

Characterization of Lettuce (Lactuca Sativa) in Soilless Farming System Using SNAP Solution Blended with Different Biofertilizer Extracts

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Abstract

The study was conducted to evaluate the characteristics of lettuce in soilless non-recirculated (hydroponic) system using Simple Nutrient Addition Program (SNAP) solution blended with different biofertilizer extracts in terms of number of leaves, width of leaves, length of leaves, plant height and yield in the greenhouse under DEBESMSCAT, Masbate, Philippine condition. The experimental design used was Complete Randomized Design (CRD) with seven (7) treatments and three (3) replications. A total of one hundred sixty-eight (168) seedlings were transplanted and arranged for treatment and replication. The study used the recommended level of SNAP solution blended with different biofertilizer extracts. Treatment A - SNAP solution and 300ml of fermented plant juice, treatment B - SNAP solution and 300ml of fermented fruit juice, treatment C - SNAP solution and 300ml Fish Amino acid, treatment D - SNAP solution and 300ml Vermi tea, treatment E - SNAP solution and 300ml cattle manure tea, treatment F - SNAP solution and 300ml chicken dung tea and treatment G - SNAP solution (control). Result of the study revealed that the application of SNAP solution blended with different bio-extract gave significant effect on the growth and yield characteristics of lettuce in terms of number of leaves, width of leaves, length of leaves, plant height and yield. The study concluded that the characteristics of lettuce were significantly affected by biofertilizer blended in SNAP solution. The results of this study the use and application of Vermi tea with SNAP solution in lettuce production is highly recommended in non-recirculated hydroponic system.

Keywords: Hydroponics system; Bio-fertilizer extracts; Lettuce (Lactuca sativa); Simple Nutrient Addition Program (SNAP)

Introduction

In the next 40 years the world population is expected to increase to 9.5 billion. This population will increase over 60% in food production all over the world by 2050 to address the shortage that will be faced by the increasing population (Saiz-Rubio et al., 2020). The world for now is hoping for the resources such as soil and water to sustain the food production and meet the demands of increasing population. The high rates of development, suburbanization and environmental degradation triggered in past decades have negatively impacted the soil quality specifically the soil characteristics and nutrient content, and extent of food production (Manos et al., 2019). In addition to the challenges, problem of nutrient depletion in soils and scarcity in water arises across the world and these are expected to aggravate in the aspect of the increasing population particularly in urban and suburban areas (Magwaza et al., 2019). Problems of weather changes and climate, all over the globe, soil and water pollution, soil degradation and infertility also greatly affected the traditional farming (Bationo et al., 2011).

In smart agriculture, plant culture in soilless condition is one of the growing technologies in some part of the world like Africa and Asia which includes the growing of crops with or without a soil media or using a recirculating and non-recirculating nutrient solution (Qiansheng et al., 2018). The media refers to an organic or synthetic solid materials that is used in the place of soil either in single or mixture form that provide support to the plant to stand like carbonized rice hulls, coco-peat, perlite, vermiculite, saw dust, (Gruda et al., 2018; Gumisiriza et al., 2020). Soilless farming is basically used under controlled condition typically for agricultural crops and gives the chance to cultivate in the areas with unfavourable farming conditions such as poor soil quality and limited space like in urban areas (Lu et al., 2017; Zhigang et al., 2018). Soilless farming has the capacity of addressing the problems in soil degradation, limited water supply and to reduced pests and diseases, soilless farming is a key solution while promoting sustainability in agriculture production (Sambo et al., 2019).

Hydroponics is a unit of hydroculture in which the plants are grown soilless, and used alternative mineral nutrient solution in a water solvent. Crops can be grown-up with their roots exposed to the mineral solutions, that is supported by a media. One of the fascinating parts of this system is that the nutrients can come from a huge source and are not limited to poultry manure or fish waste (Higgins, 2015). This system requires limited area, low labor, time, and low energy. Additionally, there's a lot of methods of installing these kind of farming systems, and can be particular according to the farmer's requirement. The shifting from traditional irrigation methods in the farm to the hydroponics, that limit the use of pesticides, toxic agrochemicals and others soil and water pollutants. To prevent excess costs and increase profit in farming or gardening, hydroponics was also based on the automation of the nutrient supply. Several types of research were already conducted and mostly aimed at the optimization of the nutrient cycle in indoor systems and the adjustment of the substrates analysis in the system (Savvas, 2013).

