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Banana peel, *A. pintoi*, and *T. gigantea* on Fermented Plant Juice (FPJ) Extracts and Coco-water as Growth and Yield (*Lactuca sativa* L.) Grown Hydroponic Systems

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ABSTRACT— Lettuce is cultivated as a leaf vegetable sometimes for seeds and stem. Most lettuce varieties are eaten fresh and commonly served as the base of green salads. Thus, this study employed an alternative of the fermented plant juice (FPJ) in an instance of intercepting something to banana peel (BP), *Arachis pintoi* (AP), and *Trichantea gigantea* (TG). The additives of coco-water (CW) appear in BP+AP+TG, and types of nutrient solution (CNS) with the outcome on the hydroponic system of growth and yield of lettuce. The experiment was laid out following a Simple Factor arranged in RCBD with three replications and have five (5) samples per treatment per replication. The following treatments were evaluated as T_1 - CW; T_2 - CNS; T_3 - BP+C; T_4 - AP+CW; T_5 - TG+CW; T_6 - BP+AP (1:1)+CW; T_7 - AP+TG(1:1)+CW; T_8 - TG+BP(1:1)+CW; and T^9 - AP+BP+TG(1:1:1)+CW. The results a significant effect on the plant height (taller height), number of leaves (more leaves), the diameter of leaves (wider leaver), and length of leaves (longer leaves) of the treatments by nutrient solution (T_2) of lettuce. The T_2 was comparable effect T1 but among in the treatments of the BP, AP, and TG in lettuce. The root length and root dry weight were a significant effect on the longer of roots to length and denser of the dried weight roof of T_2 in the treatment of lettuce, respectively. The yield that nutrient solution (T_2) had achieved the more immeasurable yield of lettuce. It shows T_2 and T1 were 11.14 and 7.98 ton/ha; respectively, acquired comparable effect in the treatments of high yield of lettuce.

KEYWORDS: Coco-water, commercial nutrient solution, fermented plant juice extracts (FPJ)

1. INTRODUCTION

Lettuce (*Lactuca sativa L.*) is the most popular salad vegetable in the country. It has high fiber content which is a good source of dietary supplements. It is considered a highly valued crop in the Philippines due to its higher margins in production [1]. In the Samar region, production of lettuce is just limited because of its fragile weather condition that affects the growth performance of lettuce. Generally, lettuce was eaten raw for salad recipes or "kinilaw" [2] which could be infected by *Escherichia coli* and *Salmonella enterica* as a risk factor [3] especially, when grown in the field. Those problems can be overcome through a hydroponics system of production under the protected structure. The hydroponics system is one of the important technologies that can be occupied in limited space with less amount of soil. Thereby, eliminating/reducing the problem of harmful microorganisms and soil acidity, and discourages the cause of flooding [4]. Accurately, banana peels are nutrients especially potassium of the element that is used as fertilizer. It is essential for promoting generally is necessary to help fruit grow and involved enzymes in a plant [5]. Farmers should include the yellow banana peels and mix them with the green ones for better effectiveness of the banana peel-based fertilizers [6]. In conclusion, *Arachis pintoi* as an aspect of the hydroponic system is a hydroponics culture system based on organic agriculture systems that do not use synthetic inputs such as fertilizers or pesticides. Organic hydroponics, nutrient solutions are derived from organic plant and animal material or naturally mined substances [7, 8, 9]. Finally, *Trichanther gigantea* is the fermentation of this plant species is among the highest

when compared to other fodder tree and shrub species and been assessed by the gas production method. This is very rapid fermentation occurs, illustrated here by the rate of fermentation of the rapidly fermentable fraction [10].

