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Vermichar Tea as Nutrient Supplement for Hydroponically-Grown Lettuce (*Lactuca sativa* L.)

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Abstract
Aim: The study aimed to evaluate the effect of vermichar tea as nutrient for hydroponically- grown lettuce (*Lactuca sativa* L.) using the Grand Rapid loose leaf variety.
Methodology: The plants were subjected to different formulated nutrient solutions by the use of Commercial Nutrient Solution, and Vermichar Tea. Three replications and a completely randomized design were used to set up the experiment.
Results: The vermichar tea used composed of 0.14% total Nitrogen, 0.07% total Phosphorus, and 0.86% total of Potassium. The fertilizer solutions' pH levels before transplanting and harvesting were same, but ten and twenty days after transplanting, notable variations were noted. The temperature of the nutrient solutions before transplanting, 20 days after transplanting, and at harvest were not affected by the vermichar tea, but they differed at the tenth day after transplanting. The total dissolved solids (TDS) and electrical conductivity (EC) were significantly affected before transplanting, 10 DAT, 20 DAT, and at harvest. The salinity of the nutrient solutions before transplanting 10 DAT and 20 DAT differed significantly, but there were no significant differences at harvest. Plant height at ten and 20 days after transplanting and at harvest, leaf area, plant weight, root length, and root weight were significantly affected by 30% CNS: 70% VT and 50% CNS: 50% VT. The sensory evaluation conducted with 50 panelists on the overall Acceptability Consumer Index (ACI) showed that the panelists liked 25% CNS: 75% VT which was the most accepted among the different treatments tested in terms of quality attributes such as taste, texture, color and general acceptability, and the overall ranking.
Conclusion: Based on the result of analysis, the nutrient solutions composed of 0.14% total of Nitrogen, 0.07% total of Phosphorus, and 0.86% total of Potassium. Based on the result of the study, the pH, electrical conductivity (EC), temperature, total soluble solids (TDS), and salinity of the nutrient solution were essential for maximizing the benefits of vermichar tea in hydroponic growing systems. The vermichar tea as nutrient solutions affects the pH at 10 and 20 DAT but not at harvest. The vermichar tea nutrient solutions affects the temperature only at 10 DAT but the TDS and EC were affected by the nutrient solutions before harvesting while the salinity was also affected by the nutrient solutions beforte transplanting but not at harvest. The use of vermichar tea as a nutrient solution in hydroponic lettuce production has a positive influence on the sensory qualities of the crop, including taste, texture, color, and general acceptability. The texture of the lettuce is also improved, with leaves exhibiting a crisper and fresher feel. In terms of color, vermichar tea promotes vibrant, rich green foliage, which is a key indicator of chlorophyll content and overall plant vitality. These improvements in taste, texture, and color make hydroponic lettuce grown with vermichar tea nutrient solution more appealing to consumers, leading to higher general acceptability.
Keywords: *biochar, hydroponic lettuce, vermicast, vermichar tea*

INTRODUCTION

Urbanization, natural disasters, climate change, and the careless use of pesticides and herbicides, which reduce soil fertility, are some of the issues facing soil-based agriculture. As an alternative, hydroponic farming is becoming more and more well-liked worldwide because of its effective management of natural resources and high-quality yields. In hydroponics, plants are cultivated in a soilless media consisting of a water and fertilizer solution that acts as a source of nutrients. It has been demonstrated that hydroponics is a great alternative crop production

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method. It is a very rigorous and demanding system that guarantees higher crop yields. To solve these problems and maintain food production to feed the world's expanding population, the practice of growing plants without soil as a planting medium was introduced.

Hydroponic systems, irrespective of their scale, reduce dependence on the soil as a substrate and instead derive nutrition directly from the hydroponic solution comprising water and nutrients. An optimized and well-balanced supply of nutrients is a prerequisite for efficient use of the resources by hydroponically grown vegetables, not only to ensure a high yield but also to guarantee the quality of the edible tissues. The nutrient solution applied depends on the stage of plant development; some elements in the nutrient solution were depleted more quickly than others, and as water evaporates from the nutrient solution, the fertilizer becomes more concentrated and can burn plant roots. In hydroponics, nutrient management is very important and must be done as highly efficiently as possible to improve productivity without harming the environment.