Lettuce is a green leafy vegetable belonging to the Asteraceae family. It is a cool-season vegetable that grow in temperature ranging from 7ºC to 24ºC and commonly consumed in salad mixed (Sublett et al., 2018). Lettuce has been also used as medicine for different ailments including stomach problems, swelling in body parts, pain and urinary tract infection from ancient times due to the presence of metabolites such as flavonoids and phenols (Djeussi, 2017). Almost all variety is grown for its leaves and stems, which are eaten either raw or half-cooked. Lettuce mainly use as a leafy green, it has also gathered religious and medicinal significance over centuries of human consumption. The North America and Europe formerly conquered the market for lettuce, but on the late 20th century the consumption of lettuce had become popular in the world. World production of chicory and lettuce in 2017 was estimated to 27 million tons and 56% of which came from China (FAOSTAT, 2018).

The conventional and traditional open field farming or gardening faces a number of problems such as plants being subjected to increasing temperature, heavy rain, wind, and diseases. Indoor cultivation in the form of low-cost protective structures like screenhouse and greenhouse offers the possibility of solving some of these problems in crop production. Testing this method of farming in tropical climates could form awareness among farmers, gardeners and policy makers to the potentialities of this technology to increase yield and quality of vegetables grown in difficult environments like in Masbate, Philippines. Traditional hydroponics system also encountered several problems these include the nitrogen deficiency, due to copper supplementation from hog feed, deficiency of zinc related to the use of poultry manure, toxicity resulting from the decomposition of large amounts of incorporated straw; and loss of nitrogen from ammonia volatilization during breakdown urine from animal faeces.

Organic fertilizers reduce the many of toxic compounds (such as nitrate) in human body that accumulated from mineral fertilizers in vegetables like lettuce and cabbage, hence, cultivating for quality of produced leafy vegetables at the same time for human health. The increased of consumer awareness on food safety and security and environmental concerns has added to the expansion of organic farming over the last few years in many parts of the world (Worthington, 2001 and Relf et al., 2002). Therefore, it may be possible to reduce the increasing effects of diseases and enhance the human immunity system. The income of farms may also increase when farmers reduce the usage of chemical fertilizers and pesticides inputs for growing the crops (Vernon, 1999).

Manure has been used in the crop production as a good source of organic matter and soil amendments that provide the crops with mineral nutrients and enhances the soil quality. In modern terminology tea manure or compost tea is an extracted form produce from fermented manure in water (Litterick et al., 2004). Tea manure (biofertilizer extract) has many soluble nutrients so it can be used for soaking seeds or seedlings before planting and transplanting. Application to soil is very feasible through irrigation systems or to plant foliage. Tea manure is very rich in plant hormones and growth regulators. It invigorates the microorganisms that have an indirect or direct suitable effects on the plant rhizosphere, as well it improves the soil physical and chemical composition and prevent some plant diseases pathogen (Abbasi et al., 2002, Biocycle, 2004 and Meshref et al., 2010). There is limited awareness on the application of biofertilizers for crop production and consequently the objective of this study was to assess the effects biofertilizer extract in the organic-based production of lettuce in soilless (hydroponic) non-recirculating systems.

The study evaluated the growth and yield of lettuce in soilless farming system using SNAP solution blended with different biofertilizer-extracts specifically, the study aimed to evaluate the growth in terms of plant height, number of leaves, sizes of leaves (length and width); evaluate the yield in terms of weight of plant per replication and treatment and perform simple cost and return analysis.

Materials and Methods

Research Design

This study used Complete Randomized Design (CRD). The treatments used were SNAP solution blended with different biofertilizer extracts and it was divided into three. The study has a total of 168 seedlings of lettuce and it was divided into three replications. The treatment used in the study were the following: treatment A - SNAP with 300ml fermented plant juice (FPJ), treatment B - SNAP with 300 millilitres (ml) fermented fruit juice (FFJ), treatment C - SNAP with 300ml fish amino acid (FAA), treatment D - SNAP 300ml ml vermi tea (VT), treatment E - SNAP with 300ml cattle manure tea (CMT), treatment F - SNAP with 300ml chicken dung tea (CDT) and treatment G - SNAP (commercialized) without biofertilizer (control).