Furthermore, a hydroponic system is popularly used to come up with an off-season production during the onset of wet seasons [11]. However, the nutrients solution used in the hydroponic system was formulated commercially which is very costly and at times creates environmental problems. An alternative, affordable, and safest way to provide nutrients solution in hydroponics is the utilization of organic nutrients solution from different sources of fermented plant juice extracts such as banana peel, *Arachis pintoi*, and *Trichantera gigantea* which have higher nitrogen and potassium content (12). Because fermented plant juice extracts are organically formulated nutrients coming from plant's sap and chlorophyll's which has rich in enzyme solution and microorganisms such as lactic acid bacteria and yeast that invigorates plants growth and development [12,13].

However, the influence of coco-water as an additive for nutrient solution in the hydroponic system was still under verification. To come up with a protocol on the effectiveness of coco-water on the growth and yield of lettuce under a hydroponics system. Hence, this study was ascertained.

2. Material and Methods

2.1 Treatments and Experimental Design

The experiment was laid out following a Simple Factor arranged in RCBD with three replications and having five (5) samples per treatment per replication. The following treatments were evaluated:

T_1 - Coco-water (CW)
T_2 - Commercial nutrient solution (CNS) T3 - Banana peel (BP) + CW
T_4 - Arachis pintoi (AP) + CW
T_5 - Trichantea gigantea (TG) + CW
T_6 - BP + AP (1:1) + CW
T_7 - AP + TG (1:1) + CW
T_8 - TG + BP (1:1) + CW
T_9 - AP+BP+TG (1:1:1) + CW

2.2 Hydroponic Structure Installation

The coco lumber and bamboo were used as frame materials with plastic transparent polyethylene 'UV' plastic film in the roofing.

Figure 1. The coco lumber and bamboo were used plastic transparent 'UV' film in the roofing.

2.3 Container Preparation

The tray has a dimension of 30 cm long x 22 cm wide with a depth of 8 cm was used as a container in growing lettuce. Polyethylene transparent plastic was placed as a mat to support the medium in place.

2.4 Aggregate Preparation

Alluvial soil and coconut husk were used as a potting medium. Alluvial soil was thoroughly washed with clean tap water. The coconut husk was submerged in water for 3-5 days and allowed to dry by exposing to sunlight for 3 days and thereafter, it was finely chopped. A mixture ratio of 3:1 (3 pails of clean alluvial soil and 1 pail of dried coconut husk: v/v) were prepared and placed half-filled into the container.

2.5 Seedling Production

Seeds of lettuce were sown in seed boxes filled with a pasteurized mixture of garden soil, compost, and carbonized rice hull at a 1:1:1 ratio (v/v). It was placed under a shaded area. The seedlings were pricked 7 days after sowing into the seedling tray. The seedling was hardened by gradual exposure to sunlight and regular water withdrawal for 7 days.

2.6 Planting Distance

Planting distance of 10 cm per hill x 6 cm between rows was prepared before planting in which only healthy lettuce seedlings were considered as sample plants.

2.7 Preparation of Fermented Plant Juice (FPJ)

Arachis pintoi, *Trichantera gigantea*, and Banana peel of 5 kg were chopped into tiny pieces and thereafter placed separately in a plastic pail. It was mixed separately in 5 kg of brown sugar and was poured by the same quantity of water following the 1:1:1 ratio (v/v). Each sample of fermented plant juice was tightly covered with craft paper and then placed in a cool dry place. Thereafter, it was fermented for 1 month until a sweet/alcoholic odor appeared. The fermented *Arachis pintoi*, *Trichantera gigantea*, and Banana peel were strained by using an ordinary strainer (0.425-mm mesh). Each extracted plant juice was placed in a plastic container and directly stored in a cool and dry place before application.

2.8 Application of the different FPJ extracts solution

Different FPJ extracts at 1-liter volume were diluted in 15 liters of water (v/v). Inorganic nutrient solution (T_2) as formulated by [14] was used in the study. In treatment T_1, coco-water alone (CW) was applied. Meanwhile, T_3 (banana peel (BP) + CW), T_4 (*Arachis pintoi* (AP) + CW), and T_5 (*Trichantera gigantea* (TG) + CW) were applied at once following the rate of 50 ml for the 1st week, 100 ml for 2nd week, and 150 ml for 3rd week. However, treatment combination of T_6 - (BP + AP + CW), T7 (AP + TG + CW), T_8 (TG + BP + CW) were applied with the 1:1 ratio (v/v) following the same rate of application per week. Furthermore, T_9 (BP + TG + AP + CW) was applied with the 1:1:1 ratio (v/v) which was also applied with the same weekly application rate as previously mentioned.