The proper fertilizer and balanced nutrient solutions were applied as part of nutrient management. Essential nutrients are dissolved in the right amounts and proportions in hydroponics to allow for normal plant growth. It is commonly recognized that the degree to which plants absorb nutrients from the growing media has a significant impact on the yield and quality of crops cultivated in hydroponic systems. Therefore, the most crucial elements influencing crop output and quality are the nutrient solution and its administration, which form the basis of an effective hydroponics system.

The amount of arable land is declining as a result of fast urbanization and industrialization, and traditional farming methods are also having a number of detrimental effects on the environment. Techniques for producing enough food must change in order to feed the world's expanding population in a sustainable manner. An alternative for sustainable production and the preservation of rapidly dwindling land and water resources is the modification of growth media. In the current situation, soilless agriculture could be successfully started and taken into consideration as a substitute for conventional methods of producing nutritious crops, vegetables, or food plants.

Vermichar, a combination of biochar and vermicompost, is an innovative soil amendment applied in crop production to improve plant development and soil health. The pyrolysis of organic materials yields biochar, which is rich in carbon and has a porous structure that improves the soil's capacity to hold onto nutrients and water. In contrast, vermicompost is an organic fertilizer made by earthworms that convert organic waste into humus that is rich in nutrients. The integration of these two components forms vermichar, which combines the benefits of both materials (Joseph *et al*., 2015). Vermichar tea, a liquid extract derived from a mixture of vermicompost and biochar, is increasingly recognized as a beneficial additive to nutrient solutions in hydroponic systems. There are several benefits to its use, chief among them being its rich bioactive substances, vital nutrients, and microbiological content. When added to hydroponic nutrient solutions, vermichar tea enhances plant growth by improving nutrient availability and promoting the establishment of beneficial microorganisms (Liu *et al*., 2020). By breaking down organic stuff and transforming it into forms that plants may easily absorb, these microorganisms increase the efficiency of nutrient intake. Additionally, vermichar tea contains humic substances that can stimulate plant root development and improve stress resilience. A typical problem in hydroponics caused by pH imbalances, nutrient lockout is less likely when it helps buffer pH levels in the nutrient solution. Furthermore, vermichar tea can contribute to disease suppression by introducing beneficial microbes that outcompete harmful pathogens in the root zone, promoting healthier plant growth in soilless systems (Graber *et a*l., 2010).

The use of vermitea nutrient solutions in hydroponic lettuce cultivation supports multiple United Nations Sustainable Development Goals (SDGs) by promoting environmentally responsible and sustainable agricultural practices. It directly contributes to zero hunger by enhancing crop yields and improving the nutritional quality of lettuce, thereby bolstering food security. Additionally, vermitea reduces reliance on synthetic fertilizers, aligning with clean water and sanitation by minimizing nutrient runoff and water pollution, ensuring cleaner and more sustainable water resources. By utilizing organic waste, such as vermicompost, to create nutrient solutions, vermitea supports responsible consumption and production and fosters a circular economy that reduces agricultural waste and dependence on synthetic inputs. Additionally, supplementing with vermitea lowers greenhouse gas emissions linked to the manufacture of traditional fertilizers, supporting a lower carbon footprint and aiding in climate action. It also aids in protecting natural ecosystems by encouraging soilless farming practices, thereby supporting life on land through the preservation of soil health and biodiversity. Lastly, by reducing chemical residues in food production, vermitea enhances the health benefits of hydroponic produce, aligning with good health and well-being. Together, these sustainable practices create a holistic approach to hydroponic agriculture that balances environmental stewardship, economic resilience, and human health.

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Objectives

This study was conducted to evaluate the effect of vermichar tea as nutrient supplement for hydroponically-grown lettuce (*Lactuca sativa* L.).

Specifically, it aimed to:

1. ascertain the NPK content of the formulated growing nutrient solutions using vermichar tea;
2. determine the total dissolved solids (TDS), salinity, pH, electrical conductivity, as well as the temperature of the formulated growing nutrient solutions using vermichar tea; and
3. analyze the effects of different vermichar tea concentrations on the growth and yield of hydroponic lettuce.

METHODS

Construction of the Stands and Making Holes of the Styrofoam Box

Construction of the stands using bamboo and making holes in the Styrofoam boxes was done, measuring 1m by 3m long. Holes in the Styrofoam boxes were made 8 cm in diameter, making 15 holes per box with a distance of 10 cm between holes.

