Received October 2021; | Revised January 2022; | Accepted January 2022

DOI: 10.52631/jemds.v2i1.62

RESEARCH ARTICLE

Potentialities Of Lettuce (Lactuca Sativa L.) In Hydroponics System Under Simple Nutrient Addition Program (SNAP)

Eligio C. Borres* | Eddie B. Basulgan | Rikkie Mae L. Dalanon

[1]Dr. Emilio B. Espinosa Sr. Memorial State College of Agriculture and Technology Masbate, Philippines

Correspondence
*Corresponding Author.
Email:
eligioborres@gmail.com

Abstract

The study was conducted to evaluate the potential of lettuce in a non-recirculated hydroponics system using a simple nutrient addition program (SNAP) in terms of plant height, number of leaves, length of leaves, width of leaves, and yield under screenhouse conditions. The study was conducted at the High Value Commercial Crops (HVCC) production area, DEBESMSCAT, Cabitan, Mandaon Masbate, from February 22, 2021, to March 23, 2021. The experimental design used was the CRD with four (4) treatments and three (3) replications. The study used different levels of SNAP solution. Treatment A used 25ml of SNAP A and SNAP B, Treatment B (30ml), Treatment C (35ml) and Treatment D (Control). The results of the study revealed that the application of SNAP solution to the lettuce did not have a significant effect on the length and width of lettuce leaves. However, the application of SNAP solution to the lettuce had a significant effect on the height, number of leaves, and yield. The different levels of SNAP solution had a highly significant effect on water consumption and the SNAP hydroponics system proved highly efficient in water consumption during the summer season inside the screenhouse under DEBESMSCAT, Masbate condition.

KEYWORDS:
Simple Nutrient Addition Program (SNAP), Lettuce production, Hydroponics system, Soilless vegetable production, non-recirculated hydroponics system.

1 | INTRODUCTION

Lactuca sativa is a member of the Lactuca (lettuce) genus and the Asteraceae (sunflower or aster) family. Lettuce is closely related to several Lactuca species from southwest Asia (Zohary et al., 2012).

Lettuce was first cultivated in ancient Egypt for the production of oil from its seeds. This plant was probably selectively bred by the Egyptians into a plant grown for its edible leaves (Katz and Weaver, pp. 375–376). Lettuce is most often used for salads, although it is also seen in other kinds of food, such as soups, sandwiches, and wraps; it can also be grilled (Hugh Fearnley-Whittingstall, 2013). Conservation of soil and water resources is very important for the sustainability of agriculture production and the environment. Nowadays, soil and water resources are under great pressure due to the increasing population and the growing demand for food. Coupled with urbanization, soil and water quality are deteriorating, and it causes a lot of problems in agricultural production.

Soil nutrient and water deficiencies in gardens cause a lot of plant problems. These range from deformed and yellowish leaves to stunted plants and the bitter taste of lettuce. However, these problems can be overcome by using soilless technology and the use of a simple nutrient addition program (SNAP).

Hydroponics is a type of horticulture and a subset of hydroculture that involves growing plants (usually crops) without soil, by using mineral nutrient solutions in an aqueous solvent (Santos, J. D. et al., 2013). Hydroponics removes the barriers between the plant and its nutrients. This provides the roots with direct access to water and nutrients. Since there's no soil, there's no need to apply harmful pesticides or chemicals. It also reduces the risk of plant disease or contact with external elements.

Hydroponics provides an instant as well as a long-term solution to the problem of households producing their own vegetables in most urban areas. Santo Ocampo (2005) reported that if the hydroponics were set up in a protective structure like a screenhouse or greenhouse, it would provide a year-round vegetable supply to the family. The susceptibilities of vegetables to weeds, insect pests, and diseases are lessened if crops are grown hydroponically (Baez Manipon 2000). Furthermore, the hydroponics system has a lower cost during planting, growing, and harvesting of crops (Hassall et al. 1993).