2.9 Care and Management

Watering was done twice a day (early in the morning and late in the afternoon) at the minimum rate (50 ml) towards harvesting or as needed. Manual weeding was done as soon as the weeds appeared. Insects were controlled by handpicking.

2.10 Data Gathered

2.10.1 Horticultural Characteristics

a. Plant height. This was done by measuring the initial height one week after transplanting and final

height during harvest from the ground level up to the tip of the terminal end of the main stem using a ruler.

b. Number of leaves. This was done by counting the leaves produced by lettuce towards its growing period.

c. Length of leaves. This was obtained by getting the length from the tip of the leaf and at the base of the leaf.

d. Diameter of leaves. This was measured by getting the three broader leaves of lettuce.

2.10.2 Root Characteristics

a. Length of roots (cm) - This was obtained by measuring the longest roots of the lettuce at harvest.

b. Root dried-weight (ml) - This was obtained through the displacement method in which water was poured to a graduated cylinder at 400 ml level as the initial reading. The roots of lettuce were then soaked. The excess water displaces by the lettuce was recorded and mark as the final reading. The difference between the final and initial reading was recorded as the root dried-weight.

2.10.3 Yields

a. Yield per plant (ton/ha) - This was obtained by weighing all harvested leaves of lettuce divided by the number of harvested lettuce plants.

2.11 Data Analyses

Data analysis was done using the Statistical Tool for Agricultural Research (STAR), Plant Breeding Genetics and Biotechnology Biometrics and Breeding Informatics, version 2.0.1 software (2014). Treatment means were compared using Least Significance Difference (LSD) at a 5% level of significance.

3. Results and Discussion

3.1 Horticultural Characteristics

3.1.1 Plant Height (cm)

Table 1 showed a significant difference within treatments of the highest plant height of lettuce. The T2 (13.38 cm) was the longest plant height from among the coco-water, nutrient solution, banana peel, *Arachis pintoi;* and *Trichantera gigantean* in the treatment. This shows that the early growth of lettuce showed similar results from among treatments. But towards the vegetative period and vigorous growth was achieved from the liquid nutrient solution. However, coco-water (T_1) showed a consistent comparable effect to T_1 and T_4 were 11.05 and 9.68 cm of lettuce, respectively.

3.1.2 Number of Leaves

The number of leaves of lettuce was important for the increase in yield of the plant as the weight of leafy vegetables like lettuce will depend on leaf proliferation. Table 2 showed that a significant difference in the number of leaves was the highest average number of leaves T_2 (11.17) of lettuce. Coco- water (T_1) comparable effect to the nutrient solution (T_2) in the treatment. It indicates that the coco- water (T_1) significantly improved the leaf proliferation when applied alone.

3.1.3 Diameter of Leaves (cm)

The application a significant effect on the diameter of leaves of the nutrient solution (T_2) on 9.80 cm of lettuce. The nutrient solution (T_2) more leaves diameter from among the treatments in accept comparable in the T_1 (7.20). The results revealed that (T_1) coco-water had influenced the leaf expansion of leaf to increase as it shows a non-comparable banana peel, *Arachis pintoi*, and *Trichantera gigantean* in the treatments.

3.1.4 Length of Leaves (cm)

The quality of leaf produce from leafy vegetables will be improved when it attained the longest leaf of lettuce. The length of leaves showed had a significant effect among the treatment combination of lettuce. The longest leaves the length of 11.05 cm (T_2) of the nutrient solution in the treatments. It showed a comparable effect to T_1, T_3, and T_6 in the treatment of lettuce.

