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Performance of Lettuce Cultivars Applied with Organic Concoctions

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Abstract

Lettuce (Latuca sativa L.) is widely consumed leafy vegetable known for its high nutritional value and fast growth cycle. The application of organic concoctions offers a sustainable alternative to synthetic inputs, potentially enhancing the growth, yield and quality of lettuce crops. This study was conducted to determine the performance in growth, yield and sensory quality of Lettuce Cultivars applied with different organic concoctions. It was laid out in 3x4 factorial design replicated three times, factor A with different lettuce cultivars such as (A1) Lollo Bionda, (A2) Lollo Rossa and (A3) Eton, while the Factor B were treatments with different organic concoctions: (B2) Fermented Plant Juice, (B3) Fermented Fruit Juice, and (B4) organic commercial foliar fertilizer along with (B1) control were tested under greenhouse condition. Base on the findings the application of Treatment B2 (Fermented Plant Juice) significantly enhances the vegetative growth of lettuce across all measured parameters: plant height, number of leaves, leaf and root length with results comparable to Treatment B4 (Organic Commercial Foliar Fertilizer) and in some cases, Treatment B1 (Control). The biological and economical yield was significantly influenced by the application of FPJ in Eton variety. The plant height, number of leaves, leaf and root length, biological and economic yield, sensory evaluation parameters such as aroma, appearance, crispiness, and general acceptability were not significantly affected by the different varieties and their interaction with organic concoctions. While the taste of lettuce significantly influenced cultivar Lollo Bionda with FPJ application and their interaction. FPJ also significantly improve the sensory quality of lettuce in aroma, appearance, crispiness and general acceptance. These findings suggest that fermented plant juice is highly effective in promoting growth and yield and improving sensory quality attributes of lettuce cultivars, making it a promising and sustainable organic input for leafy vegetable production.

Keywords: *Organic concoctions, lettuce, FFJ, FPJ, commercial organic fertilizer*

1.0 Introduction

In recent years, concerns about food security have grown, accompanied by an abrupt increase in food prices, focusing on increasing food demand and how this will be addressed (Agcaoili, 2019). Lettuce (Lactuca sativa L.), an annual leafy herb belonging to the family of Asteraceae, is one of the most popular salad crops and occupies the largest production area among salad crops in the world (Tesfa et al, 2015).

In the Philippines, Lettuce production doubled in 10 years (Gonzaga et al, 2017). It is considered one of the most important salad crops and is used as a garnish for other food preparations. It is rich in vitamins B complex, K, and C, as well as folates, thiamine, and riboflavin. It is mainly produced in the highlands of the Cordillera Administrative Region (CAR), with a higher price and market value in the local and national markets. Many commercial growers produce lettuce like gourmet farms because it remains one of the most in-demand salad kits for a healthier lifestyle, especially when grown organically (De Poliquit, 2019).

The low yield and quality of lettuce can be attributed to a combination of factors, including the lack of suitable varieties. Different lettuce varieties differ in shape, structure, chemical composition, marketable qualities, range of adaptable climatic conditions, hardiness, and yield performance (Islam et al., 2021).

Lettuce is among the most important crops that require organic growth. It is the most sought-after green vegetable for salads and sandwiches. It contains incredible sources of essential nutrients, and modern scientific research has confirmed its health benefits (Cervantes et al., 2017). It is also one of the most nutritious salad vegetables, and its demand is increasing daily. Producers are utilizing synthetic fertilizers to meet the high market demand for lettuce, which negatively impacts both human and environmental health (Bhatta, 2022). Organic agriculture presents an alternative to agricultural systems.

This worldwide shift increased the demand for organically grown crops. Organic farming has been practiced in the Philippines even before the promulgation of the Philippine Organic Agriculture Act of 2010. Organic fertilizers like fermented and decomposed organic materials have been used in many organic farms (Laysa & Taruma, 2024)

Meanwhile, plant extracts have garnered significant interest as potential foliar sprays in agricultural practices due to their bioactive compounds, which can enhance plant growth, nutrient uptake, and protect against pests and diseases. Multiple plant extracts were extensively studied for their exceptional efficacy in lettuce production (Mambuay et al., 2024).

Fermented Fruit Juice and Fermented Plant Juice are popular plant extracts nowadays. They are very simple and easy to make. The materials can be found in the locality. Despite these, many farmers still do not use FFJ and FPJ since fermentation takes a considerable amount of time. Instead, some farmers use readily available organic fertilizers available in the market.

On the other hand, Antenor Farmtech Research and Development on Biotechnology produces commercial organic fertilizer called biosa, a local organic liquid fertilizer composed of seaweed and seakelp extract, Fish emulsion or amino acid extract from tuna fishmeal, plant-based extract, neem tree leaves meal, fungalbased microorganisms and beneficial microorganisms such as azotobacter, and lactobacillus Pseudomonas. From this perspective, the researcher examines the impact of these organic fertilizers on the vegetative growth of lettuce cultivars.

This study aimed to determine the growth and yield of three different Lettuce varieties as influenced by different types of concoctions in terms of growth parameters (plant height, number of leaves, leaf length, root length) and yield parameters (biological yield, economical yield). In addition, this study also aimed to identify the plant's quality based on sensory quality parameters of lettuce leaves, including taste, aroma/flavor, appearance, crispiness, and general acceptability and determine the suitable organic concoctions for various cultivars.

This study would serve as a key to understanding the performance of lettuce cultivars applied with different types of organic concoctions. As has been demonstrated in other crops, plant extracts can enhance their growth and development. Furtheremore, Lettuce is now famous in salads and as an ingredient in dressings. Hence, this study can serve as a guide in growing and managing lettuce to produce organically grown, high-quality plants and improve its productivity by using various concoctions.

2.0 Methodology

2.1 Experimental Design and Treatments

The study used a factorial design in a Completely Randomized Design (CRD) pattern. Each treatment was replicated three times, consisting of 40 seedlings per variety and 120 lettuce seedlings per replication. Factor A represented with lettuce cultivars: A_1 lettuce Lollo Bionda, A_2 lettuce Lollo Ross and A_3 lettuce Eton while Factor B were the type of nutrients applied. B_1 water, B_2 Fermented Plant Juice (FPJ), B_3 Fermented Fruit Juice (FFJ) and B_4 organic commercial foliar fertilizer.