Procurement of Vermichar

The vermichar was produced at the Center of Organic Agricultural Research and Extension Training (COARET) of the Isabela State University, Echague, Isabela.

Production of Vermichar Tea

A ratio of 1:1 kilogram of vermichar was wrapped with muslin cloth soaked in one liter of water for 24 hours. Addition of one (1) kilogram of molasses to the solution as a source of nutrients for beneficial microbial development, and actively aerated and ready to use.

Vermichar Tea Nutrient Analysis

The sample vermichar tea was brought to the Integrated Laboratory Division, Department of Agriculture, Regional Field No.2, Tuguegarao City, Cagayan for nutrient analysis. The method used to get the pH level was the Potentiometric method. Nitrogen content was measured using the Kjeldahl- Jadbauer- Gunning. Phosphorus content was assessed using Vanadomolybdate. Potassium content was analyzed using the Flame Atomic Emission method, and the Micronutrients were analyzed using the Inductively Coupled-Plasma spectroscopy method.

Experimental Treatments

The amount of Commercial Nutrient Solution and Vermichar Tea per treatment mixed in 30 liters of water per box are the following:

T_1 – 75 ml Commercial Nutrient Solution
T_2 – 18.75 ml Commercial Nutrient Solution + 56.25 ml Vermichar Tea
T_3 – 22.50 ml Commercial Nutrient Solution + 53.20 ml Vermichar Tea
T_4 – 37.50 ml Commercial Nutrient Solution + 37.50 ml Vermichar Tea
T_5 – 1.50 ml Vermichar Tea
T_6 – 3.0 ml Vermichar Tea

Seedling Production

Seeds of the Curly Green (Loose) lettuce variety were used in the study. The sponge was dipped in mixtures of five (5) ml of vermichar tea and added to one (1) liter of water. One seed of loose green lettuce was sown per hole of the seedling foam. The seedling foam was placed under partial shade until ten (10) days after sowing and was ready for transplanting.

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Experimental Lay-out and Design

The Styrofoam boxes having the different treatments/growing solutions used in the experiment were laid out following the procedure for Completely Randomized Design (CRD) with three replications.

Preparation of Potting and Transplanting

The hydroponic sowing sponge foam was used as a medium and placed in a capacity of 8-ounce Styrofoam cup with tiny holes. One seedling of uniform size was transplanted per cup.

Care and Management of the Crop and Harvesting

Sanitation of surroundings was maintained at all times, and insect pests and diseases were immediately controlled by handpicking. Harvesting was done upon reaching the marketable size.

Data Gathered

Data collected in the study include: pH, electrical conductivity (µS/cm), temperature (°C), salinity (ppm), and total dissolved solids (ppm) of the nutrient solution before transplanting, and at 10, 20 days after transplanting (DAT), and harvest; plant height (cm) at 10, 20 DAT, and harvest; leaf area (mm^2); fresh weight per plant (g); yield per box (g); root length (cm); root weight (g); and sensory evaluation.

Population and Sampling

This study was supported by fifty panelists who were requested to evaluate the taste, texture, color, and general acceptability. The sensory characteristics of the products were evaluated following the 6-point Hedonic Scale (Villanueva *et al*., 2011). Simultaneously, participants rated the acceptability of these lettuce types based on attributes like taste, texture, color, and general acceptability, employing the same hedonic scale.

Instrument

According to Stone and Sidel (2004), the acceptability ratings have the following ratings, ranges, and qualitative descriptions that were used to get the level of general acceptability of the effect of vermichar tea on hydroponically-grown lettuce in terms of color, texture, taste, and general acceptability.

Data Collection

The collected data were analyzed using the Analysis of Variance (ANOVA) for Completely Randomized Design (CRD) on the quality of nutrient solution as affected by vermichar tea and growth and yield of hydroponically grown lettuce as affected by vermichar tea nutrient solution while the sensory evaluation of hydroponically grown lettuce as affected by vermichar tea nutrient solution was analyzed Analysis of Variance (ANOVA) for Randomized Complete Block Design (RCBD). The Statistical Tool for Agricultural Research software was used to analyze the data and the Tukey's Honestly Significantly Difference test (HSD) was used to compare means if the result is significant.

RESULTS and DISCUSSION

NPK Content of the Nutrient Solutions. Based on the analysis of the formulated nutrient solution, it was composed of 0.14% total Nitrogen, 0.07% total Phosphorus, and 0.86% total of Potassium.

