Additive Effects of Coco-water on Fermented Plant Juice (FPJ) Extracts Influencing the Growth and Yield of Lettuce (Lactuca sativa L.) Grown under Hydroponics System

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Abstract – *Lettuce (Lactuca sativa L.) is the most demanded vegetable for salad. In hydroponics, cost of production is very expensive because of the higher cost incurred from commercial nutrient solution (CNS). Thus, this study employed an alternative for CNS which is organic nutrient solution with the additives of coco-water and was conducted to determine the influence of coco-water, types of nutrient solution and its interaction effect on the growth and yield of lettuce and to determine the economic analysis coco-water as an additive. The experiment was laid-out by 2x9 split-plot factorial arranged in RCBD with three replications.*

The addition of coco-water had significantly increased the length and diameter of leaves; plant height; percent foliage N and K content; length, fresh and oven-dry weight of roots; and yield relative to without coco-water addition.

The types of hydroponic solution had influenced all the growth and yield parameters in which CNS had predominantly increased the number, length and diameter of leaves; plant height; percent foliage of N, P and K content; length, fresh and oven-dry weight of roots; and yield of lettuce relative to FPJ extracts and coco-water alone application.

Significant interaction effect was obtained between coco-water and types of nutrient solution. Addition of coco-water had significantly increased the percent foliage P and K; fresh and oven-dry weight of roots; and yield relative to without the addition coco-water which was observed greatly in CNS.

Application of coco-water as hydroponics nutrient solution and as an additive to hydroponics solution was financially viable which has positive net present value and higher percentage of internal rate of return (IRR).

Keywords*: Coco-water, hydroponics, commercial nutrient solution, fermented plant juice extracts (FPJ)*

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 as high valued crops in the Philippines due to its higher margins in production [1].

In 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 possibly be infected by *Escherichia coli* and *Salmonella enterica* as risk factor [3] especially, when grown in the field. Those problems can be overcome through hydroponics system of production under protected structure. 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]. Furthermore, hydroponic system was popularly used to come up with an off-season production during the onset of wet seasons [5].

However, nutrients solution used in 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. 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. However, Salas *et. al* [6] as cited by Malinao [7] revealed that organic nutrient solution did not greatly affects the growth performance of lettuce relative to inorganic nutrient solution. This might be due to the increase of acidity of fermented plant juice incurred throughout the growing period of lettuce which was brought about by the rapid oxidation process of starch and sugar to form acetic acid [8]. This in effect could possibly threatened the crops when applied in longer duration. Even though, it was diluted with water prior to application but still the acetic acid accumulation has already merged from the FPJ extracts stock solution. Moreover, at the time of application, losses of important nutrients might occur due to gradual exposure of formulated nutrient solution into the air or volatilization. Therefore, to come up with greater uphold of available nutrients and to stabilize acidity of FPJ formulated nutrient extracts solution, it can be recovered by adding coco-water as mixture additives component. The richness of nutrients component of coco water was reported by Zafar [9] in which a single coconut has 308 grams serving of water; rich in vitamins, minerals and other nutrients; and higher potassium content of 249 mg/100 ml coco-water which is close to twice the amount in banana that is important for electrolytes. The potassium content of harvested lettuce was 247 mg per 100g of lettuce which has almost the same amount in 100 ml of coco-water as previously mentioned by Zafar [9]. The influence of K in coco-water was reported by Roldan [10] in pechay in which exchangeable K in soil is greater than the commercial liquid fertilizer. Moreover, Founder [11] 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. This was observed in the in-vitro micropropagation of banana where the coco-water have significantly increased the number and length of shoots [12]. However, the influence of coco-water as an additives for nutrient solution in 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. Hence, this study was ascertained.

OBJECTIVES OF THE STUDY

The study aimed to determine the influence of coco-water as an additive; to determine influence of different types of nutrient solution, and their interaction effect influencing the growth and yield of lettuce under hydroponic system; and to determine the economic analysis (net present value) of using coco-water as additives for hydroponics solution.