Materials and Methods

The materials used in the study were galvanized iron (GI) pipes, angle bars, cyclone wire, U bolts, ultra violet (UV) plastic sheet, used styro box of imported grapes, bamboo slats, plywood and lumber for benches, packaging tape, scissor, cutter knife, tin can, nails, used styro cups, polyethylene (PE) plastics, seeds of lettuce and SNAP solution. Additionally, the study used animal manure, plant leaves, fruit peels, fish entrails and vermi cast for biofertilizer extracts. The study also used ruler, weighing scale, calliper and beaker and pH meter and field notebook for data gathering.

Construction of Greenhouse and Benches

The study constructed the three (3) meters (m) by 6.0 m greenhouse for to protect the hydroponic setup from heavy rains and sunlight. The greenhouse or shelter was constructed using metal framing and covered with UV plastics sheets. Four units of benches with 1.0 m height by 1.2 m width and 4.0 m length were constructed and installed inside the greenhouse to hold and ensure the safety of hydroponic boxes. The benches were constructed using available light materials and layout based from the experimental setup.

Seed Sowing and Seedling Preparation

The lettuce seeds were sown in the seedling trays with sterilized soil media (vermi cast) and watered every day to maintain soil moisture. The seed trays were placed under a inside the improvised greenhouse to protect the seedlings from the heavy rains and direct sunlight. The seedlings were cared in 15 days inside the shelter before transplanted in the styro cups.

Preparation hydroponics boxes and Seedling Plugs

The hydroponics system used 21 pieces of empty styro boxes to hold the nutrient solutions. The boxes were sealed using packaging tape and installed with PE plastics that serve as liner. Then it was checked for leakage in 1 day before the filling it of required amount of water and nutrient solutions were applied. After the preparation of hydroponic boxes and solutions, the seedling plugs were then prepared. The 15 days old seedlings were uprooted from the trays and transplanted in 8.0 oz used styro cups. The cups were provided with 4 slits in the lower side and 4 holes in the bottom part. This to allow the roots to grow-out and reached the nutrient solution. A 2.5 centimetres (cm) thick soil media was laid inside the cups to holds the seedlings enough to stand. The soil media should not be filled more than 2.5 cm so the root will grow-out in the cups.

Treatment Preparation and Application

The biofertilizers were prepared and fermented for 7 days based on the required mixture and ratio. The biofertilizer extracts were mixed thoroughly with SNAP solution to form treatments. After the hydroponic boxes were prepared and tested for leakage, the boxes were installed in the benches based on the research design. The boxes were the then filled with 15 litres (li) tap water. Then different treatments were applied and mixed thoroughly in the water. The treatment A used SNAP solution with 300ml FPJ, the treatment B used SNAP solution with 300ml FFJ, treatment C used SNAP solution with 300ml FAA, treatment D used SNAP solution with 300ml VT, treatment E used SNAP solution with 300ml CMT, treatment F used SNAP solution with 300ml CDT, and treatment G used only SNAP solution (control). The amount of SNAP solution blended in different biofertilizer was based on the recommended rate of application per 10 li of water.

Transplanting of Seedling

The seedling plugs were transplanted in the installed hydroponic boxes according to the assigned treatments. Eight seedling plugs were transferred per box which made 24 plant samples per treatment. A total of 168 plant samples were transplanted for the study in all the treatments. The seedlings plugs were installed in the boxes and submerged 2.5 cm deep in the nutrient solutions.

Monitoring and Management of Hydroponics System and Nutrient Solution Levels

After the transplanting of seedling plugs, care and management of the system were made. The hydroponic boxes were monitored every day to check the water level. The nutrient solutions were regularly refilled every after 3 days up to the desired level and volume of water. The presence of insect pest in the lettuce plants were also checked and immediate control was taken.

