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RESPONSE OF LETTUCE (*Lactuca sativa* L.) APPLIED WITH DIFFERENT FERMENTED PLANT JUICE AS FOLIAR ORGANIC PLANT SUPPLEMENT

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ABSTRACT

Natural farming practices strive to maximize the utilization of locally available resources in agricultural production, and one such resource is fermented plant juices (FPJ). These juices serve as a rich source of essential nutrients, plant hormones, and minerals that directly impact the growth and development of lettuce *(Lactuca sativa L.)*. To investigate the effects of various fermented plant juices as foliar nutrients, a field experiment was conducted to evaluate the lettuce growth and yield performance. The treatments consisted of different plant extracts, namely *Ipomoea aquatica*, *Leucaena leucocephala*, and *Moringa oleifera*. The study findings indicate that there was a notable increase in plant height ($p<0.05$) at fifty (50) days after application. Additionally, it was observed that there was a significant increase ($p<0.05$) in the number of leaves at twenty-one (21) days of growing. Significant performance on lettuce also were found in terms of its yield as well as on the plant diameter ($p<0.05$). Among the various plant extracts tested, the leaves of Malunggay demonstrated superior performance and displayed comparability with the commercial foliar fertilizer. This finding suggests that *Moringa oleifera* extract has the potential to be effectively utilized as a foliar fertilizer for lettuce, offering advantages such as safe to use and cost-effectiveness for farmers. By harnessing the benefits of locally available resources like *Moringa oleifera*, natural farming practices can offer sustainable and economically viable alternatives to conventional chemical fertilizers.

Keywords: Fermented plant juice (FPJ), foliar organic fertilizer, *Moringa oleifera*, *Leucaena leucocephala*, *Ipomoea aquatica*, Natural farming

INTRODUCTION

Plant extracts have garnered significant interest as potential foliar sprays in agricultural practices, owing to their bioactive compounds that can enhance plant growth, nutrient uptake and pest and disease protection (Nautiyal & Lal, 2016; Poudel & Khatiwada, 2019; Soares et al., 2013; Santoso et al., 2021; Zhan et al., 2016; Toh et al., 2020). Multiple plant extracts were extensively studied for their exceptional efficacy in lettuce production.

This study investigates the effects of three specific plant extracts, namely Malungay (*Moringa oleifera*), Ipil – ipil (*Leucaena leucocephala)*, and Kangkong (*Ipomoea aquatica*, as foliar sprays on lettuce (*Lactuca sativa*). *Moringa oleifera*, known as the "miracle tree," possesses a rich nutrient profile and bioactive compounds (Bashir et al., 2016). Previous studies have shown positive outcomes when using *Moringa oleifera* leaf extract on lettuce growth and yield (Nautiyal & Lal, 2016; Poudel & Khatiwada, 2019).

Leucaena leucocephala, a leguminous tree species, has been extensively studied as a foliar spray for lettuce. Research has indicated the positive impacts of *Leucaena leucocephala* extract on lettuce growth and mineral nutrition (Soares et al., 2013; Santoso et al., 2021). Similarly, kangkong, a leafy green vegetable popular in Asian cuisines, has shown promising results as a foliar spray for lettuce, improving growth, physiological characteristics, and antioxidant capacity (Zhan et al., 2016; Toh et al., 2020).

While the effects of these plant extracts have been explored in various contexts, their application under conditions in Marawi City remains uninvestigated. This information will provide valuable insights into the potential practical application of these plant extracts in agricultural practices within the region. Moreover, determining which of these extracts performs better in the Marawi condition will help guide local farmers in selecting the most effective foliar spray option for optimizing lettuce growth, nutrient uptake and productivity as the whole.

MATERIALS AND METHODS

The experiment was conducted from February to April 2022 at the Experimental Research Area of the College of Agriculture, Mindanao State University, Marawi City, Lanao del Sur, (7.9939° N, 124.2581° E) under Adtuyon clay loam having an elevation of 833 m above sea level. The experimental site belongs to climatic type III wherein the season of the area is not pronounced and is characterized to have an even distribution of rainfall throughout the year. The study utilized Iceberg variety of lettuce developed by the East-West Seed Company. The study employed a Randomized Complete Block Design (RCBD) with five treatments and four replications. The treatments consisted of the following: no application of fermented plant juice (FPJ) as the control, *Ipomoea aquatica* extract, *Leucaena leucocephala* extract, *Moringa*