MATERIALS AND METHOD

Treatments and Experimental Design

The experiment was laid out following a 2 x 9 factorial split-plot arranged in RCBD with three replications and having five (5) samples per treatment per replication.

The following treatments were evaluated:

A. Main plot. Additives nutrient solution application
   W_1 – without coco water
   W_2 – with coco water
B. Sub-plot. Types of nutrient solutions
   T_1- Control (water alone)
   T_2 - Commercial liquid nutrient solution (CNS)
   T_3 - Banana peel (BP)
   T_4- *Arachis pintoi* (AP)
   T_5 – *Trichantea gigantea* (TG)
   T_6- BP + AP (1:1)
   T_7- *AP* + *TG* (1:1)
   T_8- *TG* + BP (1:1)
   T_9-AP+BP+TG (1:1:1)

Hydroponic Structure Installation

Coco lumber and bamboo were used as frame materials with plastic transparent 'UV' film as roofing.

Container Preparation

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

Aggregate Preparation

Alluvial soil and coconut husk were used as 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. Mixture ratio of 3:1 (3 pail of clean alluvial soil and 1 pail of dried coconut husk: v/v) were prepared and placed half-filled into the container.

Seedling Production

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

Planting Distance

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

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 a 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 cooler dry place. Thereafter, it was fermented for 1 month until 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 prior to application.

Application of the different FPJ extracts solution

Different FPJ extracts at 1-liter volume was diluted in 15 liters of water (v/v). Inorganic nutrient solution (T_2) as formulated by Salas *et al.* [6] was used in the study. In treatment T_1, coco-water alone was applied. Meanwhile, T_3 (banana peel), T_4 (*Arachis pintoi*), and T_5 (*Trichantera gigantea*) 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 - (banana peel + *Arachis pintoi*), T_7 - (*Arachis pintoi* + *Trichantera gigantea*), T_8- (*Trichantera gigantea* + banana peel) were applied with the 1:1 ratio (v/v) following the same rate of application per week. Furthermore, T_9 (Banana peel + *Trichantera gigantea* + *Arachis pintoi)* was applied with the 1:1:1 ratio (v/v) which was also applied with the same weekly application rate as previously mentioned.

The coco-water (W_2) (assigned as the main-plot) was applied uniformly to all sub-plot treatments (types of nutrient solution) following also with the same application rate of 50 ml, 100 ml and 150 ml for the 1st, 2nd and 3rd week, respectively. Fresh coco-water juice was applied in lettuce right after it was transplanted in the container. Meanwhile, without application of coco-water (W_1) (assigned as the main-plot) was initiated for every sub-plot treatment (types of nutrient solution).

Nutrient solutions were applied once every morning until lettuce was harvested.

Care and Management

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

Data Gathered

1. Number of leaves. This was done by counting the leaves produced by lettuce towards its growing period.
2. Length of leaves. This was obtained by getting the length of from the tip of the leaf and at the base of the leaf.
3. Diameter of leaves. This was measured by getting the three broader leaves of lettuce.
4. 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.
5. Length of roots (cm). This was obtained by measuring the longest roots of the lettuce at harvest.
6. Fresh and oven dried weight of roots. The fresh root detached from harvested lettuce was thoroughly washed with water, air dried for 30 minutes, and weighed by using a platform balance. The samples were then oven dried at 70 ^{O} C for 3 days, allowed to cool off for about 1 hour. It was then weighed again in a platform balance to measure the oven-dried weight.
7. Yield per plant (g). This was obtained by weighing all harvested leaves of lettuce divided by the number of harvested lettuce plants.
8. Economic Analysis (NPV)

   This was done by using the formula of NPV:

   $NPV = C \times \{(1 - (1 + R)^{-T}) / R\} - \text{Initial Investment}$

   Where;