2.2 Research Locale

The study was conducted at Lun Padidu, Malapatan, Sarangani Province, from March 27, 2025, to May 6, 2025, for at least 40 days.

2.3 Materials and Method

The study used angle bars, steel mating, ultra violet (UV) plastic sheet, garden net, lumber, packaging tape, scissors, cutter knife, nails, polyethylene (PE) plastic bags, fermented plant juice, fermented fruit juice, local commercial liquid organic fertilizer, hand sprayer, and three varieties of lettuce. Additionally, the study used garden soil, vermicompost, coco peat, plant leaves and fruits, popsicle sticks, and a permanent marker. The study also utilized a ruler, a weighing scale, a ballpoint pen, a field notebook for data gathering, and other tools that supported the research.

Construction of Greenhouse

The study also constructed an eight (8) meter by six (6) meter greenhouse to protect the potted samples from heavy rains and sunlight (Borres, 2022). The greenhouse or shelter was constructed using coconut lumber and was covered with UV plastic sheets as roofing. It had four sides covered with a garden net. Three units of benches, each with a height of 0.5 m, a width of 1.2 m, and a length of 4.8 m, were constructed and installed inside the greenhouse to hold and ensure the safety of potted plants. The benches were constructed using steel matting, angle bars, and a layout designed according to the experimental setup.

Procurement of Seeds

The experimental seeds were purchased from a reliable source. They were of high quality and without defects. Three hundred sixty lettuce seeds (120 each cultivar) were selected and served as an experimental unit.

Soil Sterilization

The soil was sterilized by sun-drying for 12 hours before planting. This method helps eradicate microorganisms, pathogens, and plant culture pests.

Preparation of Potting Media

The soil media used in this study were sterilized (Borres, 2022) and composed of a 1:1:1 mixture of coco peat, garden soil, and vermicompost. The vermicompost was purchased at Felicidad Farm, General Santos City. All the soil medium ingredients were sieved to eliminate unnecessary particles. The prepared soil medium was filled into polyethylene bags measuring 6 inches by 8 inches. Each poly bag contained .75 kg of soil medium.

Organic Concoctions Preparation

Fermented Plant Juice and Fermented Fruit Juice were prepared according to DA-ATI standards. A ratio of 1:1/2 for FPJ and 1:1 for FFJ was used. Kangkong and Alugbati were the main ingredients of FPJ. Squash and ripe bananas were used as the main ingredients of FFJ. The juice was fermented for 7 days, and then the extracted juice was harvested. The harvested concoctions were sent to Analytical Solutions and Services in General Santos City to check the levels of nitrogen, phosphorus, and potassium in the concoctions. Organic commercial Fertilizer (Biossa) was purchased from Antenor Farmtech Research and Development on Biotechnology, Lake Sebu, South Cotabato.

2.4 Management Practices

Raising Seedlings. Seeds were raised using a seed tray. A 1:1:1 potting mixture of garden soil, vermicompost, and cocopeat was used. The bed was planted at a depth of 0.5 cm.

Planting. After two weeks, lettuce seedlings were transplanted to corresponding pots with a 1:1:1 potting mixture. The pots were arranged according to the experimental layout. One lettuce seedling was transplanted into one pot. Each pot measures 20 cm x 30 cm. It was labeled using popsicle sticks according to treatment and cultivars.

Watering. Watering was done as often as necessary, and monitoring was done to ensure that the seeds were properly germinated and replanted if needed.

Weeding. Hand weeding was used as soon as the weeds started to grow, and careful cultivation was employed to prevent damage.

Formulation and Application of the Solution. The recommended application rate of the concoctions was followed to prepare the solutions. The recommended rate for all concoctions was a 2:1 ratio, meaning two tablespoons of concoction were diluted in a liter of water. The application rate was based on the literature provided by the Agricultural Training Institute (Frayco, 2023). The treatment was done after 7 days of transplanting and was applied 3 times a week at 7:00 in the morning. Each plant was given different concoctions based on treatment (Diamante et al, 2022).

2.5 Data Gathered

2.5.1 Plant Height (cm) of Lettuce at Harvest. This was done early in the morning; the data were collected from the 10 sample plants in each treatment by measuring the length of the longest leaf from the base to the tip using a ruler.

2.5.2 Number of Leaves of Lettuce at Harvest. This was done by counting the number of healthy plants at harvest. It was computed by dividing the number of leaves from ten sample plants per replication of each treatment and lettuce cultivar by the total number of samples.

2.5.3 Leaf length (cm) of Lettuce at Harvest. This was determined by measuring the length of the leaves that exhibited the best size and appearance at harvest, from the base to the uppermost part of the leaf using a ruler.

2.5.4 Root Length (cm) of Lettuce at harvest. This was distinguished by measuring from the base to the longest extended root of the plant. This was done after harvesting.

2.5.5 Biological Yield (g). The data were collected by weighing all the fresh produce, including the root, for each treatment per cultivar at harvest.

2.5.7 Economical Yield (g). It was determined by weighing the plant, excluding the root, per treatment and cultivar after harvest.

2.5.8 Sensory Quality. The plants were examined by 20 untrained lettuce panels at harvest. A leaf of lettuce produced in each treatment per cultivar was presented to each judge in letter and number-coded disposable dishes. It was replicated three times. The following sensory parameters were evaluated based on Heymann and Lawless(2013) rating scale: taste, flavor/aroma, appearance, crispiness, and general acceptability. Panelists were asked to evaluate each sample for preference liking based on a 7-point hedonic scale, where 7 = highly acceptable, 6 = moderately acceptable, 5 = slightly acceptable, 4 = neither acceptable nor unacceptable, 3 = slightly unacceptable, 2 = moderately unacceptable, and 1 = highly unacceptable.