Quality of Nutrient Solution as Affected by Vermichar Tea

pH of the Nutrient Solution. Table 1 shows the pH levels of nutrient solutions before transplanting, at 10 and 20 days after transplanting, and at harvest of hydroponically grown lettuce. The pH level of the nutrient solution in the different treatments before transplanting showed no significant differences with each other, with means ranging from 6.38 to 6.54. A significant difference in pH levels was observed 10 and 20 days after transplanting. The highest pH level at 10 DAT was in 25% CNS:75% VT (7.30) and 30% CNS:70% VT (7.28), while lower but comparable values were found in 50% CNS:50% VT, 5% VT, and the commercial solution. At 20 DAT, all vermichar tea treatments showed similar pH levels (6.54–7.30), with 50% CNS:50% VT and 5% VT not differing from pure CNS (6.31). At harvest, pH values ranged from 6.64 to 7.50 with no significant differences among treatments.

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Table 1. pH Level and Temperature (°C) of the nutrient solution for hydroponically- grown lettuce.

TREATMENTS	pH Level				Temperature (°C)			
	Before Transplanting	10 DAT	20 DAT	At Harvest	Before Transplanting	10 DAT	20 DAT	At Harvest
T_1 – CNS	6.54	6.37d	6.31b	6.64	32.23	29.73a	29.20	29.33
T_2 – 25% CNS : 75% VT	6.38	7.30a	7.30a	7.50	32.63	29.63ab	29.20	29.37
T_3 –30% CNS : 70% VT	6.40	7.28a	7.20a	7.50	32.23	29.80a	29.30	29.57
T_4 –50% CNS : 50% VT	6.27	6.64 c	6.54ab	7.16	32.23	29.70a	29.20	29.33
T_5 – 5% VT	6.43	6.55c	6.59ab	6.98	31.43	29.87a	29.43	29.77
T_6 –10% VT	6.38	6.88b	7.17a	6.96	31.90	29.40b	29.20	29.40
ANOVA RESULT	ns	**	**	ns	ns	**	ns	ns
C.V. (%)	2.20	0.89	4.37	5.05	3.27	0.36	0.66	0.93
HSD	-	0.16	0.82	-	-	0.30	-	-

Note: Means with common letters are not significantly different with each other using Tukey's Honestly Significant Different Test (HSD).
ns – not significant ** – significant at 1% level

Temperature of the Nutrient Solution (°C). Table 1 presents nutrient solution's temperatures before transplanting, 10 and 20 days after transplanting, and at harvest. No significant temperature differences were found before transplanting, with all treatments ranging from 31.43°C to 32. 63°C.

The temperature of the nutrient solutions 10 days after transplanting varied significantly among treatments. The 100 ml vermichar tea and 25% CNS : 75% VT had the lowest temperature with 29.40 °C and 29.63 °C. However, the latter treatment was comparable to the rest of the nutrient solutions in the other treatments, which ranged from 29.70 to 29.87 °C.

No significant temperature differences were observed among treatments at 20 days after transplanting and at harvest, with values ranging from 29.20–29.43°C and 29.33–29.77°C, respectively.

Total Dissolved Solids of the Nutrient Solution (ppm). Table 2 presents total dissolved solids (TDS) of nutrient solutions at various stages. Significant differences were observed before transplanting, with the highest TDS in pure CNS (517.20 ppm), followed by 50% CNS:50% VT (394.80 ppm) and 30% CNS:70% VT (363.60 ppm). Lower, comparable values were seen in 25% CNS:75% VT (344.10 ppm), 5% VT (282.30 ppm), and pure VT treatments (276.30 ppm).

Table 2. Total dissolved solids (ppm) and Electrical Conductivity (µS/cm) of the nutrient solution for hydroponically-grown lettuce.