   C= expected cash flow per period

   R = required rate of return

   t = the number of periods in the future the cash flow is initiated
9. Nutrient Levels Analyses for N, P, K

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RESULTS AND DISCUSSION

Table 1. Horticultural growth and development characteristics of lettuce 25 days after planting

TREATMENT	NUMBER OF LEAVES	LENGTH OF LEAVES (cm)	DIAMETER OF LEAVES (cm)	PLANT HEIGHT (cm)	Percent (%)		
					N	P	K
Main plot (A). *Additives nutrient application*							
W1- without coco-water	5.59	5.59 b	4.35 b	10.02 b	0.11b	0.15	0.51 b
W2- with coco-water	6.69	7.72 a	5.48 a	10.79 a	0.18a	0.23	0.71 a
Sub-plot (B). *Types of nutrient solution*							
T1- coco-water alone	7.08 b	7.00 b	6.17 b	11.28 b	0.17b	0.15 bc	0.44 c
T2- commercial liquid nutrient sol'n (CNS)	10.08 a	10.57 a	8.53 a	14.30 a	0.31a	0.40 a	1.12 a
T3- Banana peel (BP)	6.00 bc	6.04 b	4.58 bc	9.93 b	0.14b	0.17 bc	0.45 cd
T4- *Arachis pintoi* (AP)	6.17 bc	6.18 b	4.24 bc	10.57 b	0.13b	0.22 b	0.64 c
T5- *Trichantera gigantea* (TC)	5.33 bc	5.85 b	4.07 c	9.32 b	0.11b	0.17 bc	0.56 bcd
T6- BP+AP	5.42 bc	6.69 b	4.21 bc	9.52 b	0.11b	0.16 bc	0.56 bc
T7- BP+TC	4.42 c	4.96 b	3.82 c	9.57 b	0.10b	0.16 bc	0.56 b
T8- AP+TC	5.83 bc	7.16 b	4.81 bc	10.04 b	0.11b	0.21 b	0.51 c
T9- AP + BP + TC	4.92 bc	5.43 b	3.83 c	9.14 b	0.13b	0.16 bc	0.57 bcd
A x B	NS	NS	NS	NS	NS	S	S
CV (A)	28.5	23.28	6.41	28.50	30.79	70.13	30.81
(B)	18.98	22.49	21.42	18.98	22.46	18.97	11.54

Means within additives nutrient application and types of nutrient solution column having the same letter do not differ significantly at 5 % level of significance using LSD. S- significant; NS- non-significant

Sample roots used in dry weight determination were ground using Willey mill and then were submitted to the Central Analytical Services Laboratory of the Philippine Root Crops Research and Training Center, Visayas State University for N, P and K analyses.

Data Analysis

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 5% level of significance.

Horticultural Characteristics of Foliage Growth of Lettuce

The length and diameter and plant height were significantly influenced by coco-water application (Table 1). The application of coco-water (W_2) had longer and broader leaves with much taller lettuce plant relative to without application of coco-water (W_1) 25 days after planting. This was reported by Roldan [9] on pechay in which application of formulated liquid fertilizer from coco-water nutrient solution had significantly increased its plant height. Furthermore, Mondal *et al*. [12] revealed that coco-water from *in-vitro* application significantly increased shoot length of banana var. *cavendish* explants. The positive effect of coco-water as additives could possibly attributed by the presence of undefined nutrients as well as growth hormones and vitamins needed for cell development [9; 13; 14; 11]. However, no significant effect was observed in the number of leaves parameter.

