.8 (BUK) and 80.5 (Tafa) at 8 WAT, but trailing behind compost and plant teas at harvest. Its initial nutrient pulse may benefit early growth, though reduced late-season effectiveness could be linked to nutrient leaching or microbial competition (Elkholy *et al.*, 2018). The control (no fertilizer) produced the lowest chlorophyll content, declining to as low as 37.8 (BUK) and 52.1 (Tafa) at harvest, demonstrating nutrient deficiency stress. This outcome reinforces the critical role of nutrient input, particularly nitrogen, in maintaining leaf physiological function under dry-season stress conditions. Thus, chlorophyll content is a key physiological indicator of nitrogen status, photosynthetic efficiency, and overall plant health

Table 4: Influence of Plant, Compost and Poultry litter Teas on Leaf Chlorophyll content (SPAD) of Tomato at BUK and Tafa during 2017/2018 dry season

Treatment	Weeks after transplanting (WAT)							
	4		6		8		Harvest	
	BUK	Tafa	BUK	Tafa	BUK	Tafa	BUK	Tafa
Inorganic fertilizer	65.2 a	62.6 a	73.4 a	93.7 a	86.8 a	94.5 a	83.0 a	91.8 a
Poultry Litter Tea (ml m^{-2})								
100	53.1 b	43.7 f	53.9 f	51.4 f	68.0 e	80.7 e	50.2 f	72.9 f
200	47.7 c	44.5 f	65.9 c	56.3 e	68.7 e	81.2 e	66.2 e	73.7 f
300	46.1 d	51.3 c	65.1 d	63.4 c	75.8 c	75.8 c	55.1 e	80.5 d
Compost Tea (ml m^{-2})								
100	43.2 de	50.3 d	60.2 de	61.1 d	75.5 d	84.3 d	60.9 d	79.5 e
200	41.4 c	52.2 c	55.8 f	63.2 c	63.2 c	80.0 c	65.4 c	81.4 cd
300	50.1 c	55.2 b	71.1 b	66.0 b	66.0 b	90.3 b	75.4 b	84.4 b
Plant Tea (ml m^{-2})								
100	41.3 c	48.9 c	59.7 c	52.7 ef	73.1 d	80.4 e	53.7 ef	78.1 e
200	52.5 c	52.1 c	56.1 c	62.3 d	78.6 c	75.3 f	43.4 g	80.7 d
300	55.1 b	54.3 b	67.9 b	64.1 c	79.5 b	89.1 c	66.6 c	82.5 c
No fertilizer	45.8 d	30.9 g	50.0 g	41.7 g	49.8 f	50.6 g	37.8 h	52.1 g
SE±	2.17	2.21	3.51	1.83	3.22	3.91	2.38	2.19

Means followed by the same letters are not significantly different at 5% of probability using SNK.

Table 5: Influence of Plant, Compost and Poultry litter Teas on Number of days to 50% flowering, Number of fruits plant^{-1}, Fruit diameter, Total fruit weight plant^{-1} and Total yield of Tomato at BUK and Tafa during 2017/2018 dry season