TREATMENTS	Total Dissolved Solids (ppm)				Electrical Conductivity (µS/cm)			
	Before Transplanting	10 DAT	20 DAT	At Harvest	Before Transplanting	10 DAT	20 DAT	At Harvest
T_1 – CNS	517.20a	724.50a	741.00ab	801.00ab	574.67a	805.00a	823.33ab	890.00ab
T_2 – 25% CNS : 75% VT	344.10c	539.40c	458.10b	403.80bc	382.33c	599.33c	509.00b	448.67bc
T_3 –30% CNS : 70% VT	363.60bc	526.20cd	464.10b	458.10bc	404.00bc	584.67cd	515.67b	435.33c
T_4 –50% CNS : 50% VT	394.80b	535.20cd	530.40b	391.80c	438.67b	594.67cd	589.33b	509.00bc
T_5 – 5% VT	282.30d	518.70d	989.10a	972.90a	313.67d	576.33d	1099.00a	1081.00a
T_6 –10% VT	276.30d	573.60b	975.30a	885.60a	307.00d	637.33b	1083.67a	984.00a
ANOVA RESULT	**	**	**	**	**	**	**	**
C.V. (%)	3.84	1.11	17.54	22.36	3.84	1.11	17.54	22.36

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HSD	38.22	17.36	333.33	400.00	42.46	19.28	370.37	444.44

Note: Means with common letters are not significantly different with each other using Tukey's Honestly Significant Different Test (HSD).
** - significant at 1% level

The total dissolved solids ten days after transplanting revealed a significant result wherein the pure commercial nutrient solution had the highest TDS with a mean of 724.50 ppm, followed by 100 ml of Vermichar Tea with 573.60 ppm. The nutrient solution with 50% CNS : 50 % VT, 30% CNS : 70% VT, and 25% CNS : 75% VT had comparable TDS with 539.40, 526.20, and 535.32 ppm. However, it was noted that the nutrient solution containing 5% VT obtain the least total dissolved solids with a mean value of 518.70 ppm.

At 20 days after transplanting, it was noted that the TDS of different nutrient solutions differed significantly between treatments. Analysis showed that the nutrient solution containing 50% CNS : 50% VT, 10% VT, and pure commercial nutrient solution had the highest TDS with 989.10, 975.30, and 741.00 ppm, respectively. However, the nutrient solution from pure commercial nutrient solution had comparable TDS to that of the nutrient solution containing 30% CNS : 70% VT, 50% CNS : 50% VT, and 25% CNS : 75% VT with 458.10, 464.10, and 530.40 ppm, respectively.

The highest total dissolved solids at harvest were observed on 5% VT, 10% VT, and pure commercial nutrient solution with 972.90, 885.60, and 801.00 ppm. However, the nutrient solution on pure commercial nutrient solution was comparable to the nutrient solution containing 30% CNS : 70% VT and 25% CNS : 75% VT (403.80 and 458.10 ppm) and yet comparable to the nutrient solution containing 50% CNS : 50% VT with 391.80 ppm.

Electrical Conductivity of the Nutrient Solution (µS/cm). Table 2 shows the electrical conductivity of nutrient solutions, which differed significantly between treatments before transplanting. The result shows that the pure commercial nutrient solution had the highest electrical conductivity with 574.67 uS/cm, followed by the nutrient solution containing 50% CNS : 50% VT and 30% CNS : 70% VT with 438.67 and 404.00 uS/cm. However, the former treatment was comparable to the nutrient solution containing 25% CNS : 75% VT with 382.33 uS/cm. The least were observed in the nutrient solution with 5% VT and 10% VT with 313.67 and 307.00 uS/cm, respectively.

A significant result was observed on the electrical conductivity of the nutrient solution ten days after transplanting. The highest electrical conductivity was observed on nutrient solution using pure commercial nutrient solution with a mean of 805.00 uS/cm, followed by the nutrient solution containing 100 ml of Vermichar Tea with a mean of 637.33 uS/cm. Next in rank was a nutrient solution containing 25% CNS : 75% VT, 50% CNS : 50% VT, and 30% CNS : 70% VTwith respective mean values of 599.33, 594.67, and 584.67 uS/cm. However, the latter treatment obtained a comparable result with he nutrient solution containing 5% VT with a mean of 576.33 uS/cm.

The electrical conductivity level of the nutrient solution at 20 days after transplanting varied significantly between treatments, wherein the 5% VT, 10% VT, and pure commercial nutrient solution had the highest EC levels with 1099.00, 1083.67, and 823.33 uS/cm, respectively. However, the latter treatments disclosed a comparable mean value to a nutrient solution containing 25% CNS : 75% VT, 30% CNS : 70% VT, and 50% CNS : 50% VT, with their respective mean values of 509.00, 515.67, and 589.33 uS/cm.