Data Gathering

The research study was conducted at Dr. Emilio B. Espinosa Sr. Memorial State College of Agriculture and Technology, Cabitan, Mandaon, Masbate. The data were gathered from October to November 2021. The data gathering of study focused on growth and yield of lettuce in non-recirculated soilless farming system using SNAP solution blended with different biofertilizer-extracts.

Growth Parameters

Growing vegetable under protective structures like improvised greenhouse is not new, and mostly yield of crops grown increase and documented. These includes the reduction periods of leaf wetness creating less favorable environments for diseases to infect, plants are also protected from soil splash, it reduced growing of weeds, control soil temperature, humidity, and reduced the leaching of nutrients (Gonzaga et al., 2017).

Plant Height. The measurement of growth in terms of increase in plant height 3 days after transplanting (DAT) up the end of the study (harvesting). The measurement was done every after 3 days using ruler and expressed in cm.

Number of Leaves. The data gathering in number of leaves started 3 DAT. The number of leaves of lettuce was counted every after 3 days interval.

Length of leaves. The data in length of leaves was gathered 3 DAT and was measured in 3 days interval using a ruler. The length of leaves of lettuce was expressed in cm.

Width of leaves. The data gathering in width of leaves started 3 DAT and was measured using ruler every after 3 days. The width of leaves was expressed in cm.

Yield of Parameters

The application of compost in the garden by rates of 75, 100 and 125% with compost tea significantly improved the growth of plant and yield for lettuce plants. The compost as organic fertilizer that has many positive benefits compared to inorganic fertilizer mainly in sandy soil such as increases in water retention conditioning effect, raising the cation exchange capacity, it also provides stability of temperature and improves the nutrient availability in soil, which are very essential requirement for growth of plants (EL-Etr et al., 2004; Hafez et al., 2004; Xu et al., 2005; Masarirambi et al., 2010). The compost tea and compost increased plant growth and yield quantity and quality (Abou-El-Hassan et al., 2013). The effect might be due to the advantageous effects of tea manure that contains numerous macro and micro nutrients in readily available in the solution and compost, natural hormones such as vitamins, antioxidants and cytokines, that be accessible for the plant. All these reflect on growth of plant and its content that results to healthier yield and quality of lettuce plants. (Abbasi et al., 2002, Biocycle, 2004; Meshref et al., 2010 and Abou-El-Hassan et al., 2013).)

Average Weight of Lettuce. The lettuce was harvested after 21 days. The yield of lettuce was measured in terms of weight using weighing scale and was expressed in grams.

Yield per Treatment. The yield per treatment was the total weight of lettuce in all replications. It was measured after harvesting using weighing scale and expressed in grams.

Data Analysis

The results were analyzed using the Analysis of Variance (ANOVA) in Complete Randomized Design (CRD). The data were analyzed using statistical software SPSS version 25. Further analysis was done using Tukey’s Honest Significant Difference (HSD) to compare the means.

Results and Discussions

Growth of Lettuce

Plant Height

The result of study on plant height found that the average height ranges from 19 cm to 29.87 cm. The treatment D had the highest mean among other treatments with 29.87 cm. It was followed by treatment G with 27.40 cm, then treatment E with 27.00 cm, treatment F with 25.00 cm, was treatment C with 20.37, treatment B with 20.03 and the last was treatment A with only had 19.00 cm height. The results of study on height of lettuce found the treatment (D, E, F and G) from animal manure mixed with SNAP had the better response compared to the treatment (A, B and C) that used fermented extracts. This was due to the properties of tea manures that already undergone decomposition and were subjected to short fermentation process. This process broke down the dead tissues of plant and converted it to simpler forms of organic components that resulted to readily available and more absorbable nutrients to plants. Additionally, the nutrients were further enhanced by SNAP that was added in the solution, thus this resulted to better plant response in terms of height. The results on plant height in this study were higher than the lettuce produce using 600g of guano fertilizer with 13.74 cm height reported (Poliquit, 2019) and lettuce in hydroponic system that used different substrate with tallest plant height of 23.33cm reported (Rahman et al., 2019). The result of analysis in plant height revealed highly significant difference among other treatments. The results were further analyzed using Tukey's HSD as shown in the table 1. The result of analysis showed that the lettuce in treatment D, E, F and G were significantly different from lettuce in treatment B and C, and lettuce treatment A in terms of plant height.