2.6 Statistical Analysis.

The data gathered in this experiment were statistically analyzed using the Analysis of Variance (ANOVA) technique, following the 3x4 factorial design in a Completely Randomized Design. Design (CRD). The Least Significant Difference (LSD) was applied to test for significant differences among the mean values of the treatments. A p-value of <0.05 was considered significant.

3.0 Results and Discussion

3.1 Plant Height (cm) of Different Lettuce Cultivars

The plant height of different lettuce cultivars that are applied with different organic concoctions is presented in Table 1.

The result revealed no significant difference between the treatment methods of different lettuce cultivars. Cultivar A_3 (Eton) had the highest plant height, with a mean of 8.13 cm, followed by Cultivar A_2 (Lollo Rossa), which had a mean of 7.38 cm. Cultivar A_1 (Lollo Bionda) had the lowest mean, 6.67 cm.

Meanwhile, statistical analysis revealed a significant difference between treatment means and those applied to different organic concoctions. Treatment B2 (FPJ) got the highest mean of 8.83 cm, comparable to Treatment B_4 (Organic Commercial foliar fertilizer) with a mean of 7.54 cm, followed by Treatment B_3 (FFJ) with a mean of 6.64 cm. In comparison, Treatment B_1 (control) got the shortest plant height with a mean of 6.57 cm.

Moreover, the interaction of different lettuce cultivars and different organic concoctions (AxB) revealed no significant difference among treatment means. Treatment cultivar Lollo Bionda with Fermented Fruit Juice (A_2 B_2) got the highest plant height with a mean of 11.06 cm, and the lowest plant height is cultivar Eton with control (A_3 B_1) with a mean of 5.33 cm.

These findings indicate that the use of FPJ significantly enhances plant height in lettuce, likely due to its relatively high nitrogen content (see Appendix D), which supports vegetative growth. This aligns with the study by Tagotong et al. (2015), which highlights FPJ's effectiveness in promoting leaf production and overall plant vigor in leafy vegetables. The commercial foliar fertilizer also proved effective, possibly due to its balanced nutrient composition and the presence of beneficial microorganisms that enhance nutrient absorption and stress resistance, as reported by Centor Europe (2025). While FFJ had high potassium, its lower nitrogen content may have contributed to its comparatively lower effectiveness in promoting plant height.

Table 1. Plant Height (cm) of Different Lettuce Cultivars Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	**Factor B Different Types of Nutrients**				**Means of A. 2/**
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	6.48	6.85	5.66	7.68	6.67
A_2 (Lollo Rossa)	7.87	11.06	6.31	7.27	8.13
A_3 (Eton)	5.33	8.58	7.95	7.67	7.38
Means of B.1/**	6.57^{bcd}	8.83^{a}	6.64^{bc}	7.54^{ab}	7.39

CV=20.71%

1/, Means with common letter superscript are not significantly different at the 1%level, LSD

**Highly significant @ 1%

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

3.2 Number of Leaves of the Different Lettuce Cultivars

Table 2 shows the response in the number of leaves of different lettuce cultivars applied with various organic formulations.Statistical analysis revealed no significant difference between treatment means for different lettuce cultivars. Cultivar A_3 (Eton) had the highest number of leaves, with a mean of 4.78, followed by Cultivar A_2 (Lollo Rossa), with a mean of 4.35, and Cultivar A1 (Lollo Bionda), with a mean of 4.06.

Meanwhile, there is significant difference among treatment means applied with different organic concoctions. Treatment B_2 (FPJ) had the highest mean of 4.91, which is comparable to Treatments B_4 (Commercial Organic Foliar Fertilizer) and B_1 (Control), with means of 4.63 and 4.29, respectively. B_3 (Fermented Fruit Juice) got the lowest number of leaves, with a mean of 3.76.

The results indicate that the application of FPJ significantly increases the number of leaves in lettuce plants, likely due to its relatively high nitrogen content (see Table 12), which plays a crucial role in leaf formation and vegetative growth. This aligns with Alam (2021), who reported that FPJ enhances leaf production, plant height, and overall yield in lettuce. Similarly, Mas'ud Alfanda (2024) observed improvements in growth

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parameters such as leaf length, plant height, and root development in hydroponically grown lettuce treated with FPJ.

Table 2. Number of Leaves of Different Lettuce Cultivars Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	Factor B Different Organic Concoctions				Means of A. 2/
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	4.17	3.93	3.43	4.70	4.06
A_2 (Lollo Rossa)	4.53	5.37	3.60	3.90	4.35
A_3 (Eton)	4.17	5.43	4.23	5.30	4.78
Means of B.1/*	4.29 ^{abc}	4.91 ^{a}	3.76 ^{cbd}	4.63 ^{ab}	4.40

CV=15.91%.

1/ Means with common letter superscript are not significantly different at the 5%level LSD.

*significant @ 5% level

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

3.3 Leaf length (cm) of the Different Lettuce Cultivars

The leaf length of the different lettuce cultivars that were applied with different organic concoctions is presented in Table 3.Study shows no significant difference between treatment means for different lettuce cultivars. Cultivar Eton (A_3) had the highest leaf length, with a mean of 6.64, followed by cultivar Lollo Rossa (A_2) with a mean of 6.23. The lowest leaf length was Cultivar Lollo Bionda(A_1), with a mean of 5.94.

On the otherhand, statistical analysis revealed a significant difference among treatment means applied with different organic concoctions. Treatment B_2 (FPJ) had the highest mean of 7.59, comparable to the mean of 6.81 for B_4 (organic commercial foliar fertilizer). It is followed by B3's mean of 5.47, while B3 has the lowest leaf length with a mean of 5.20.

The results indicate that treatment B_2, which involves the application of fermented plant juice, has a significant effect on leaf length. This finding aligns with the study by Home (2019); FPJ also enhances the growth of leafy vegetables by improving nutrient absorption, promoting leaf development, and strengthening overall plant vitality. Furthermore, fermented plant juice supplies plants with extra nitrogen, enhancing their photosynthetic efficiency. It also delivers additional phosphorus and enhances the plants' ability to absorb phosphorus from the soil, which may promote vegetative growth and increase the volume and size of crops, according to Vitale (2024).