Regardless of additives nutrient application, types of nutrient solution had significantly influenced the number, length and diameter of leaves, and plant height of lettuce 25 days after planting. Application of CNS (T_2) had more, longer and broader leaves and produces taller lettuce plant as compared to different type and combination of FPJ extracts (T_3 to T_9) as well as in the control (T_1). This was confirmed by Williams [15] from lettuce grown under re-circulating hydroponic system that organically formulated fertilizer had much lower nitrate-nitrogen concentrations in the leaf cells which resulted to have a smaller leaf size and growth compared to those produced from inorganic fertilizers. Furthermore, there was no significant effect from the type and combination of different fermented plant

extracts which showed comparable effect from each other.

All horticultural characteristics of foliage growth and development evaluated were all not significantly influenced by the interaction effect between additives nutrient solution and types of nutrient solution.

N, P and K Analyses of Foliage of Lettuce

The percent N and K of foliage of lettuce was significantly influenced by additives nutrient solution application (Table 1). The influenced of with coco-water application (W_2) has higher percent foliage N and K content as compared to without coco-water application (W_1). This could probably due to the higher nutrient presence in coco-water. The higher percent N of lettuce foliage could be the result of better foliage growth faced by lettuce from 25 days growing period (Table 1). This was confirmed by Mondal [12] in banana explants that coco-water has much higher reduced N compounds which significantly increased the frequency of shoots regeneration, multiplication and elongation. Furthermore, the increased of percent foliage K content obtained by coco-water application could possibly due to the presence of higher K content of coco-water (249 mg of K/100 ml) as reported by Zafar [9]. Meanwhile, no significant effect was observed in percent phosphorus (P) of lettuce foliage.

Table 2. Interaction effects between coco-water and different types of nutrient solution on percent P and K of lettuce foliage 25 days after planting

Types of Nutrient Solution	P (%)		K (%)	
	without coco-water	with coco-water	without coco-water	with coco-water
T1- coco-water alone	0.168 Ab	0.152 Ac	0.317 Bd	0.561 Ab
T2- commercial liquid nutrient sol'n (CNS)	0.335 Ba	0.462 Aa	1.078 Aa	1.165 Aa
T3- Banana peel (BP)	0.112 Ab	0.237 Abc	0.337 Bcd	0.574 Ab
T4- *Arachis pintoi* (AP)	0.150 Bb	0.289 Ab	0.565 Ab	0.723 Ab
T5- *Trichantera gigantea* (TC)	0.125 Ab	0.217 Abc	0.498 Abcd	0.619 Ab
T6- BP+AP	0.103 Ab	0.221 Abc	0.526 Bbc	0.711 Ab
T7- BP+TC	0.099 Ab	0.224 Abc	0.535 Ab	0.594 Ab
T8- AP+TC	0.158 Ab	0.270 Ab	0.315 Bd	0.705 Ab
T9- AP + BP + TC	0.117 Ab	0.205 Abc	0.452 Bbcd	0.690 Ab

Interaction Effects

There was a significant interaction effect between additives nutrient solution and different types of nutrient solution on percent P and K of lettuce foliage (Table 2). Significance difference was observed from with and without coco-water application for both percentages of P and K foliage content of 0.13 and 0.09, respectively. This was greatly observed in CNS (T_2) and with coco-water application or vice versa. Numerically, the influence of adding coco-water from among FPJ extract as well in the control treatment enhances the percentages of P and K content of lettuce foliage.

Means within additives nutrient application having big letter and types of nutrient solution having the small letter in a column do not differ significantly at 5 % level of significance using LSD.

Horticultural Characteristics of Root Development of Lettuce

The additive nutrient solution had significantly influenced the root development of lettuce 25 days after planting (Table 3). Coco-water (W_2) has longer and heavier root mass as compared to without coco-water application (W_1). The increased of length and fresh and dry weight of roots of lettuce could possibly attributed from longer and broader leaf production of lettuce (Table 1). The significant effect of coco-water in hastening root development was reported by the Dunsin *et al*. [16] on *Parkia biglobosa* cuttings that application of coco-water had significantly increased the number and percentage of roots due to presence of cytokinins. The influence of cytokinin was further explained by Yong *et al*. [17] that it helps stimulate the root growth and development of a certain crops via auxin synergist.