Table 1. Height of lettuce (cm)

Treatment	Replication			Total	Mean
	I	II	III		
A	20.40	16.90	19.70	57.00	19.00[c]
B	16.60	22.50	21.00	60.10	20.03[b]
C	21.00	20.90	19.20	61.10	20.37[b]
D	27.60	31.40	30.60	89.60	29.87[a]
E	24.80	25.80	30.40	81.00	27.00[a]
F	28.60	19.20	27.20	75.00	25.00[a]
G	25.40	23.80	33.00	82.20	27.40[a]
Grand Total				506.00	
Grand Mean					**24.10**

Means with different letter is significantly different by Tukey's test at $P \leq 0.05$.
Turkey's HSD at 5% = 0.006
a. R Squared = 0.682 (Adjusted R Squared = 0.546)

Number of Leaves

The result of study on number of leaves ranges from 5.0 to 9.3 leaves. The treatment D found with the most numbers with 9.13 leaves follow by treatment G with 8.67, then by treatment E with 7.73, next was the treatment F with 7.33. Then it was followed by treatment C with 5.97, next was treatment B with 5.87 and the last was treatment A with only had 5.07. Base from the result, the lettuce in the vermi tea with SNAP and the solution that used only SNAP (control) had those best results in terms of number of leaves. This may be due to the absorbability of the two treatment solutions, compare to other treatments. The result of study in number of leaves was not comparable to the number of leaves produced in hydroponic system that used different growing substrate with 21.44 leaves at 42 DAT (Rahman et al., 2019) far more than 9.13 leaves. However, the results were higher than the lettuce produced in protected garden with 6.59 leaves (Poliquit, 2019). The analysis of results in number of leaves revealed highly significant differences among other treatment. The results were further analyzed using Tukey's HSD to compare the means and found that the treatment D and G are significant difference in treatment B, C, E and F and as to the treatment A as reflected in Table 2.

Table 2. Number of leaves of lettuce (pc)

Treatment	Replication			Total	Mean
	I	II	III		
A	5.80	4.00	5.40	15.20	5.07[c]

Treatment	Replication			Total	Mean
	I	II	III		
B	5.20	6.20	6.20	17.60	5.87[b]
C	6.20	5.00	6.70	17.90	5.97[b]
D	8.40	10.20	8.80	27.40	9.13[a]
E	5.20	8.60	9.40	23.20	7.73[b]
F	7.40	6.00	8.60	22.00	7.33[b]
G	8.80	7.40	9.80	26.00	8.67[a]
Grand Total				149.30	
Grand Mean					7.11

Means with different letter is significantly different by Tukey's test at $P \leq 0.05$.
Turkey's HSD at 5% = 0.020
a. R Squared = 0.613 (Adjusted R Squared = 0.448)

Length of Leaves

The result of study on average length of leaves ranges from 8.24 cm to 14.18 cm. The treatment D was observed with the highest mean among other treatments with 14.18 cm, followed by treatment G with 13.18 cm, then the treatment E with 11.73 cm. Next was treatment F 11.53 cm, then followed by the treatment. B with 11.80 cm. Then next was the treatment C with 11.34 cm and the last was 8.24 cm in treatment A. The results indicated that lettuce in treatments with tea manure had better response compare to treatments that used the fermented juice. This may be due to characteristics of biofertilizer extracts, mostly manures undergone decomposition before the application compared to the fermented juice extracts.

Table 3. Length of Leaves of lettuce (cm)

Treatment	Replication			Total	Mean
	I	II	III		
A	7.43	8.10	9.19	24.72	8.24[c]
B	10.80	11.90	12.71	35.41	11.80[b]
C	12.60	11.33	10.10	34.03	11.34[b]
D	13.02	13.68	15.86	42.55	14.18[a]
E	8.96	12.70	13.54	35.20	11.73[b]
F	12.00	9.21	13.38	34.59	11.53[b]
G	12.65	13.00	15.78	41.43	13.81[a]
Grand Total				247.93	
Grand Mean					11.80

Means with different letter is significantly different by Tukey's test at $P \leq 0.05$.
Turkey's HSD at 5% = 0.013
a. R Squared = 0.643 (Adjusted R Squared = 0.490)

The results of this study have better results in terms of length of leaves compared to the lettuce produced in hydroponics that used different growing substrates reported (Rahman et al., 2019). The analysis of results in length of leaves of lettuce revealed significantly different among treatments. The results were also further analyzed using Tukey's HSD and found that the treatments D and G were significantly different among other treatment, and the treatments B, C, E and F were also significantly different in treatment D and G, and treatment A, as shown in Table 3.