Table 1. Plant height, no. of leaves, diameter of leaves, and length of leaves of lettuce at 25 days recorded after transplanting (cm).

Treatments	Plant Height *(cm)*	No. of Leaves	Diameter of Leaves *(cm)*	Length of Leaves *(cm)*
T_1 - CW	11.05 ^{ab}	8.00 ^{ab}	7.12 ^{ab}	8.47 ^{ab}
T_2 - NS	13.38 ^{a}	11.17 ^{a}	9.80 ^{a}	11.05 ^{a}
T_3 - BP+ CW (1:1)	9.15 ^{b}	6.67 ^{b}	5.25 ^{b}	7.08 ^{ab}
T_4 - AP + CW (1:1)	9.68 ^{ab}	6.50 ^{b}	4.85 ^{b}	7.03 ^{b}
T_5 - TC + CW (1:1)	9.10 ^{b}	5.50 ^{b}	4.70 ^{b}	7.03 ^{b}
T_6 - AP + BP +CW (1:1:1)	8.78 ^{b}	5.83 ^{b}	4.63 ^{b}	7.87 ^{ab}
T_7 - BP + TC + CW (1:1:1)	8.77 ^{b}	5.00 ^{b}	4.23 ^{b}	5.82 ^{b}
T_8 - AP + TC + CW (1:1:1)	8.93 ^{b}	6.50 ^{b}	4.63 ^{b}	5.52 ^{b}
T_9 - AP + BP + TC + CW (1:1:1:1)	8.38 ^{b}	5.00 ^{b}	4.10 ^{b}	5.62 ^{b}
% CV	*14.73*	*17.15*	*19.33*	*17.83*

Means with the same letter are not significantly different at 5% level using Tukey's Test.
*CW – Coco water; NS – Nutrient solution; BP – Banana peel; AP - *Arachis pintoi*; and TC - *Trichantera gigantean*

The plant height, number of leaves, the diameter of leaves, and length of leaves were (T_2) nutrient solutions of lettuce. The banana peel, *Arachis pintoi*; and *Trichantera gigantean* of the fermented plant juice were not very significant sources that useful in the benefactor vegetable in the treatments. Despite its wide production and utilization, the optimum production of lettuce has not been attained in the area. This article will explore the hydroponic lettuce nutrients which were essential for healthy plants and decide which plant to cultivate [15]. Variety of lettuce because it grows in small and loose heads that were easy to handle [16]. Traditionally, maintaining a healthy hydroponic system of the nutrient solution (T_2) of lettuce though pH level (acid or acidic) [17], [18], and increase of acidity of fermented plant juice [19], the organic nutrient solution did not affect the growth performance relative inorganic nutrient solution [20]. In contrast, the hydroponics systems of unintentionally leave out one of the fertilizer salts or use the wrong fertilizer salt in the mixture [15], [21], calcium is one of the nutrients that will prevent hydroponics plants [16], and ppm (parts per million), TDS (total dissolved solids), EC (osmotic concentration), and CF (conductivity factor) of meter measurement of nutrients to the water of hydroponics system [22]. Whereas, the comparable effect of coco-water (T_1) was a high K (potassium) serving of water, rich in vitamins, minerals, and other nutrients [23]. The influence of K in coco-water was reported [24] in pechay in which exchangeable K in soil is greater than the commercial liquid fertilizer. Moreover, [25] found out that coco water has higher cytokinin's which regulates in maintaining greenness of leaves and encourages cell division of plants towards its growth and development.