Meanwhile, the types of nutrient solution application had significantly influenced the length, fresh and dry weight of roots of lettuce 25 days after planting. Application of CNS (T_2) had significantly longer and heavier root mass as compared to different types of FPJ extract (T_3 to T_9) and coco-water alone (T_1). The higher number and weight of lettuce roots might be attributed by the better quality of lettuce foliage production (Table 1). This was confirmed by Wood [18] that it numerously produces healthy rooting system. The influence of CNS was revealed by Rosalada [19] from tomato crop grown under hydroponics system in which it produces better rooting system as compared to different FPJ extracts (organic) formulations. Furthermore, the application of different plant extracts (*Arachis pintoi*, *Tricahntera giantea* and banana peel) did not significantly influenced the rooting performance of lettuce as it has comparable value with that of coco-water alone (T_1).

Table 3. Horticultural root development characteristics and yield of lettuce 25 days after planting

TREATMENT	LENGTH OF ROOTS (cm)	FRESH WEIGHT OF ROOTS (gram)	OVEN DRY WEIGHT OF ROOTS (gram)	YIELD (kg m^{-1})
Main plot (A). *Additives nutrient application*				
W1- without coco-water	10.81 b	0.92 b	0.44 b	1.33 b
W2- with coco-water	12.84 a	1.58 a	1.12 a	1.70 a
Sub-plot (B). *Types of nutrient solution*				
T1- coco-water alone	11.71 b	1.72 b	0.92 b	1.32 b
T2- commercial liquid nutrient sol'n	16.90 a	3.45 a	2.92 a	2.79 a
T3- Banana peel (BP)	10.43 bc	0.90 c	0.54 b	1.30 b
T4- *Arachis pintoi* (AP)	11.99 b	0.93 c	0.55 b	1.23 b
T5- *Trichantera gigantea* (TC)	11.04 b	0.79 c	0.40 b	1.28 b
T6- BP+AP	11.54 b	0.97 bc	0.47 b	1.32 b
T7- BP+TC	9.71 c	0.70 c	0.35 b	1.19 b
T8- AP+TC	11.87 b	1.06 bc	0.62 b	1.42 b
T9- AP + BP + TC	11.27 b	0.68 c	0.27 b	1.28 b
A x B	NS	S	S	S
CV (A)	8.58	54.87	72.83	11.51
(B)	28.82	31.24	71.70	16.57

Means within additives nutrient solution having big letter and types of nutrient solution having the small letter in a column do not differ significantly at 5 % level of significance using LSD.

Fresh and dry weight of roots was significantly affected by coco-water x different types of nutrient solution (Table 4). The results indicated that the magnitude difference between additives nutrient solution application depends on different types of nutrient solution, and vice versa. The application of coco-water has significantly higher fresh and dry weight with a difference of 1.36 and 1.45, respectively than without coco-water application and this was observed in CNS (T_2). However, in terms of fresh weight, although noncomparable to T_2, the application of with and without coco-water have showed a noncomparable effect for each other as observed in coco-water alone (T_1). Coco-water have heavier fresh weight of lettuce foliage relative to without coco-water with a difference of 1.83 gram.

Table 4. Interaction effect between coco-water and different types of nutrient solution on fresh weight, oven-dry weight and yield of lettuce foliage 25 days after planting