The EC level of the nutrient solution at harvest disclosed significant results. The highest EC level was consistently achieved by the nutrient solution on 5% VT, 10% VT, and pure commercial nutrient solution with 1081.00, 984.00, and 890.00 uS/cm. However, the use of pure commercial nutrient solution was comparable to the nutrient solution with 25% CNS : 75% VT and 50% CNS : 50% VT with 448.67 and 509.00 uS/cm, and yet comparable to the nutrient solution of 30% CNS : 70% VT with 435.33 uS/cm.

Salinity of the Nutrient Solution (ppm). The salinity (ppm) of the nutrient solution for hydroponically- grown lettuce is presented in Table 3. The salinity level of the nutrient solutions before transplanting exhibited significant variations between treatments. Using pure commercial nutrient solution and 50% CNS : 50% VT, recorded the highest salinity level with a mean of 236.33 and 225.00 ppm, followed by 25% CNS : 75% VT and 30% CNS : 70% VT with 191.67 and 203.33 ppm. The least were observed in 5% VT and 10% VT with 157.00 and 151.67 ppm, respectively. Significant differences on the salinity level of the nutrient solution at ten days after transplanting, wherein the nutrient solution using pure commercial nutrient solution had the highest salinity level with 320.67 ppm,

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followed by the nutrient solution using 5% VT and 10% VT with 294.67 and 295.00 ppm. Next in rank was observed on the use of 50% CNS : 50% VT with 256.67 ppm. The least was observed using the 25% CNS : 75% VT and the 30% CNS : 70% VT at 237.00 and 239.00 ppm. There were significant differences in the salinity level of the formulated nutrient solutions at 20 days after transplanting. The nutrient solution containing 5% VT and 10% VT and pure commercial recorded the highest salinity level with 528.33, 564.67, and 410.00 ppm. However, the use of pure commercial nutrient solution had comparable salinity levels with the use of 25% CNS : 75% VT, 30% CNS : 70% VT, and 50% CNS : 50% VT, with their respective mean values of 253.00, 256.67, and 294.33 ppm. At harvest, salinity levels ranged from 223.00 to 894.67 ppm with no significant differences among nutrient solutions.

Table 3. Salinity (ppm) and Plant height (cm) of hydroponically- grown lettuce as affected by vermichar tea nutrient solution.

TREATMENTS	Salinity (ppm)				Plant Height (cm)		
	Before Transplanting	10 DAT	20 DAT	At Harvest	10 DAT	20 DAT	At Harvest
T_1 – CNS	236.33a	320.67a	410.00ab	377.33	10.48ab	21.17ab	32.36a
T_2 – 25% CNS : 75% VT	191.67b	237.00d	253.00b	223.00	10.82ab	22.28a	32.85a
T_3 –30% CNS : 70% VT	203.33b	239.00d	256.67b	894.67	10.96a	22.31a	33.38a
T_4 –50% CNS : 50% VT	225.00a	256.67c	294.33b	254.33	10.90a	22.54a	33.53a
T_5 – 5% VT	157.00c	294.67b	528.33a	540.00	9.12c	19.89b	24.85b
T_6 –10% VT	151.67c	295.00b	564.67a	490.67	9.98bc	20.35b	27.19b
ANOVA RESULT	**	**	**	ns	**	**	**
C.V. (%)	3.39	0.92	15.97	105.43	2.51	2.44	3.44
HSD	18.03	6.90	168.45	-	0.91	1.84	3.71

Note: Means with common letters are not significantly different with each other using Tukey's Honestly Significant Different Test (HSD).
ns – not significant ** - significant at 1% level

Effect of Vermichar Tea on the Growth and Yield of Hydroponically- Grown Lettuce

Plant Height (cm). The plant height of hydroponically- grown lettuce as affected by vermichar tea nutrient solution is shown in Table 3. The height of the hydroponically grown lettuce at 10 days after transplanting was significantly affected by the vermichar tea nutrient solution, wherein the nutrient solution containing 25% CNS : 75% VT, 30% CNS : 70% VT, 50% CNS : 50% VT, and pure commercial nutrient solution had comparable heights with means ranging from 10.48 to 10.96 centimeters; however, the former did not also vary with plants grown in nutrient solution containing 10% VT with 9.98 centimeters and yet comparable to plants grown in nutrient solution containing 5% VT with 9.12 centimeters.