Width of Leaves

The results of study on width of leaves of lettuce ranges from 5.55 cm to 11.64 cm. The treatment D had the widest leaves with 11.64 cm, followed by treatment G with 9.34 cm, next was treatment F with 7.84 cm, then the treatment E with 7.82 and the treatment C with 7.20 cm. Next was treatment B with 6.32 cm and the smallest measured width was 5.55 cm in treatment A. The results on width of leaves from treatment B to G found with good response compare to the production of lettuce of (Calori et al, 2014) in hydroponics system that obtained an average of 6.3 cm. This implied that the tea manure combined with SNAP and fermented juice extracts combine with SNAP had better response in lettuce in term of width of leaves. The results of analysis on width of leaves revealed highly significant differences among other treatment. The results were further analyzed in Turkey's HSD and found that lettuce in treatments D and G were significantly different from treatment C, E and F and treatment A and B as shown in Table 4.

Table 4. Width of Leaves of lettuce (cm)

Treatment	**Replication**			**Total**	**Mean**
	I	II	III		
A	7.78	3.72	5.15	16.65	5.55c
B	4.80	7.20	6.96	18.96	6.32c
C	7.95	7.25	6.41	21.61	7.20b
D	10.31	12.94	11.66	34.91	11.64a
E	6.04	8.27	9.13	23.45	7.82b
F	8.07	6.25	9.19	23.52	7.84b
G	8.42	8.25	11.34	28.01	9.34a
Grand Total				167.10	
Grand Mean					7.96

Means with different letter is significantly different by Tukey's test at $P \leq 0.05$.
Turkey's HSD at 5% = 0.005
a. R Squared = 0.696 (Adjusted R Squared = .566)

Yield of Lettuce

Average Weight of Lettuce

The results on weight lettuce showed that the average ranges from 25.21 grams (g) to 138.13g. The lettuce in treatment G was recorded with the heaviest plant with 138.13g, followed the 129.58g in treatment D, next was the treatment F with 81.04 grams, then 57.50g in treatment C. Next was the treatment B with 30.63 grams and the last was 25.21g in treatment A. The results on weight of lettuce found that treatment D and G had remarkable response compare to the lettuce in treatments, (E and F) mixed with tea manure and blended with SNAP. This may be due to the optimum nutrient content of SNAP and characteristics of vermi cast compare to other treatments (E and F) and treatments that undergone fermentation process. The weight of lettuce in this study were lower compared to the produced lettuce in hydroponics system using liquid organic fertilizer that obtained an average fresh weight of 163.9 g/plant and 182.3 g/plant using inorganic fertilizer (Ahmed et al., 2021) and lettuce hydroponic system that used different growing substrate with average fresh weight of 92.49g/plant 42 DAT (Rahman et al., 2019). The results on lettuce weight had better response that obtained highest average weight of 138.14g in Treatment G and 129.58g in Treatment D. The results of analysis on weight per plant revealed highly significant difference among other treatments as shown in Table 5. Further analysis was made using Tukey's HSD to compare the mean. The results found that treatments D, E, F and G were all significantly different from treatments B and C. And the treatments B and C were also significantly different from treatment A.

Table 5. Average weight of lettuce (g)

Treatment	Replication			Total	Mean
	I	II	III		
A	21.88	31.25	22.50	75.63	25.21c
B	35.00	35.00	21.88	91.88	30.63b
C	63.75	51.25	57.50	172.50	57.50b
D	126.25	133.13	129.38	388.75	129.58a
E	65.00	67.50	70.00	202.50	67.50a
F	81.88	71.88	89.38	243.13	81.04a
G	137.50	137.50	139.38	414.38	138.13a
Grand Total				1,588.75	
Grand Mean					75.66

Means with different letter is significantly different by Tukey's test at $P \leq 0.05$.
Turkey's HSD at 5% = 0.000.
a. R Squared = 0.988 (Adjusted R Squared = 0.982).