3.2 Root Characteristics

3.2.1 Root Length and Root dried-weight

Root length of lettuce has a significant influence on all treatments evaluated in Table 2. It signifies that nutrient

solution (T_2) had influenced the root length and root dried-weight (DW) of lettuce were 14.70 cm and 4.67 g; hence, comparable effect root length and root DW of coco-water were obtained from among treatments, respectively. The results showed that longer of root length and denser of root DW or quantity of root produce of lettuce. Furthermore, the application of different fermented plant juice extracts (*Arachis pintoi*, *Tricahntera giantea*, and banana peel) did not significantly influence the rooting performance of lettuce as it has comparable value with that of coco-water alone (T_1). This was confirmed by [26] that it numerously produces a healthy rooting system. The influence of CNS was revealed by [27] from tomato crop grown under hydroponics system in which it produces better rooting system as compared to different FPJ extracts (organic) formulations.

Table 2. Root length and root dried-weight at 25 days after transplanting (cm, ml).

Treatments	Root Length *(cm)*	Root dried-weight *(ml)*
T_1 - CW	12.07^{ab}	3.00^{ab}
T_2 - NS	14.70^{a}	4.67^{a}
T_3 - BP+ CW (1:1)	9.92^{b}	2.67^{b}
T_4 - AP + CW (1:1)	9.95^{b}	2.67^{b}
T_5 - TC + CW (1:1)	8.47^{b}	2.33^{b}
T_6 - AP + BP +CW (1:1:1)	7.93^{b}	2.00^{b}
T_7 - BP + TC + CW (1:1:1)	7.65^{b}	2.17^{b}
T_8 - AP + TC + CW (1:1:1)	7.28^{b}	1.33^{b}
T_9 - AP + BP + TC + CW (1:1:1:1)	6.42^{bc}	1.33^{b}
% CV	*33.88*	*38.08*

% CV 33.88 38.08

Means with the same letter are not significantly different at 5% level using Tukey's Test.

3.3 Yield

The results of the actual yield and computed yield per g/plant and tons/ha of lettuce grown under the hydroponic system in Table 3. It shows that nutrient solution (T_2) had achieved the highest yield as compared to the banana peel, *Arachis pintoi*, and *Trichantera gigantean* in the treatment. The nutrient solution (T_2) was 11.14 ton/ha of the more immeasurable yield lettuce in the treatment. However, acquired comparable affect coco-water (T_1) of 7.98 ton/ha to the lettuce yield. Furthermore, the higher yield of lettuce obtained by CNS (T_2) under hydroponics system from this study was within the range of 4.4 to 7.8 ton/ha equivalent to the actual 2.2 to 3.9 kg/m as reported by [28]. Oppositely of acquiring, banana peel + coco-water (T_3) and Arachis pintoi + coco-water (T_4) were 4.62 and 4.57 ton/ha; respectively, to within the extent proceeding in the treatments [28]. However, the average yield of lettuce was very low compared to other treatments due to T_3 and T_4 thought within the practical application.

Table 3. Yield of lettuce at of 25 days after transplanting.

Treatments	Actual Yield *g/plant*	Computed Yield *ton/ ha*
T_1 - CW	5.99^{ab}	7.98^{ab}
T_2 - NS	8.36^{a}	11.14^{a}
T_3 - BP+ CW (1:1)	3.47^{b}	4.62^{b}
T_4 - AP + CW (1:1)	3.43^{b}	4.57^{b}

T_5 - TC + CW (1:1)	2.53^{bc}	3.37^{bc}
T_6 - AP + BP +CW (1:1:1)	2.45^{bc}	3.26^{bc}
T_7 - BP + TC + CW (1:1:1)	2.00^{bc}	2.66^{bc}
T_8 - AP + TC + CW (1:1:1)	2.97^{b}	3.96^{b}
T_9 - AP + BP + TC + CW (1:1:1:1)	1.64^{c}	2.18^{c}
% CV = 34.57		

Means with the same letter are not significantly different at 5% level using Tukey's Test.
*2,000,000 kg of soil and 1.5 kg per lettuce