Similarly, the height of the plants at 20 days after transplanting varied according to the formulated nutrient solutions. The nutrient solutions containing 25% CNS : 75% VT, 30% CNS : 70% VT, 50% CNS : 50% VT, and pure commercial nutrients produced taller plants with mean values ranging from 21.17 to 22.54 centimeters. However, the plants grown in pure commercial nutrient solution had comparable heights to the plants grown in nutrient solution containing 5% VT and 10% VT with 19.89 and 20.35 centimeters.

Plant height at harvest showed significant differences. Treatments with CNS and vermichar tea had heights similar to pure CNS (32.36–33.53 cm), while shorter plants were seen with 5% VT (24.85 cm) and 10% VT (27.19 cm).

Leaf Area (mm). The effect of vermichar tea as nutrient solution on leaf area for hydroponically grown lettuce is shown in Table 4. The leaf area of hydroponically- grown lettuce was significantly affected by vermichar tea. The largest leaf area was obtained on plants grown on nutrient solution containing 25% CNS : 75 % VT, 30% CNS : 70% VT, and 50% CNS : 50% VT with mean values of 143.96, 155.10, and 164.94 milimeters, respectively,

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followed by the commercial nutrient solution with a mean of 110.99 milimeters. The smallest leaf area was recorded on the nutrient solution containing 5% VT and 10% VT with respective means of 72.37 and 52.55 milimeters. Combining vermichar tea with synthetic solutions enhances leaf area in hydroponic lettuce by improving nutrient uptake and plant health.

Table 4. Leaf Area (mm) , Fresh Weight per Plant (g), Yield per Box (g), Root Length (cm) and Root Weight (g) of hydroponically- grown lettuce as affected by vermichar tea nutrient solution.

TREATMENTS	Leaf Area (mm)	Fresh Weight per Plant (g)	Yield per Box (g)	Root Length (cm)	Root Weight (g)
T_1 – CNS	110.99b	11.67b	2625.00 b	12.83d	3.53d
T_2 – 25% CNS : 75% VT	143.96a	13.77b	3097.50 b	26.58b	5.67bc
T_3 –30% CNS : 70% VT	155.10a	18.60a	4185.00 a	28.22a	6.53ab
T_4 –50% CNS : 50% VT	164.94a	19.73a	4440.00 a	29.13a	7.13a
T_5 – 5% VT	72.37c	7.07c	1590.00 c	19.25c	5.77b
T_6 –10% VT	52.55c	7.03c	1582.50 c	18.12c	5.37c
ANOVA RESULT	**	**	**	**	**
C.V. (%)	7.82	8.02	8.02	2.25	7.24
HSD	25.00	2.85	642.10	13.79	1.13

Note: Means with common letters are not significantly different with each other using Tukey's Honestly Significant Different Test (HSD).
** - significant at 1% level

Fresh Weight per Plant (g) and Yield per Box (g). Table 4 shows the fresh weight per plant (g) affected by vermichar tea nutrient solutions in hydroponic lettuce. The nutrient solutions significantly affected the weight of hydroponically grown lettuce, wherein the heaviest plants were grown under the nutrient solution containing 30% CNS : 70% VT and 50% CNS : 50% VT with their respective mean values of 18.60 and 19.73 grams, followed by the plants grown under the nutrient solution containing 25% CNS : 75% VT and pure commercial nutrient solution with 13.77 and 11.67 grams. The least was observed on nutrient solution using 5% VT and 10% VT with mean values of 7.07 and 7.03 grams.

A significant result was noted on the weight of plants per box, wherein the heaviest plants grown were found in plants grown in nutrient solution using 50% CNS : 50% VT and 30% CNS : 70% VT, with mean values of 4185.00 and 4440.00 grams, followed by the plants grown under the nutrient solution containing 25% CNS : 75% VT and pure commercial nutrient solution with 3097.50 and 2625.00 grams. The least was observed on nutrient solution using 5% VT and 10% VT with mean values of 1590.00 and 1582.50 grams.

Root Length (cm) and Root Weight (g). Table 4 shows that vermichar tea nutrient solutions significantly affected root length in hydroponic lettuce. The longest roots were found in 30% CNS:70% VT (28.22 cm) and 50% CNS:50% VT (29.13 cm), followed by 25% CNS:75% VT (26.58 cm). Shorter roots occurred with 5% VT (19.25 cm), 10% VT (18.12 cm), and the shortest in pure commercial solution (12.83 cm).