Yield per Treatment

The results of study on yield per treatment was presented in Table 6. The results showed the yield ranges from 201.67g to 1,105.00g. The treatment G had the highest yield with 1,105g, followed by treatment D with 1,036.67g, next was 648.3g in treatment F, then treatment E with 540g. The next was treatment C with 460g, treatment B with 245g and treatment A, respectively. The yield of lettuce best showed in treatments G and D.

Table 6. Yield per treatment (g)

Treatment	Replication			Total	Mean
	I	II	III		
A	175.00	250.00	180.00	605.00	201.67c
B	280.00	280.00	175.00	735.00	245.00b
C	510.00	410.00	460.00	1,380.00	460.00b
D	1010.00	1065.00	1035.00	3,110.00	1,036.67a
E	520.00	540.00	560.00	1,620.00	540.00a
F	655.00	575.00	715.00	1,945.00	648.33a
G	1100.00	1100.00	1115.00	3,315.00	1,105.00a
Grand Total				12,710.00	
Grand Mean					605.24

Means with different letter is significantly different by Tukey's test at $P \leq 0.05$.
Turkey's HSD at 5% = 0.000
a. R Squared = 0.988 (Adjusted R Squared = 0.982)

This means that lettuce in vermi cast and SNAP (control) responded best compared to other treatments, this may be due to the characteristics of two solutions and nutrient content, compare to other treatments that used tea manures and further than the response of lettuce in treatments that used fermented juice. The results of this study on yield were higher compared to the results of lettuce in NFT hydroponic system (Calori et al., 2014) that produced only 1.3 kg per square meter. The analysis of results on yield per treatments revealed highly significant difference among other treatments as shown in table 6. To compare the means of yield per treatment the results was tested in Turkey's HSD. The test revealed that the treatment D, E, F and G has significant differences to treatments B and C, and so on treatment A.

Conclusion

The general objective of this study was to evaluate the effects of SNAP solution blended with different bio-extracts on the characteristic of lettuce in soilless farming system based on number of leaves, width of leaves, length of leaves and plant height. This research study was conducted at Dr. Emilio B. Espinosa Sr. Memorial State College of Agriculture and Technology (DEBESMSCAT), High Value Commercial Crop (HVCC) production area from October 04, 2021 to November 12, 2021 at Cabitan, Mandaon, Masbate, Philippines. The research study is limited on the evaluation of lettuce characteristics in soilless farming system (hydroponic) using SNAP solution blended with different biofertilizer extracts. The area was prepared thoroughly and improvised greenhouses were constructed. The hydroponic systems were set-up in benches constructed in the greenhouses using light materials. Before the planting, 7 treatments and 3 replications were laid out in the inside the improvised greenhouses. The study utilized the used grapes boxes (styro) for the non-recirculated hydroponic system. Each box was measured 50cm width and 75cm length, every box was filled with 15 liters water. A total 8 lettuce seedlings were planted in every box and 5 sample plants were observed in every treatment. The study used treatment A - SNAP solution and 300ml fermented plant juice, treatment B - SNAP solution and 300ml fermented fruit juice, treatment C-SNAP solution and 300ml fish amino acid, treatment D - SNAP solution and 300ml vermi tea, treatment E - SNAP solution and 300ml cattle manure tea, treatment F - SNAP solution and 300ml chicken dung tea and treatment G - SNAP solution only. Overall, a total of one hundred sixty-eight (168) seedlings were transplanted and arranged for treatment and replication. The study concluded that the characteristics of lettuce (Lactuca sativa) in soilless farming system were significantly affected by different biofertilizer extracts blended in SNAP solution in terms of number of leaves, width of leaves, length of leaves, plant height and yield. Based from the results of this study the use and application of Vermi tea with SNAP solution in lettuce production is highly recommended in non-recirculated hydroponic system.

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