The enhanced growth effect of FPJ can be attributed to its nutrient profile, particularly its nitrogen content of 0.63%, phosphorus at 0.05%, and potassium at 0.07%, as indicated in the test results in Table 12.. These findings highlight that nitrogen-rich organic formulations, such as FPJ, are particularly effective in promoting leaf development in lettuce, demonstrating their potential as a sustainable and natural growth enhancer for leafy vegetables.

Table 3. Leaf Length (cm) of the Different Lettuce Cultivars Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	**Factor B Different Organic Concoctions**				**Means of A. 2/**
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	5.47^{eghi}	6.12^{def}	4.92^{hij}	7.24^{bc}	5.94
A_2 (Lollo Rossa)	4.50^{hjkl}	9.18^{a}	4.63^{hijk}	6.60^{bcde}	6.23
A_3 (Eton)	5.64^{efgh}	7.48^{b}	6.88^{bcd}	6.58^{bcdef}	6.64
Means of B.1/*	5.20^{bc}	7.59^{a}	5.47^{cd}	6.81^{ab}	6.27

CV=16.02

1/ Means with common letter superscript are not significantly different at the 5%level LSD.

* significant @ 5% level

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

3.4 Root Length of the Different Lettuce Cultivars

Table 4 presents the root lengths of the different lettuce cultivars applied to different organic concoctions.

Statistical analysis revealed no significant difference between treatment means for different lettuce cultivars. Cultivar A_1 had the highest root length, with a mean of 6.47, followed by Cultivar A_2, with a mean of 5.87, and the lowest Cultivar A_3, with a mean of 5.27. Meanwhile, statistical analysis revealed a significant difference among treatment means applied with different organic concoctions. Treatment B_2 (FPJ) had the highest mean of 6.77, which is comparable to Treatment B_4 (Organic Commercial foliar fertilizer) and Treatment B_1 (Control), which had means of 5.99 and 5.78, respectively. B_3 (FFJ) got the lowest root length, with a mean of 4.93.

Although no significant interaction was found between lettuce cultivars and the applied organic concoctions (AxB), the combination of A_2 B_2 (Lollo Rossa treated with FPJ) showed the longest root length at 7.26 cm. It was followed closely by A_1B_2 (7.08 cm), A_2B_1 (6.98 cm), and A_1B_4 (6.40 cm). The shortest root development was seen in A_3B_3 (cultivar Eton with FFJ) with a mean of 4.19 cm.

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Table 4. Root Length of the Different Lettuce Cultivars Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	Factor B Different Organic Concoctions				Means of A. 2/
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	6.98	7.08	5.40	6.40	6.47
A_2 (Lollo Rossa)	5.30	7.26	5.20	5.71	5.87
A_3 (Eton)	5.06	5.98	4.19	5.85	5.27
Means of B.1/*	5.78^{abc}	6.77^{a}	4.93^{bcd}	5.99^{ab}	5.87

CV=17.94

1/ Means with common letter superscript are not significantly different at the 5% level of LSD.

* significant @ 5% level

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

The results of this study indicate that treatment B_2, which involves the application of fermented plant juice, has a significant effect on root length FPJ, significantly increasing leaf length, plant height, and root development compared to untreated controls. Fermented Plant Juice (FPJ) has been shown to positively affect root length by enhancing root growth and biomass in various plant species (Demir et al., 2024).

Lettuce treated with a nutrient solution containing fermented plant juice developed longer roots and greater root dry weight, resulting in comparable growth to or better than other treatments (Journal of the Austrian Society of Agricultural Economics, 2019).

The effectiveness of FPJ in promoting root growth can be attributed to its nutrient composition (Table 12). FPJ demonstrated superior performance, possibly due to its balanced nutrient profile and beneficial microbial content, which enhance nutrient uptake and promote the formation of a vigorous root system.

3.5 Biological Yield (g) of the Different Lettuce Cultivars

Table 5 presents the biological yield of the different lettuce cultivars applied to different organic concoctions.Statistical analysis revealed no significant difference between treatment means for different lettuce cultivars. Cultivar A_3 got the highest biological yield with a mean of 10.71 g, followed by Cultivar A_2 with a mean of 9.30 g. The lowest Cultivar was A_1, with a mean of 9.27g.

Meanwhile, statistical analysis revealed a significant difference among treatment means applied with different organic concoctions. Treatment B_2 got the highest number, with a mean of 13.78g, comparable to

B_4 and B_1, with a mean of 12.89g and 10.33g, respectively, while B_3 got the lowest yield, with a mean of 2.03g.

Although the interaction between cultivar and organic concoction (AxB) showed no significant difference, the highest biological yield was observed in the A_3B_2 (Eton cultivar with FPJ), which had a mean of 16.00g. This was followed by A_2B_2 and A_3B_4, each with 15.00g, and other combinations, such as A_1B_4 and A_1B_1, with 13.33g and 10.33g, respectively. The lowest biological yield was observed in A_3B_3 at 1.50 g.These results demonstrate that FPJ (Treatment B_2) significantly improves the biological yield of lettuce. This finding supports the conclusions of Denona et al. (2020), who reported that FPJ enhances plant growth by increasing plant height, leaf production, and biomass through improved nutrient uptake. Additionally, FPJ's content of natural hormones, enzymes, and nutrients contributes to stronger root systems, improved nutrient absorption, and overall enhanced plant health, ultimately leading to higher yields and better crop quality. Regular use of FPJ has been shown to support sustainable vegetable farming by naturally boosting growth parameters.

Table 5. Biological Yield (g) of the Different Lettuce Cultivars Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	**Factor B Different Types of Nutrients**				**Means of A. 2/**
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	10.33^{e}	10.33^{efghi}	3.07^{j}	13.33^{bcd}	9.27
A_2 (Lollo Rossa)	10.33^{ef}	15.00^{abc}	1.53^{jk}	10.33^{efgh}	9.30
A_3 (Eton)	10.33^{efg}	16.00^{a}	1.50^{jkl}	15.00^{ab}	10.71
Means of B.1/*	10.33^{abc}	13.78^{a}	2.03^{bcd}	12.89^{ab}	9.76

CV=20.52

1/ Means with common letter superscript are not significantly different at the 5%level LSD.