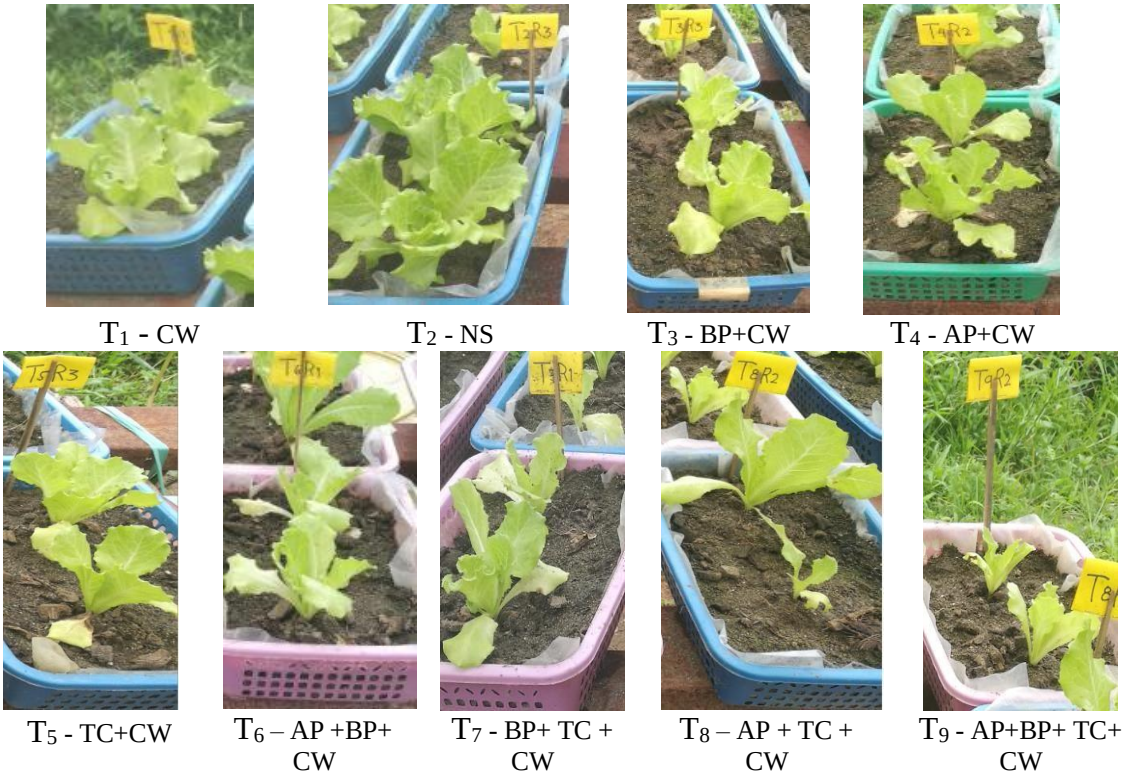

Figure 2. The coco-water, nutrient solution, Banana peel, A. pintoi; and T. gigantean in the treatments on lettuce.

4. Conclusions

The significant effect on the plant height, number of leaves, the diameter of leaves, and length of leaves of the treatments by nutrient solution (T_2) of lettuce. The root length and root dry weight was a significant effect on the longer of root length and denser of root dried weight of T_2 in the treatment of lettuce. The yield that nutrient solution (T_2) had achieved the more immeasurable yield of lettuce. However, the average yield of lettuce was very low compared to other treatments due to T_3 and T_4 thought within the practical application.

5. Recommendations

a. The meter measurement of nutrients like ppm (parts per million), TDS (total dissolved solids), EC (osmotic concentration), and CF (conductivity factor) will help ensure that you know hand to make adjustments for success to the water with FPJ extract on the banana peel, *Arachis pintoi*, and *Trichantera gigantean* in treatment of hydroponics system of lettuce.

b. The hydroponics systems unintentionally leave out of the fertilizer salts or use the wrong fertilizer salt in the mixture FPJ extract in the treatments.

c. Calcium is one of the nutrients that will prevent hydroponics produce good FPJ extract plants.

d. The influence of potassium (K) in coco-water was in pechay, and also left on lettuce of keeps in FPJ extract hydroponics production system.

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