According to the Food and Fertilizer Technology Center for the Asian and Pacific Region (2004), the SNAP hydroponics system is appropriate in urban areas where the soil or space for growing crops is not adequate. It may be done in apartments or townhouses where small terraces can be used for growing crops for home consumption. The small space is easy to protect against rain and strong sunlight.

The system requires covered containers or pots that can hold about 2 liters of water, SNAP fertilizers, and seeds of chosen heat-tolerant vegetables.

The general objective of the study was to evaluate the potential of lettuce in hydroponics systems under the Simple Nutrient Addition Program (SNAP).

Specifically, it aimed to evaluate the growth of lettuce in terms of height of plants, number of leaves, and size of leaves (length and width); evaluate the yield in terms of weight of lettuce; and water consumption per yield.

2 | MATERIALS AND RESEARCH METHODS

2.1 | Research Design and Experimental Unit

The study used Complete Randomized Design (CRD)-single factor experiment. The treatments used were different levels of SNAP solution mixed with ten (10) liters of water. The study was conducted in non-recirculated hydroponics system inside the screenhouse under DEBESMSCAT, Masbate condition. The study used 4 treatments and replicated 3 times.

The study used 90 seedlings of lettuce and divided into three replications. The Treatment A used 25 ml of SNAP A and SNAP B solution, Treatment B (30ml), Treatment C (35ml) and Treatment D (control) tap water.

2.2 | Materials and Procedure of the Study

The materials used in the study were styro boxes of imported grapes, bamboo slats, packaging tape, scissors, cutter knife, tin can, nails, tie wire, used styro cups, polyethylene (PE) plastic, seeds of lettuce, and SNAP solution.

2.2.1 | Preparation of Area and Seedlings

The study constructed 12 benches inside the screenhouse to ensure the safety of the lettuce. The benches were constructed and the layout was based on the experimental setup. A 1.0-meter (m) height by 1.0 m width and 1.0 m length bench were made of bamboo slats nailed and tied with galvanized iron wire 16. The benches hold and ensure the stability of styro boxes.

The lettuce seeds were placed in the cloth and soaked overnight before being sown in the seedling trays. The seedlings were cared for 15 days before being transplanted into the seedling plugs.

2.2.2 | Installation of SNAP Hydroponics System

The growing boxes used in the study were made from empty boxes of imported grapes with a 40-centimeter (cm) width by 60-cm length and a 20-cm thickness. Nine holes were made per box using tin cans with an 8 cm diameter. The boxes were covered with packaging tape and PE plastics to prevent leakage and evaporation of solution.

For the preparation of seedling plugs, 8-oz styro cups were used. The cups were made with holes for the water to enter the cups and to permit the roots to come out. The cups were filled with soil media to almost half their capacity, enough to hold the seedling in the cup. A hole was dug in the middle cup and the 15-day old seedlings were transferred. Then, the base of the plants was filled with media to keep the seedlings' stand in position.

The growing boxes were arranged on the benches to ensure their level and stability. The boxes were then filled with water to approximately 15 liters (li). After that, the boxes were checked for leaks.

2.2.3 | Application of Treatment

After the installation of styro boxes, the treatments were applied. Treatment A used 25 ml of SNAP A and 25 ml SNAP B solution to 10 li of water, treatment B used 30 ml, treatment C used 35 ml and the treatment D (control) pure water. The SNAP A was first mixed with water before SNAP B. The study ensured that the solutions were not mixed together at the same time.

2.2.4 | Transplanting of Seedling Plugs

The seedling plugs were transferred into the installed growing boxes according to the assigned treatments. Nine seedlings were transferred per box, which made 27 plant samples per treatment. A total of 90 plant samples were used in the study for all the treatments.

The seedling plugs were installed to a depth of one-half (1/2) inch in the solution. This is to prevent the plant from suffocating and being oversubmerged.