Treatment	Days to 50 % flowering		Number of fruits plant^{-1}		Stem diameter (cm)		Fruit diameter (cm)		Fruit weight plant^{-1} (Kg)		Total yield (Kg ha^{-1})	
	BUK	Tafa	BUK	Tafa	BUK	Tafa	BUK	Tafa	BUK	Tafa	BUK	Tafa
Inorganic fertilizer	35 c	28 c	28 a	36 a	1.35	1.45	3.25 a	3.41 a	0.69 a	0.96 a	15 360 a	21,291a
Poultry Litter Tea (ml m^{-2})												
100	42 a	35 b	15 f	20 f	1.01	1.08	2.65 e	3.14 cd	0.369 d	0.519 f	8 200 e	11 533 e
200	42 a	35 b	15 f	21 f	1.06	1.15	2.69 e	3.02 d	0.373 d	0.566 e	8 290 c	12 581 de
300	40 c	35 b	17 d	24 c	1.13	1.22	2.78 c	3.15 c	0.422 bc	0.642 cd	9 380 c	14 270 c
Compost Tea (ml m^{-2})												
100	42 a	35 b	15 f	22 de	1.01	1.13	2.78 d	2.99 d	0.376 d	0.587 d	8 360 d	13 044 d
200	40 c	35 b	18 cd	23 d	1.07	1.19	2.89 c	3.07 d	0.449 c	0.619 d	9 980 bc	13 761 d
300	38 d	28 c	21 b	27 b	1.19	1.25	2.93 b	3.38 b	0.511 b	0.724 b	11 361 b	16 001 b
Plant Tea (ml m^{-2})												
100	42 a	35 a	16 e	21 e	0.99	1.12	2.63 e	3.13 c	0.395 d	0.562 e	8 780 d	12 491 de
200	42 a	35 a	16 e	22 de	1.05	1.17	2.82 c	3.18 c	0.402 c	0.590 d	8 931 d	13 111 d
300	41 b	28 b	19 c	25 c	1.12	1.27	2.94 b	3.25 bc	0.467 bc	0.665 c	10 381 bc	14 781 c
No fertilizer	42 a	42 a	9 g	11 g	0.69	0.72	2.20 f	2.56 e	0.226 e	0.297 g	5 020 f	6 600 f
SE±	0.0010	0.13	1.04	1.16	0.045	0.039	0.15	0.39	0.18	0.15	710	980

Means followed by the same letters are not significantly different at 5% of probability using SNK.

Yield and yield related characters

The influence of plant, compost, and poultry litter teas on key reproductive and yield parameters of tomato, including days to 50% flowering, number of fruits per plant, stem and fruit diameter, total fruit weight per plant, and overall yield at BUK and Tafa during the 2017/2018 dry season is displayed in Table 5. Results depicts that application of inorganic fertilizer consistently produced the most favorable results, leading to earliest flowering (28-35 days), highest fruit count (28-36 fruits plant^{-1}), widest fruit diameter (3.25-3.41 cm), and maximum total yield (15 360-21 291 kg ha^{-1}). These findings affirm the superior efficacy of synthetic fertilizers in delivering fast, uniform nutrient availability that supports rapid reproductive transition and fruit development. Comparable effects of mineral fertilization on early flowering and yield have been documented in controlled trials by Isitekhale *et al.* (2020).

Compost tea at 300 ml m^{-2} emerged as the most effective organic treatment, closely following inorganic fertilizer in most parameters. It significantly reduced days to 50% flowering (38 days at BUK, 28 at Tafa) and yielded 21-27 fruits per plant, with fruit diameters of 2.93-3.38 cm, and total yield reaching 11 361-16 001 kg ha^{-1}. This aligns with findings by Adekiya *et al.* (2022), who reported that compost tea enhances fruit initiation and yield by improving root activity, nutrient uptake, and hormonal signaling involved in flowering. Plant tea at 300 ml m^{-2} also showed strong performance, particularly in fruit diameter (2.94-3.25 cm) and fruit count (19–25 fruits plant^{-1}), yielding 10381-14 781 kg ha^{-1}. While its impact on flowering was less pronounced, it still outperformed poultry litter tea in terms of yield and fruit quality. The effectiveness of plant-based teas has been attributed to the presence of phytohormones, amino acids, and trace minerals, which enhance cell division and flowering processes (Ullah *et al.,* 2021).

Poultry litter tea had moderate effects, with the best outcomes observed at 300 ml m^{-2}. It resulted in 17–24 fruits per plant, fruit diameters up to 3.15 cm, and yields of 9380-14 270 kg ha^{-1}. Despite its rich nutrient composition, slower mineralization and potential salt accumulation may have limited its peak performance compared to compost tea (Mensah and Koomson, 2019).