Types of Nutrient Solution	FRESH WEIGHT OF ROOTS (gram)		OVEN-DRY WEIHGT OF ROOTS (gram)		YIELD (kg m^{-1})	
	without coco-water	with coco-water	without coco-water	with coco-water	without coco-water	with coco-water
T1- coco-water alone	0.80 Bb	2.63 Ab	0.40 Ba	1.43 Ab	1.17 Ab	1.47 Ab
T2- commercial liquid nutrient sol'n (CNS)	2.77 Ba	4.13 Aa	1.47 Ba	2.92 Aa	2.16 Ba	3.42 Aa
T3- Banana peel (BP)	0.67 Ab	1.13 Ac	0.37 Aa	0.70 Ab	1.13 Ab	1.48 Ab
T4- *Arachis pintoi* (AP)	0.63 Ab	1.23 Ac	0.43 Aa	0.67 Ab	1.11 Ab	1.33 Ab
T5- *Trichantera gigantea* (TC)	0.70 Ab	0.87 Ac	0.23 Aa	0.57 Ab	1.18 Ab	1.38 Ab
T6- BP+AP	0.90 Ab	1.03 Ac	0.33 Aa	0.60 Ab	1.10 Bb	1.54 Ab
T7- BP+TC	0.43 Ab	0.97 Ac	0.17 Aa	0.53 Ab	0.93 Bb	1.44 Ab
T8- AP+TC	0.87 Ab	1.20 Ac	0.30 Aa	0.93 Ab	1.13 Bb	1.71 Ab
T9- AP + BP + TC	0.53 Ab	0.83 Ac	0.23 Aa	0.30 Ab	0.98 Bb	1.57 Ab

Means within additives nutrient solution having big letter and types of nutrient solution having the small letter in a column do not differ significantly at 5 % level of significance using LSD.

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Yield

The yield of lettuce was significantly influenced by the additives nutrient solution application (Table 3). Coco-water (W_2) had significantly higher yield as compared to without coco-water application (W_1) with a difference of 0.37 kg m^{-1}. This was possibly attributed by the better quality of foliage produce from the addition of coco-water (Table 1) accompanied by more intact and well develop lettuce rooting system (Table 3).

Regardless of additive nutrient solution, the yield of lettuce was significantly affected by the type and combination of nutrient solution. CNS (T_2) had significantly higher yield as compared to different types and combination of FPJ extracts (T_3 to T_9) and to coco-water alone (T_1).

Commercial liquid nutrient solution (2.79 kg m^{-1}) was as much as twice higher than from the rest of the FPJ extracts and coco-water alone treatment which has an average of 1.29 kg m^{-1} and 1.32 kg m^{-1}, respectively. The higher yield of lettuce obtained by CNS (T_2) under hydroponics system from this study was within the range (2.2 kg m^{-2} to 3.9 kg m^{-2}) as reported by Fallovo [20].

Interaction Effects

Yield of lettuce was significantly influenced by the interaction effect of additive nutrient solution and types and combinations of nutrient solution (Table 4). The application of coco-water significantly increased the yield of lettuce by 1.26 kg m^{-1} which was greatly observed in the CNS (T_2) and/or vice versa as compared to the other treatments. Meanwhile, in terms of types of nutrient solution, addition of coco-water had significantly higher yield than without coco-water with an average difference of 0.53 kg m^{-1} which was observed from 2 and 3 combinations of FPJ extracts (T_6 T_7 , T_8 , and T_9) of coco-water application but are comparable from T_1, T_3, T_4 and T_5 or single FPJ extract application.

Economic Analysis

Financial Viability

The projected profitability for 5 months investment for without coco-water (W_1) was not viable as it has negative net present value (NPV) (Table 5). On the other hand, the addition of coco-water (W_2) to hydroponics solution was financially feasible which was driven by hydroponics structure and cost. The average NPV towards investing coco-water as an additive in hydroponic lettuce production is approximately PhP 3,000. Given with a discount rate at 20%, the results indicated that the additional of coco-water had greatly improved the NPV of PhP 111.68 in a 10 m^2 hydroponics structure. Moreover, coco-water has real rate of return earned of investment by 24.54%. This indicates that by adding coco-water to different hydroponics solution showed a positive opportunity towards investing lettuce production under hydroponic system.

Table 5. Projected cash flow and investment returns additives nutrient solution from lettuce production under hydroponics system, 10 m^2 structures in peso (Php).