The nutrient solution significantly affected the root weight of hydroponic lettuce, wherein the plants grown on a nutrient solution of 30% CNS : 70% VT and 50% CNS : 50% VT had the heaviest roots with respective means of 6.53 and 7.13 grams. However, the plants grown on nutrient solution containing 30% CNS : 70% VT had comparable root weight to plants grown on nutrient solution containing 5% VT and 25% CNS : 75% VT with respective means of 5.77 and 5.67 grams, and further comparison of means that the latter had comparable root

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weight to plants grown on nutrient solution containing 10 % VT with a mean of 5.37 grams. The least was noted in plants grown on pure commercial nutrient solution with a mean of 3.53 grams.

Effect of Vermichar Tea on Sensory Evaluation of Hydroponically Grown Lettuce

The results of the sensory evaluation based on the overall acceptance of taste, texture, color, and general acceptability of hydroponically- grown lettuce using vermichar tea as nutrient solution is presented in Table 5. The evaluation reveals that the most acceptance value was observed in the lettuce from 25% CNS : 75% VT (T2) which ranked first with a score of 1.53. This was followed the plants applied with pure commercial nutrient solution (T1), which ranked second with a value of 1.85. The third rank was observed in plants treated with 30% CNS : 70% VT (T3) with a value of 2.02. The fourth positioned was from the plants treated with 50% CNS : 50% VT (T_4) with a value of 2.51. On the other hand, the plants 5% VT (T_5) which ranked fifth had a value of 2.96. The plants applied with 10% VT (T_6) ranked sixth with a value of 3.50. These findings suggest that the combination of commercial solutions and vermichar tea were rated most favorably by the panelists.

Table 5. Acceptability Coefficient Index (ACI) of hydroponically- grown lettuce on vermichar tea as nutrient solution.

	Taste	39.5	Texture	19.5	Color	22	General Acceptability	19	100	RANK
T_1	2.58	1.02	1.00	0.20	1.00	0.22	2.20	0.42	1.85	2
T_2	1.60	0.63	1.16	0.23	1.18	0.26	2.16	0.41	1.53	1
T_3	1.64	0.65	1.88	0.37	2.60	0.57	2.26	0.43	2.02	3
T_4	2.26	0.89	2.46	0.48	2.86	0.63	2.66	0.51	2.51	4
T_5	2.84	1.12	3.00	0.59	3.00	0.66	3.14	0.60	2.96	5
T_6	3.08	1.22	3.74	0.73	4.10	0.90	3.42	0.65	3.50	6

Conclusion

Based on the result of analysis, the nutrient solutions composed of 0.14% total of Nitrogen, 0.07% total of Phosphorus, and 0.86% total of Potassium. Based on the result of the study, the pH, electrical conductivity (EC), temperature, total soluble solids (TDS), and salinity of the nutrient solution were essential for maximizing the benefits of vermichar tea in hydroponic growing systems. The vermichar tea as nutrient solutions affects the pH at 10 and 20 DAT but not at harvest. The vermichar tea nutrient solutions affects the temperature only at 10 DAT but the TDS and EC were affected by the nutrtient solutions before harvesting while the salinity was also affected by the nutrient solutions beforte transplanting but not at harvest. The use of vermichar tea as a nutrient solution in hydroponic lettuce production has a positive influence on the sensory qualities of the crop, including taste, texture, color, and general acceptability. The texture of the lettuce is also improved, with leaves exhibiting a crisper and fresher feel. In terms of color, vermichar tea promotes vibrant, rich green foliage, which is a key indicator of chlorophyll content and overall plant vitality. These improvements in taste, texture, and color make hydroponic lettuce grown with vermichar tea nutrient solution more appealing to consumers, leading to higher general acceptability.

Recommendations

Based on results of the study, the nutrient solution using 30% CNS : 70% VT, and 50% CNS : 50% VT, for hydroponic lettuce is highly recommended due to its ability to enhance plant growth, improve root development, and boost overall yield in a sustainable manner. To achieve the best results, it is important to monitor and maintain optimal pH, electrical conductivity (EC), total dissolved solids (TDS), and salinity levels, as these factors significantly influence the efficiency of vermichar tea in nutrient delivery. Based on the positive effects of vermichar tea on the taste, texture, color, and overall acceptability of hydroponic lettuce, it is recommended that vermichar tea be adopted as a key organic nutrient solution in hydroponic systems.

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