2.2.5 | Care and Management

After the installation of seedling plugs, care and management of the system were completed. The system was visited every day to regularly check the pH level and water pH in the growing box.

2.3 | Data Gathering

The following were gathered during the study:

Plant Height. The measurement of growth in terms of increase in plant height and overall plant height at the end of the study was expressed in centimeters.

Number of Leaves. The number of leaves of lettuce was measured every 3 days after transplanting and 5 days after transplanting.

Size of Leaves. The size of leaves was measured in terms of length and width. The size of leaves was taken every 3 days and expressed in centimeters.

Yield of Lettuce. The yield of lettuce was measured in terms of weight and was expressed in grams. The yield was measured after 27 days.

Water consumption. The water consumed by plants per box from day zero to day 27. The consumption was measured after the harvest and was expressed in liters of water per kilogram of harvested.

2.4 | Data Analysis

Completely Randomized Design (CRD) was used in the study to describe the effects of different levels of SNAP solution in growth and yield performance of lettuce in non-recirculated hydroponics system. The response of lettuce was analyzed using univariate analysis. The data were analyzed using statistical software SPSS version 25.

3 | RESULTS AND DISCUSSION

3.1 | Height of Lettuce

3.1.1 | Increase of height of lettuce

The result of the study after the 27th day on the increase in height found that the average height ranged from 0.49 to 2.18 centimeters (cm). Treatment A with 25 milliliters (ml) of SNAP solution was found to have the highest mean, among others, a 2.18 cm increase in height. This was followed by treatment B (30 ml) with an average mean of 1.64 cm increase in height. Then, followed by treatment C (35) with a 1.29 cm increase, and last was control (no SNAP) with a 0.49 cm. The result showed that the 25 ml SNAP mixture had the optimum level of nutrients for lettuce to absorb for vegetative development. Since the lettuce was planted in high density, the plants competed for space and sunlight, which resulted in an elongated stem compared to other treatments. The result of the analysis in an increase in height revealed significantly different among each treatment. The findings revealed that the increase of SNAP solution mixture in non-recirculating hydroponic systems did not give an optimum rate of increase in the height of lettuce. Figure 1 , 1a and 1b show the difference in the increase in height of lettuce from day 0 to day 27. Figure 2 presents the graph of the increased height of lettuce.

(1a)  (1b) 

FIGURE 1 The lettuce height in day zero and day 27.

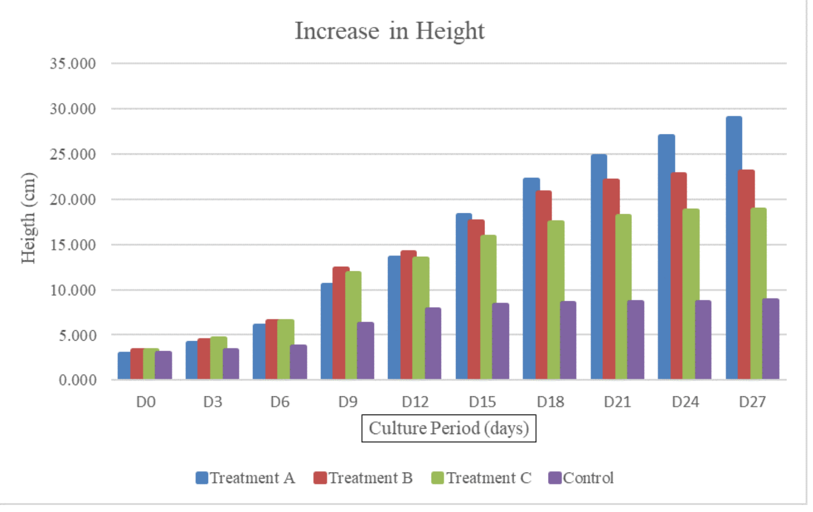

FIGURE 2 Average increase of lettuce height from Day zero to Day 27.