oleifera extract, and a commercial foliar fertilizer.Prior to the experiment, the land was thoroughly cleared of weeds using tools such as hoes, spading forks, trowels, and spades. The total area of the experimental plots was 68.25 m², divided into twenty plots measuring 1.5m x 1m each. The seeds were germinated in a seedling box containing a mixture of fine garden soil, vermicast, carbonized rice hull, and rice hull as the growing medium.Transferring of seedlings to the experimental site was done 14 days after germination with one seedling per hill at a distance of 25 by 30 cm. During transplanting, chicken manure and complete fertilizer were used as a basal application. The chemical fertilizer application were followed based on the recommendations provided by the manufacturer. Watering was carried out immediately after transplanting the seedlings, giving the soil sufficient moisture. To control weed competition, the researcher manually weeded the area using weekly using a trowel. Insect pests were monitored and controlled through manual hand-picking. Preparation and fermentation of the plant juices were conducted two weeks prior to transplanting the lettuce seedlings. Kangkong, Malunggay, and Ipil-Ipil was gathered and chopped. One (1) kilogram of it was mixed with 1 liter of molasses and placed in a separate pail by plants. This was covered with bond paper and fixed with a rubber band. The materials were left fermented for ten (10) days. The juice changed from dark green to yellow-brown or brown and smelled sweet and alcoholic. After fermentation, the juice was extracted using a cloth. The FPJ was diluted at 30 ml per liter of water. The fermented plant juices were then applied weekly for seven consecutive weeks. The application ratio used was 30 ml of fermented plant juice diluted to a liter of water (ATI, 2011). For commercial foliar fertilizer, manufacturer's recommendation consisting of 5 ml of commercial foliar fertilizer to a liter of water was prepared. Moreover, the recommended rate for FPJ is 1.5 tbps/L and the fermentation period should not be over 5 days (Denona et al., 2020). Their research suggests that a longer fermentation duration does not necessarily result in better productivity. Harvesting of the iceberg lettuce was carried out at 60 days after planting following the maturity age of this kind of variety. This was done in the late afternoon to avoid plant stress and dehydration. Harvesting tools such as knives were used to carefully cut the basal whorl of the plant. Data on growth and yield components were determined from ten experimental plants per treatment. Data collected on various parameters were recorded and statistically analyzed using analysis of variance (ANOVA). The significance of differences among treatment means was compared by Least Significant Difference (LSD) through STAR- Statistical Tool for Agricultural Research software version 2.0.1 that was developed by International Rice Research Institute (IRRI).

RESULTS AND DISCUSSIONS

Plant Height

The results presented in Table 1 demonstrate the mean data on plant height, measured at 7-day interval and the influence of fermented plant juice (FPJ) application after transplanting. The measurements were taken from the basal level of the plant to the highest tip. The analysis of variance revealed no significant differences among treatment means from 7-43 days after application. However, at 50 days after application, there was a significant variation in plant height among all the treatment means. The commercial foliar fertilizer measured the longest plant height which is comparable to malunggay plant extract.

These findings suggest that the application of fermented plant juice, specifically *Leucaena leucocephala* and *Moringa oleifera* extract, produces comparable results to the use of commercial foliar fertilizer in terms of plant height. These findings align with the study conducted by Julien (2022), which highlights FPJ as one of the best sources of bio-available nutrients for plant growth. The study indicates that FPJ enhances plant health and stimulates significant development (Hubilla, 2020). FPJ contains a wide range of nutrients from the source materials and also includes helpful bacteria that contribute to vegetative growth and act as natural growth promoters (ATI, 2011). It provides valuable insights of the potential benefits using fermented plant juice as a foliar spray in lettuce cultivation. It demonstrates its efficacy in promoting plant growth and indicates its suitability as an alternative to commercial foliar fertilizer.

Table 1. Plant height of lettuce (*Lactuca sativa* L.*)* at 7-day interval as affected by different fermented plant juice.

Plant extracts	Plant height (cm) Days after transplanting (dat)						
	7	**14**	**21**	**28**	**35**	**43**	**50***
No plant extract application	7.53	8.77	12.34	14.79	17.09	20.07	23.72 ^{bc}
Ipomoea aquatica	7.72	7.72	12.57	15.08	17.46	20.69	23.57 ^{c}
Leucaena leucocephala	7.61	9.09	12.44	15.32	17.40	20.92	24.28 ^{ab}
Moringa oleifera	7.90	9.12	12.68	15.53	17.74	21.04	24.50 ^{a}
Commercial foliar fertilizer	8.07	9.07	13.05	16.02	18.15	21.14	24.52 ^{a}

**Means followed with the same superscript are not significantly different from each other by the Least Significant Difference (LSD) Test.*

Number of Leaves

The number of leaves was measured at 7-day interval and the data was analyzed using analysis of variance (ANOVA). The results, as shown in Table 2, indicated no significant difference in terms of the number of leaves at 7 and 14 days after application.

However, at twenty-one days after the application, significant variations were observed among all the treatments. This suggests that the effectiveness of the treatments on lettuce growth became more evident over time. One possible explanation for the smaller number of leaves in the lettuce treated with organic extracts could be the lower availability of nutrients in the fermented plant juice compared to the inorganic foliar fertilizer.

Among the treatments, the commercial foliar fertilizer had most leaves. This could be attributed to its readily available macro and micronutrients that play a significant role in cell division and enhance food manufacturing processes. Furthermore, an abundant concentration of essential nutrients is prominently found in commercial foliar fertilizers.