* significant @ 5% level

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

3.6 Economical Yield(g) of the Different Lettuce Cultivars

The economical yield of the different lettuce cultivars applied with various organic concoctions is presented in Table 6. Result revealed no significant difference between treatment means for different lettuce cultivars. Cultivar A_3 got the highest economic yield (grams) with a mean of 8.75g, followed by Cultivar A_2 with a mean of 8.75g, and the lowest was Cultivar A_1 with a mean of 7.86g while statistical analysis revealed a significant difference among treatment means applied with different organic concoctions. Treatment B_2 had the highest mean of 12.33g, comparable to Treatment B_4's(Organic commercial fertilizer) mean of 9.67g, followed by Treatment B_1's (control) mean of 9.67g. Treatment B_3 (Fermented Fruit Juice) yielded the lowest mean without root, at 0.70g.

Table 6. Economical Yield of the Different Lettuce Cultivars Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	Factor B Different Types of Nutrients				Means of A. 2/
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	9.33	11.00	0.77	10.33	7.86
A_2 (Lollo Rossa)	10.00	13.00	0.67	10.67	8.58
A_3 (Eton)	9.67	13.00	0.67	11.67	8.75
Means of B.1/	9.67^{bc}	12.33^{a}	0.70^{d}	10.89^{ab}	8.40

CV=13.75

1/ Means with common letter superscript are not significantly different at the 5% level of LSD.

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

The findings clearly indicate that the application of FPJ (Treatment B_2) significantly enhances the economic yield of lettuce. This finding aligns with the study of Mambuay et al. (2024), who reported that kangkong-based FPJ significantly improved plant growth parameters and yield compared to untreated controls. FPJ promotes plant development by supplying natural growth hormones, enzymes, and essential nutrients that improve plant vigor and productivity.

The effectiveness of FPJ in boosting economic yield can be explained by its nutrient content. According to Table 12, FPJ contains 0.63% nitrogen, 0.05% phosphorus, and 0.07% potassium—nutrients crucial for leaf and biomass development. In contrast, FFJ, although rich in potassium (1.02%), has lower nitrogen (0.42%) and phosphorus (0.03%) levels, which may explain its poor performance. The Commercial Organic Foliar Fertilizer contains the highest nutrient values—0.85% nitrogen, 6.24 ppm phosphorus, and 167.38 ppm potassium, which also contributed to a high economic yield; however, FPJ still achieved the best performance. This suggests that FPJ's balanced nutrient content, combined with its microbial and bioactive compounds, makes it a powerful, sustainable alternative to commercial fertilizers.

3.7 Sensory Evaluation for Taste of Different Lettuce Cultivars

Table 7 presents a rating scale for the sensory evaluation of the taste of different lettuce cultivars applied with different organic concoctions. Statistical analysis revealed a highly significant difference among the means of different lettuce cultivars. Cultivar A_1 received the highest rating in sensory evaluation for taste, with a mean of 5.00, indicating a level of acceptability comparable to that of Cultivar A_2, which has a mean of 4.95. At the same time, Cultivar A_3 got the lowest rating in sensory evaluation for taste, with a mean of 4.44, which is also interpreted as slightly acceptable.

Meanwhile, statistical analysis revealed a highly significant difference between treatment means and those applied to different organic concoctions. Treatment B_2 got the highest mean of 5.43, interpreted as slightly acceptable. It is comparable to Treatment B_1 with a mean of 5.37, followed by Treatment B_4 with a mean of 4.55, which is also slightly acceptable. Meanwhile, B_3 received the lowest rating in sensory evaluation for taste, with a mean of 3.84, indicating neither an acceptable nor an unacceptable level of taste.

Moreover, the interaction of different lettuce cultivars and organic concoctions (AxB) revealed significant differences among treatment means. Treatment A1B1 received the highest rating in sensory evaluation for taste, with a mean of 5.87, indicating a moderately acceptable level. It is comparable to A_1 B_2, with a mean of 5.72. The lowest rating in sensory evaluation for taste is A_3B_3, with a mean of 3.68, which is interpreted as neither acceptable nor unacceptable.

The results shows that Cultivar A_1, a variety of Lollo Bionda, has a significantly higher rating on the sensory evaluation scale for taste. This finding aligns with the study of admin hydro,(2022), that Lollo Bionda is considered better or advantageous compared to many other lettuce varieties due to its appealing and unique frilly leaf texture, mild yet pleasant flavor, rich nutritional profile with vitamins and antioxidants, flexibility in harvesting, culinary versatility, and adaptability to various growing conditions. These traits make it a popular choice for fresh salads and mixed dishes, offering aesthetic and health benefits.

In addition, the result of this study indicate that treatment B_2 with the application of fermented plant juice has significantly rating scale in sensory evaluation for taste of different lettuce cultivars. This finding aligns to the study that Lettuce treated with fermented plants juice often has an improved taste due to several biochemical and microbial influences from the fermentation process that enhance flavor complexity and nutritional quality (Van Wyk, 2024). Furthermore, fermented plant juice improves the soil or growing medium by providing organic acids, vitamins, and minerals that support healthier plant growth and enhance both flavor and taste. This enriched nutrient content promotes the formation of beneficial phytochemicals and vitamins in lettuce leaves (Pujiwati et al., 2024).