	Without coco-water (W_1)					With coco-water (W_2)				
	Months					Months				
Item	1	2	3	4	5	1	2	3	4	5
Cash inflows:										
* *Gross returns*	1,330	1,330	1,330	1,330	1,330	1,729	1,729	1,729	1,729	1,729
Cash outflows:										
Establishment cost	1,835					1,835				
Operational cost:										
Materials	180	80	100	80	100	280	180	200	180	200
Labor	800	800	800	800	800	800	800	800	800	800
Transport & mktg.	100	100	100	100	100	100	100	100	100	100
Repair & mgt.		100	100	100	100		100	100	100	100
Total Cash Flows	2,915	1,080	1,100	1,080	1,100	3,015	1,180	1,200	1,180	1,200
Net Cash Flows	-1,585	250	230	250	230	-1,286	549	529	549	529
NPV (r=20%)	-823.00					111.68				
IRR	-17.55%					24.54%				

* Selling price is 100 pesos per kilo

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Table 6. Projected cash flow (NPV) and investment returns of different nutrient solution of lettuce production under hydroponics system, 10 m^2 structures in peso (Php).

Types of Nutrient Solution	NPV (20%)	IRR (%)
T_1- coco-water alone	193.00	35.40
T_2- CNS	412.54	40.53
T_3- Banana peel (BP)	-808.00	-43.90
T_4- *Arachis pintoi* (AP)	-1177.00	-26.67
T_5- *Trichantera gigantea* (TC)	-997.00	-19.01
T_6- BP+AP	-738.40	-7.20
T_7- BP+TC	-1227.00	-23.53
T_8- AP+TC	-567.00	-2.08
T_9- AP + BP + TC	-1635.00	-12.52

Regardless of additives nutrient solution, the economic viability of lettuce was influence by different nutrient solution (Table 6). The application of coco water alone (T_1) and CNS (T_2) were economically viable after 5 months period. The higher NPV was obtained by T_2 (412.54) which is as twice higher than T_1 (193) which was attributed by the highest yield obtained of CNS. However, the internal rate return of coco-water alone (T_1) was just as economically feasible with that of CNS (T_2) due to the highest cost incurred of using CNS for 5-month period of investment because at every 50 L of CNS application will cost at PhP 100. Whereas in FPJ, 50 L of formulated FPJ will cost only at 20 PhP at the rate of Php 5 for every single fresh coconut. Economically, as previously indicated that coco-water could be a good source of organic nutrients for hydroponic system of lettuce production as an alternative for CNS even though statistical test showed a noncomparable effect with CNS in terms of yield and growth performance. Conversely, application of different FPJ extracts in lettuce production is not economically viable for investment. This was due to the lower yield obtained from the types and combination of fermented plant juice extracts (Table 3).

CONCLUSION

Regardless of the different type of nutrient solution, coco-water has significantly influenced the length and diameter of leaves; plant height; percent N and K; length and fresh and oven dry-weight of roots; and yield of lettuce. But did no significantly affected the number of roots and percent phosphorus of foliage of lettuce 25 days after planting.

The types of nutrient solution had significantly influenced the number, length and diameter of leaves; plant height; percent N. P and K; length and fresh and oven dry-weight of roots; and yield of lettuce 25 days after planting.

The interaction effect of coco-water application and types of hydroponics nutrient solution have significantly influenced the percent P and K of lettuce foliage, fresh and oven-dry weight of roots and on the yield of lettuce.

Addition of coco-water in nutrients solution for lettuce production in hydroponics, utilization of coco-water alone, and commercial nutrient solution were financially feasible for investment as projected after 5 months period.

RECOMMENDATION

Coco-water as an additive for nutrients solution of hydroponics system is highly recommended for lettuce production. The use of coco-water in hydroponics system should be further studied in other crops such as fruit vegetables by increasing its volume of application.

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