Comparing the organic extracts, no significant difference was found between *Moringa oleifera* and *Leucaena leucocephala* extracts in terms of leaf number. *Ipomoea aquatica* extract had a slightly lower number of leaves among the three extracts. These findings suggest that *Moringa oleifera* and *Leucaena leucocephala* extracts had potential as effective alternatives to promote lettuce growth.

The study conducted by Abdullah et al. (2021) focused on the effects of extracts, particularly for *Moringa oleifera* juice, on leaf size and the number of leaves in various crops. Their findings indicated that the application of *Moringa oleifera* juice extracts resulted in increased leaf size and leaf number.

Table 2. Number of leaves of lettuce (*Lactuca sativa* L.*)* at seven days (7) intervals of growing.

Plant Extracts	Number of Leaves Days After Transplanting (DAT)		
	7	14	21*
No plant extract application	4.20	5.68	7.48 ^{c}
Ipomoea aquatica	3.95	5.38	7.83 ^{bc}
Leucaena leucocephala	4.00	5.63	7.50 ^{bc}
Moringa oleifera	4.07	5.55	7.90 ^{b}
Commercial foliar fertilizer	3.98	5.93	8.73 ^{a}

**Means followed with the same superscript are not significantly different from each other by the Least Significant Difference (LSD) Test.*

Yield and Yield Components

Plant diameter was found to be highest in the commercial foliar fertilizer application, as shown in Table 3. However, the application of fermented plant juices, such as *Leucaena leucocephala*, *Ipomoea aquatica*, and *Moringa oleifera* was found to be comparable to the commercial foliar fertilizer based on the statistical analysis.

During the growing period, the control or no plant extract application exhibited a lower plant diameter compared to all the treatments in the study. Generally, fermented plant juice (FPJ) is known for its nitrogen content, which is essential for plant processes in plants such as biological and physiological in nature, enhancing yield and quality (Leghari et al., 2016). FPJ provides plants with increased nitrogen, promoting vegetative growth and improving the capacity for photosynthetic growth. It also contributes to phosphorus availability and aids in the absorption of phosphorus from the soil by plants. Therefore, fermented plant juice can stimulate growth and enhance crop volume and size (Racoma and Beato, 2017).

The head size, head diameter, and weight of untrimmed heads of lettuce were numerically higher in the commercial foliar fertilizer compared to the application of FPJ and found not significantly different among

all treatments ($p<0.05$). When it comes the plant diameter of the whole plant biomass and its yield, shows significant result ($p<0.0.5$). However, among the various plant extracts used in the study, *Moringa oleifera* demonstrated superiority in terms of yield and yield components. Analysis of variance indicated that *Moringa oleifera* fermented juice is significantly comparable to the commercial foliar fertilizer. *Moringa oleifera* leaves contain numerous elements that are fundamental constituents of matter and contribute to optimal plant performance (Eva Tabuaa Gyamfil, 2011). This finding aligns with the study, suggesting that the application of *Moringa oleifera* extract positively affected lettuce yield. Its nutrient content present makes it suitable for use in any organic production.

Table 3. Yield and yield components such as plant diameter (PD), head size (HS), head diameter (HD), weight of untrimmed heads (WUH) and yield (Y) of harvested iceberg lettuce.

Plant Extracts	Yield Parameters				
	PD (cm)*	HS (cm)	HD (cm)	WUH (cm)	YLD(t/ha) *
No plant extract application	15.38 ^{b}	10.49	9.56	313.24	13.78 ^{c}
Ipomoea aquatica	16.42 ^{a}	10.99	9.50	319.01	13.98 ^{c}
Leucaena leucocephala	16.71 ^{a}	10.93	10.36	339.57	14.28 ^{c}
Moringa oleifera	16.70 ^{a}	11.13	10.76	348.24	18.88 ^{b}
Commercial foliar fertilizer	16.94 ^{a}	11.69	10.95	393.94	24.10 ^{a}

**Means followed with the same superscript within column are not significantly different from each other at by the Least Significant Difference (LSD) Test.*

CONCLUSION

The application of various fermented plant juices (FPJ) significantly enhanced the growth of the iceberg lettuce variety. Notably, among the FPJs utilized in the study, *Moringa oleifera* extract exhibited exceptional efficacy by significantly increasing the number of leaves at 21 days and plant height at 50 days after the application of plant extracts. The yield and yield components such as plant diameter and yield (t/ha) achieved with fermented *Moringa oleifera* were remarkably higher and comparable to commercial foliar fertilizer. Farmers now can use fermented *Moringa oleifera* extract as a viable alternative organic foliar fertilizer, promoting natural farming practices and for farm sustainability. In addition to being an economical approach that mitigates the high costs associated with chemical fertilizers in the market, *Moringa oleifera* leaves also hold the advantage of being locally available to the farmers.

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