Moreover, the results of this study indicate that AxB, Cultivar A_1 Lollo Bionda, with the application of Treatment B_1, has a significant effect on taste. This finding aligns with the study, in which rapid growth induced by high nitrogen fertilization can lead to diluted flavors and higher water content, resulting in a less intense taste. Additionally, over-fertilization can cause nitrate accumulation in leaves, which may contribute to a bitter or bland flavor (Chadwick et al., 2016). While it is Comparable to B_2, fermented plant juice significantly impacts the rating scale of sensory evaluation for a taste of different lettuce cultivars applied with different organic concoctions. This finding aligns with the application of fermented plant juice (FPJ) to lettuce varieties, such as Lollo Bionda, which enhances their growth, yield, and overall quality, including flavor. Furthermore, FPJ enhances plant nutrition and photosynthesis, resulting in healthier and more flavorful lettuce leaves (Agronomymsugensan, 2024)

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The results of this study further shows that treatment B_2, which involves the application of fermented plant juice, has a significant impact on the sensory evaluation of the taste of different lettuce cultivars. The effectiveness of FPJ in improving sensory taste can be further explained by its nutrient profile, as shown in Table 12. Nevertheless, FPJ outperformed other treatments in sensory evaluation, suggesting that its balanced nutrients, along with bioactive compounds from fermentation, play a critical role in enhancing the overall eating quality of lettuce.

Table 7. Sensory Evaluation for Taste of Lettuce Cultivars Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	Factor B Different Types of Nutrients				Means of A. 2/
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	5.87 ^{a}	5.72 ^{ab}	3.85 ^{jk}	4.58 ^{gh}	5.00^{a}
A_2 (Lollo Rossa)	5.45 ^{cd}	5.52 ^{bc}	4.00 ^{j}	4.83 ^{f}	4.95^{ab}
A_3 (Eton)	4.78 ^{fg}	5.07 ^{de}	3.68 ^{kl}	4.23 ^{i}	4.44^{cd}
Means of B.1/**	5.37 ^{ab}	5.43 ^{a}	3.84 ^{d}	4.55 ^{c}	4.80

CV=4.45

1/,2/Means with common letter superscript are not significantly different at the 1%level LSD

**Highly significant @ 1%

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

3.8 Sensory Evaluation for Aroma of Different Lettuce Cultivars

Table 8 presents a rating scale for sensory evaluation of the aroma of different lettuce cultivars with different organic concoctions. Statistical analysis revealed no significant difference between treatment means for different lettuce cultivars. Cultivar A_2 got the highest rating in sensory evaluation for aroma with a mean of 5.13, which is interpreted as slightly acceptable. Cultivar A_1 follows it with a mean of 5.06, which is also interpreted as slightly acceptable. Cultivar A_3 got the lowest mean of 4.68, which is interpreted as slightly acceptable. Meanwhile, analysis revealed a highly significant difference between treatment means and those applied to different organic concoctions. Treatment B_2 got the highest mean of 5.89, which is interpreted as moderately acceptable. It is comparable to Treatment B_1, which had a mean of 5.74. Treatment B_4 followed with a mean of 4.27. Treatment B_3 received the lowest rating in the sensory evaluation for aroma, with a mean of 3.92, which is interpreted as being slightly unacceptable.

Moreover, the interaction of different lettuce cultivars and different organic concoctions (AxB) revealed no significant difference among treatment means. Treatment A_1B_2 (Lollo Bionda with FPJ application) got the highest rating in sensory evaluation for aroma, with a mean of 6.05, which is interpreted as moderately

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acceptable. The lowest rating in sensory evaluation for aroma is A_3B_3 (Lettuce Eton with FFJ application), with a mean of 3.63, which is interpreted as neither acceptable nor unacceptable.

This study's results indicate that treatment B_2 (FPJ) with the application of fermented plant juice can have a significant impact on the sensory evaluation rating scale for the aroma of different lettuce cultivars when applied with various organic concoctions. This finding aligns with the study, which found that fermented plant juice is rich in nitrogen and phosphorus, promoting healthier and more vigorous growth in lettuce plants. This enhanced growth stimulates photosynthesis and overall plant metabolism, improving leaf quality and producing aroma-related compounds (Alam, 2021). Furthermore, microorganisms in fermented plant juice (FPJ) enhance nutrient bioavailability and support plant growth, which can indirectly improve aroma by boosting plant health and the production of volatile compounds (Mambuay et al., 2024).

Table 8. Sensory Evaluation of Lettuce Cultivars for Aroma Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	Factor B Different Types of Nutrients				Means of A. 2/
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	6.00	6.05	4.02	4.17	5.06
A_2 (Lollo Rossa)	5.72	5.90	4.12	4.80	5.13
A_3 (Eton)	5.50	5.73	3.63	3.85	4.68
Means of B.1/*	5.74^{ab}	5.89^{a}	3.92^{cd}	4.27^{c}	4.96

CV= 14.43

1/ Means with common letter superscript are not significantly different at the 5% level of LSD.

* significant @ 5% level

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

3.9 Sensory Evaluation for Appearance of Different Lettuce Cultivars

Table 9 presents a rating scale for evaluating the sensory appearance of different lettuce cultivars applied with different organic concoctions.Statistical analysis revealed no significant difference among treatment means of different lettuce cultivars. Cultivar Lollo Bionda got the highest rating in sensory evaluation for appearance, with a mean of 4.96, which is interpreted as slightly acceptable. It is followed by Cultivar Lollo Rossa, which has a mean of 4.74 and is also interpreted as slightly acceptable. Cultivar Eton got the lowest mean of 3.90, which is also interpreted as slightly acceptable.

Similarly, there was no significant difference among treatment means of the different organic concoctions. However, Treatment B_2 (Fermented Plant Juice or FPJ) achieved the highest mean rating of 5.74, interpreted as moderately acceptable. This was closely followed by Treatment B_1 (Control) with a mean of 5.57. Treatments B_4 (Commercial Organic Foliar Fertilizer) and B_3 (Fermented Fruit Juice or FFJ) both received lower ratings of 3.89, which were interpreted as neither acceptable nor unacceptable.

In terms of treatment and cultivar interaction (AxB), there were also no statistically significant differences. Still, the A_1B_2 combination (Lollo Bionda with FPJ) received the highest appearance rating at 6.68, classified as highly acceptable. On the other hand, A_3B_3 scored the lowest at 2.94, considered slightly unacceptable.