The control (no fertilizer) recorded the poorest results across all parameters, with delayed flowering (42 days), lowest fruit count (9-11 plant^{-1}), smallest fruits (2.20-2.56 cm), and yields of only 5 020-6 600 kg ha^{-1}. These results underscore the necessity of nutrient supplementation for reproductive success and marketable yield in tomato, especially under dry-season stress. These traits are critical indicators of tomato productivity and economic return.

CONCLUSION

Compost tea at 300 ml m^{-2} significantly enhanced tomato growth, physiological efficiency, and yield, offering a reliable organic alternative to inorganic fertilizer. Its consistent performance across traits and sites affirms its potential for climate-resilient, input-efficient agriculture. We therefore recommend the use of 300 ml m^{-2} compost tea in dry-season tomato production systems to improve crop performance sustainably. Further studies should explore its integration with other bio-inputs and assess long-term soil health impacts under varied agroecological conditions.

REFERENCES

Adekiya A.O., Olaniran O.A., Adebiyi O.M. (2022). Effects of compost tea and biochar on growth, yield and soil fertility in tomato cultivation. *Archives of Agronomy and Soil Science*, 68: 1247-1260.

Adeniyi O.R., Daudu C., Abdulrahman A.A. (2021). Fertilizer regime and chlorophyll index response in tomato: Implications for nitrogen management. *Journal of Plant Sciences*, 9: 45-52.

Ahmed T., Noman M., Qi Y., Shahid M., Hussain S., Masood H.A., Xu L., Ali H.M., Negm S., El-Kott A.F., Yao Y., Qi X., Li B. (2023). Fertilization of Microbial Composts: A Technology for Improving Stress Resilience in Plants. *Plants*, 12: 3550.

Al-Mahdawi A.J., Abbas R.H. (2019). The effect of organic manure tea on growth and yield characteristics of tomato. *The Iraqi Journal of Agricultural Science,* 50: 1166-1174.

Altieri M.A., Nicholls C.I., Henao A., Lana M.A. (2018). Agroecology and the design of climate change-resilient farming systems. *Agronomy for Sustainable Development*, 35: 869-890.

Bali R., Pineault J., Chagnon P. L., Hijri M. (2021). Fresh compost tea application does not change rhizosphere soil bacterial community structure, and has no effects on soybean growth or yield. *Plants (Basel, Switzerland)*, 10: 1638.

Chen Q., Song Y., An Y., Lu Y., Zhong G. (2024). Soil microorganisms: Their role in enhancing crop nutrition and health. *Diversity*, 16: 734.

Cui S., Chen X., Lin J., Zhou Y. (2022). Organic inputs regulate microbial-driven soil organic carbon dynamics. *Soil Biology and Biochemistry*, 170: 108741.

Elkholy M.E., Mohamed F.M., Abdelwahab M.M. (2018). Effect of poultry manure tea and compost on vegetative growth and yield of tomato. *Annals of Agricultural Sciences*, 63: 233-241.

Eudoxie G., Martin C. (2019). Evaluating compost tea effects on tomato seedlings and soil biological activity. *Acta Horticulturae*, 1234: 211-216.

Gamage I.H., Jeyaruban M.G., Samarasinghe W.L.G. (2023). Organic amendments as a sustainable strategy to improve soil fertility and climate resilience. *Agricultural Systems*, 207: 103654.

Ingam E.R. (2005). The Compost Tea Brewing Manual. 5th Edition, Soil Food web Institute, Covalis. p. 91.

Isitekhale H.H.E., Akinyemi O., Ogbebor N.O. (2020). Response of tomato to nitrogen fertilization under tropical dry season conditions. *Nigerian Journal of Agricultural Sciences*, 18: 55-64.

Jafari M., Babajani A., Nikbakht A. (2020). Effect of compost tea on morphological traits and photosynthesis of greenhouse tomato. *Journal of Plant Nutrition*, 43: 420-430.

Khan A., Shah Z., Ali S. (2023). Role of compost and microbial biostimulants in enhancing leaf pigment concentration and productivity in tomatoes. *Sustainable Agriculture Research*, 12: 17-25.

Kirchmann H., Thorvaldsson G., Bergström L. (2016). Challenging targets for future agriculture. *European Journal of Agronomy*, 80: 3-16.

Kumar V., Yadav A.N., Saxena A.K. (2022). Microbiome dynamics in agroecosystems: Drivers, management strategies, and implications for sustainable agriculture. *Environmental Sustainability*, 5: 183-199.

Maida K.M., Ahmed A.A., Yahaya A. (2021). Comparative effects of organic and inorganic fertilizers on growth and leaf development of tomato. *African Journal of Horticultural Science*, 19: 15-23.

Mbuyisa S., Bertling I., Ngcobo B.L. (2024). Impact of foliar-applied plant extracts on growth, physiological and yield attributes of the potato (*Solanum tuberosum* L.). *Agronomy*, 14: 38.

Mensah J.K., Koomson C.K. (2019). Poultry manure tea as an organic fertilizer in tomato cultivation: Growth and yield response. *Ghana Journal of Horticulture*, 17: 12-20.

Odueme P.U., Bodunde J.G., Olasantan F.O., Adigun J.A. (2019). Growth and yield of three tomato (*Lycopersicon esculentum* Mill) varieties as affected fertilizer types. *Nigerian Journal of Horticultural Science*, 24:45-57.

Ramírez-Gottfried R., Ramos R., Hernández-Castro M. (2023). Comparative performance of compost and manure teas on growth and nutrient uptake of tomato plants. *Agronomy*, 13: 315.

Ramzan A., Javaid A., Bashir S. (2022). Plant-based teas as foliar biostimulants: Effects on chlorophyll synthesis and yield in tomato. *Horticultural Science and Technology*, 40: 789-798.

Searchinger T., Waite R., Hanson C., Ranganathan J. (2014). *Creating a sustainable food future*. World Resources Institute.

Shittu E.A. (2024). Correlation and regression analysis of cucumber (*Cucumis sativus* L) as affected by manure teas of different sources and rates in the Sudano-Sahelian ecology of Nigeria. *World Scientific News,* 198: 182-193.

Shittu E.A., Hussaini M.A., Garba A. (2024). Physiological growth characters, yield and quality response of cucumber (*Cucumis sativus* L.) as impacted by compost and horse manure teas (p. 153-157). *Proceedings of the 8th Annual Conference and 67th AGM-ABEOKUTA of The Association of Deans of Agriculture in Nigeria Universities (ADAN).*

Tarashkar R., Kale S., Mahadik P. (2023). Manure teas as biofertilizers: Physicochemical properties and impact on soil health and vegetable crops. *Journal of Environmental Management*, 337: 117697.

Ullah A., Yaqoob A., Raza A., Sultan T. (2021). Plant-based liquid fertilizers: A sustainable alternative to chemical fertilizers in vegetable production. *Environmental and Sustainability Indicators*, 11: 100145.

Wei Z., Yang T., Lin Q. (2022). Pathogen risks and microbial ecology of organic fertilizers: A review. *Science of The Total Environment*, 806: 150542.

Ye J., Wang Y., Kang J., Chen Y., Hong L., Li M., Jia Y., Wang Y., Jia X., Wu Z., Wang H. (2022). Effects of long-term use of organic fertilizer with different dosages on soil improvement, nitrogen transformation, tea yield and quality in acidified tea plantations. *Plants*, 12: 122.

Zehra A., Farooq M., Mehmood T. (2022). Bio-extracts and plant teas as foliar supplements: Impacts on crop physiology and sustainable yield improvement. *Sustainability in Agriculture*, 14: 7023.