These findings indicate that, although there were no statistically significant differences in sensory appearance among lettuce cultivars or treatments, there are noteworthy practical implications. The relatively higher appearance rating of Cultivar A_1 (Lollo Bionda), especially when treated with Fermented Plant Juice (FPJ), suggests that this combination is more visually appealing to consumers. The superior mean rating of FPJ among the organic concoctions, although not statistically significant, suggests that FPJ has the potential to enhance the physical quality of lettuce in terms of appearance. This may be due to the nutrients and natural growth-promoting compounds in FPJ, which contribute to better leaf development, coloration, and overall plant vigor.Conversely, the consistently lower ratings of Fermented Fruit Juice (FFJ) and the commercial foliar fertilizer suggest these treatments may be less effective in enhancing the visual traits of lettuce.

The enhanced appearance of lettuce under FPJ treatment can be attributed to its nutrient profile, as indicated in Table 12. FPJ contains 0.63% nitrogen, 0.05% phosphorus, and 0.07% potassium—nutrients critical for cell expansion, chlorophyll formation, and overall leaf development. While FFJ has a higher potassium content (1.02%), it lacks sufficient nitrogen (0.42%) and phosphorus (0.03%), which likely limited its influence on visual growth parameters. Although the Commercial Organic Foliar Fertilizer contains the highest nutrient concentrations (0.85% nitrogen, 6.24 ppm phosphorus, and 167.38 ppm potassium), its lower performance in sensory appearance evaluation suggests that nutrient balance, along with the bioactive compounds and microbial content present in FPJ, plays a more effective role in enhancing lettuce's visual appeal.

This finding aligns with the study that fermented plant juice (FPJ) has been found to slightly improve the growth and appearance of lettuce, influencing factors such as leaf width, plant height, canopy size, and overall yield (Garden is Life, 2023). FPJ made from fast-growing, nutrient-rich plants can improve leaf development through its essential nutrients and growth hormones, ultimately enhancing the appearance of lettuce. (Poliquit et al., 2019).

Table 9. Rating Scale in Sensory Evaluation of Lettuce Cultivars for Appearance Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	Factor B Different Types of Nutrients				Means of A. 2/
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	

A_1 (Lollo Bionda)	6.10	6.18	3.12	3.95	4.96
A_2 (Lollo Rossa)	5.83	5.77	3.10	4.23	4.74
A_3 (Eton)	4.77	4.72	2.60	3.48	3.90
Means of B.1/	5.57	5.74	2.94	3.98	4.49

CV=29.42

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

3.10 Sensory Evaluation for Crispiness of Different Lettuce Cultivars

Table 10 presents a rating scale for the sensory evaluation of the crispiness of different lettuce cultivars applied with different organic concoctions.Statistical analysis revealed no significant difference among treatment means of different lettuce cultivars. Cultivar A_1 got the highest rating in sensory evaluation for crispiness with a mean of 4.98, which was interpreted as slightly acceptable. It was followed by Cultivar A_2 with a mean of 4.58, while Cultivar A_3 got the lowest mean of 4.63, which was also interpreted as slightly acceptable.

Meanwhile, statistical analysis revealed a highly significant difference between treatment means and those applied to different organic concoctions. Treatment B_2 got the highest mean of 5.73, which is interpreted as moderately acceptable. It is comparable to Treatment B_1 (Control), which had a mean of 5.55, followed by Treatment B_4 (organic commercial foliar fertilizer), which had a mean of 4.27. Treatment B_3 (Fermented Fruit Juice) received the lowest rating in the sensory evaluation for crispiness, with a mean of 3.56, which falls neither in the acceptable nor unacceptable range.

In terms of treatment and cultivar interaction (AxB), there were no significant differences, though A_1B_1 scored the highest crispiness rating at 6.20 (highly acceptable), while A_3B_3 received the lowest at 3.43 (slightly unacceptable).

The superior performance of FPJ in improving crispiness can be explained by its nutrient content, as shown in Table 12 FPJ contains nutrients that are essential for promoting strong cell wall development and leaf expansion, both of which contribute to the crispness of the plant. Although FFJ has a higher potassium content (1.02%), it lacks sufficient nitrogen (0.42%) and phosphorus (0.03%), which likely limits its contribution to overall leaf quality and firmness. On the other hand, the Commercial Organic Foliar Fertilizer, despite having the highest nutrient values (0.85% N, 6.24 ppm P, 167.38 ppm K), did not outperform FPJ, suggesting that FPJ's additional benefits, such as microbial content and organic acids, may enhance physiological processes that directly influence texture and freshness.

This finding aligns with the study that applying fermented plant juice (FPJ) can enhance the growth and yield of lettuce, ultimately contributing to better leaf quality and increased crispness (Frayco et al., 2023). Furthermore, the enhanced growth from FPJ indicates that lettuce leaves are likely to be fresher, healthier, and crisper, as crispness is commonly associated with leaf turgidity and nutrient levels (Agronomymsugensan, 2024).

Table 10. Sensory Evaluation of Lettuce Cultivars for Crispiness Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	Factor B Different Types of Nutrients				Means of A. 2/
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	5.68	6.20	3.20	4.35	4.98
A_2 (Lollo Rossa)	5.48	5.25	3.55	4.03	4.58
A_3 (Eton)	5.48	5.73	3.43	3.87	4.63
Means of B.1/*	5.55^{ab}	5.73^{a}	3.56^{cd}	4.08^{bc}	4.73

CV=17.61

1/ Means with common letter superscript are not significantly different at the 5%level LSD.

* significant @ 5% level

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer

3.11 Sensory Evaluation for General Acceptability of Different Lettuce Cultivars

Table 11 presents a rating scale for sensory evaluation of the general acceptability of different lettuce cultivars with different organic concoctions. Statistical analysis revealed no significant difference between treatment means for different lettuce cultivars. Cultivar A_1 received the highest rating in sensory evaluation for general acceptability, with a mean of 4.90, indicating a level of acceptability that was considered slightly acceptable. Cultivar A_2 followed it with a mean of 4.10, and Cultivar A_3 got the lowest mean of 3.65, which is interpreted as neither acceptable nor unacceptable.Meanwhile, statistical analysis revealed a highly significant difference between treatment means and those applied to different organic concoctions. Treatment B_2 (FPJ) got the highest mean of 5.12, which is interpreted as slightly acceptable. It is comparable to Treatment B_1 (control), which had a mean of 5.05. Treatment B_4 (organic Commercial Fertilizer) followed with a mean of 3.51. Treatment B_3 (FFJ) received the lowest rating in sensory evaluation for general acceptability, with a mean of 3.21, which is interpreted as being slightly unacceptable.

These findings reinforce the effectiveness of FPJ (Treatment B_2) in significantly enhancing the general acceptability of lettuce. This aligns with Rahman et al. (2021), who emphasized that lettuce treated with FPJ not only shows improved growth and yield but also retains high marketable quality. Tangpos (2022) further supported that FPJ-treated lettuce meets the preferences of consumers seeking fresh, nutritious, and organically grown produce.

The superior general acceptability of FPJ-treated lettuce is further supported by its nutrient composition, as detailed in Table 12. FPJ contains 0.63% nitrogen, 0.05% phosphorus, and 0.07% potassium—key nutrients that promote vegetative growth, leaf health, and the overall appearance and texture of the crop. These qualities are central to consumer preferences and satisfaction. Although the Commercial Organic Foliar Fertilizer has higher levels of nitrogen (0.85%), phosphorus (6.24 ppm), and potassium (167.38 ppm), its performance in terms of general acceptability was still lower than FPJ. This suggests that, beyond nutrient content, the presence of beneficial microorganisms, natural enzymes, and growth hormones in FPJ plays a crucial role in improving both agronomic and sensory traits.

Table 11. Sensory Evaluation of Lettuce Cultivars for General Acceptability Applied with Different Organic Concoctions

Factor A Lettuce Cultivars	Factor B Different Types of Nutrients				Means of A. 2/
	B_1 (Control)	B_2 (FPJ)	B_3 (FFJ)	B_4 (OCFF)	
A_1 (Lollo Bionda)	5.93	6.20	3.67	3.80	4.90
A_2 (Lollo Rossa)	4.90	4.57	3.40	3.55	4.10
A_3 (Eton)	4.32	4.58	2.55	3.17	3.65
Means of B.1/*	5.05^{ab}	5.12^{a}	3.21^{cd}	3.51^{abc}	4.18

CV= 20.08

1/ Means with common letter superscript are not significantly different at the 5% level of LSD.

* significant @ 5% level

FPJ- Fermented Plant Juice

FFJ- Fermented Fruit Juice

OCFF- Organic Commercial Foliar Fertilizer.

T**able 12. Analysis of Nitrogen, Phosphorus and Potassium (J. Caberoy, 2025)**.

Organic Concoctions	Parameters		
	Nitrogen	Phosphorus	Potassium
Fermented Plant Juice	0.85%	0.05%	0.07%
Fermented Fruit Juice	0.63%	0.03%	1.02%
Commercial Organic Foliar Fertilizer	0.85%	6.24 ppm	167.38ppm

Analyze by ASTS (Analytical Solutions Testing and Services). Units206/207, second floor Valley High, Microtel, Business Complex, General Santos City, Philippines 9500.

4.0 Conclusion

This study concluded that different lettuce cultivars (Lollo Bionda, Lollo Rossa, and Eton) and the interaction between cultivars and organic concoctions (Factor AxB) have no significant influence on plant height, number of leaves, leaf length, root length, biological yield, and economic yield. Likewise, the different varieties and their interaction with the treatments did not significantly affect the sensory evaluation parameters, such as general acceptability, aroma, appearance, and crispiness. While the application of Treatment Fermented Plant Juice significantly enhances the vegetative growth of lettuce across all measured parameters, such as plant height, number of leaves, leaf length, and root length, with results comparable to Organic Commercial leaf fertilizer and, in some cases, with the control treatment.The Eton variety, with the application of Fermented Plant Juice, significantly influenced both biological and economic yields, indicating that Eton responded well to FPJ application. It was comparable to the application of organic commercial foliar fertilizer and control treatment.

Moreover, the taste of lettuce was significantly influenced by cultivar A_1 (Lollo Bionda), Treatment B_2 (FPJ), and their interaction (A_1B_2), while application of Fermented Plant Juice also significantly improved taste, aroma/flavor, appearance, crispiness, and general acceptability in sensory evaluations.

These findings suggest that fermented plant juice is highly effective in promoting growth and yield, as well as improving sensory quality attributes of lettuce cultivars, making it a promising and sustainable organic input for leafy vegetable production. FPJ stands out as a highly effective and sustainable organic input for lettuce production, supporting both productivity and marketability.

5.0 Recommendations

Based on the findings and conclusions derived from this study, the following recommendations are presented:

1. The researcher recommends using Fermented Plant Juice (FPJ) as an organic foliar fertilizer to enhance lettuce's growth performance. FPJ significantly improves plant height, leaf number, leaf length, and root length, with results comparable to those of commercial organic fertilizers.
2. It is recommended that FPJ be applied to improve the biological and economic yield of lettuce cultivars, particularly Eton and Lollo Bionda, which demonstrated strong responses in both vegetative and sensory parameters.
3. It is also recommended that FPJ be utilized to enhance lettuce's sensory quality attributes, including taste, aroma, appearance, crispness, and overall acceptability, which are crucial for consumer preference and marketability.
4. The researcher recommends further studies on the application of FPJ across other leafy vegetables or high-value crops to validate its broader agricultural benefits and optimize formulation, frequency, and concentration.

6.0 Contributions of Authors

All the authors were responsible for the conceptualization of the study. Jeniffer P. Caberoy conducted and collected the necessary data, analyzed the study, and drafted the manuscript. Jesusa D. Ortuoste provided technical guidance, supervised the research process, and reviewed and edited the manuscript.

7.0 Conflict of Interest

The author declares no conflicts of interest, financial or otherwise, that could have influenced the study's findings or conclusions.

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