3.1.2 | Overall Height of Lettuce

The result was that the overall height of lettuce 27 days after transplanting found that the average height ranged from 8.78 to 28.99 cm. Treatment A (25ml) significantly produces taller plants with the highest mean of 28.99 cm compared to treatment B (30ml) with 23.05 cm of height and treatment C (35ml) with 18.83 cm. The treatment D (control) with 8.78 cm produces the lowest height. The results on plant height were comparable to the study of Gonzales et al. 2020 on Emperor-Crisphead that produced the tallest mean of 8.4 to 29 cm, Greenwave-Romaine with a mean of 7.6-29.7 cm, and Loose leaf with a mean of 4.2 cm to 19.6 cm. The result of analysis in overall lettuce height revealed significantly different among other treatment as shown in figure 1b. The results for overall height revealed that the increase in SNAP solution mixture did not give optimum growth (height) on lettuce. Figure 3 shows the graph of lettuce height per treatment and per replication at the 27th day.

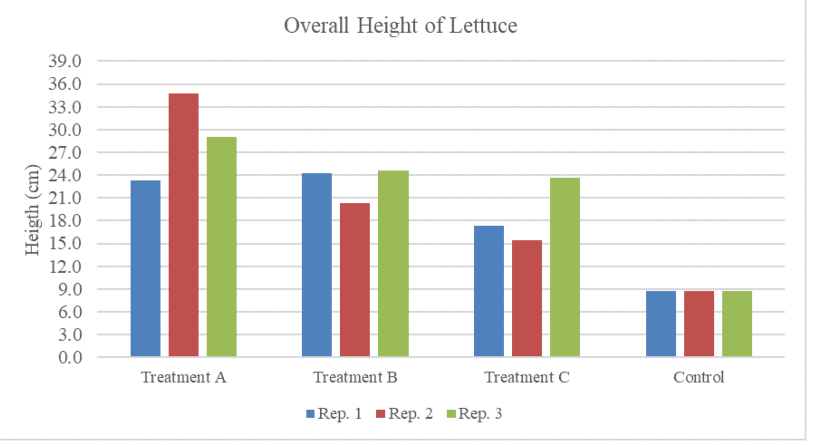

FIGURE 3 Plant Height of Lettuce per replication and treatments at 27th day.

3.2 | Leaves of Lettuce

3.2.1 | Number of Leaves

The results of a study on the number of leaves of lettuce found that treatment A (25ml) had the highest number of leaves with 5.04 compared to treatment B (30ml) with 4.74 and treatment C (35ml) with a mean of 4.0. Treatment D (control) got the lowest result with a mean of 3.95. The growth of lettuce in terms of the number of leaves significantly responds to Treatment A (25ml). This indicated that the mixture had the optimal levels of nutrients for leaf development and the increase in the mixture did not have a positive effect on the number of leaves of lettuce as shown in figure 1b. The results of analysis on a number of leaves revealed a highly significant difference among other treatments. Figure 4 shows the graph of the number of leaves.

3.2.2 | Increase in length of Leaves

The results of a study on the increase in the length of leaves after 27 days range from 0.65 cm to 2.35 cm. Treatment A using 25ml of SNAP solution got the highest mean, having 2.35 cm compared to the levels of treatment B (30ml) with 1.57 cm and the leaves of treatment C (35ml) with 1.2 cm. The control had a lower mean of 0.65 cm. length of the leaves. The results indicated that Treatment A had the optimum levels of nutrients for lettuce to develop longer leaves, as manifested in the results on increase in height and overall plant height. The results also found that the increase in the SNAP solution mixture up to 35 ml did not give an optimum response to lettuce in terms of the rate of increase in the length of the leaves. The results of the analysis of the increase in the length of lettuce leaves revealed significantly different results among other treatments. Figure 5 shows the graph of the increase in length of lettuce leaves per replication and per treatment from day zero to the 27th day.

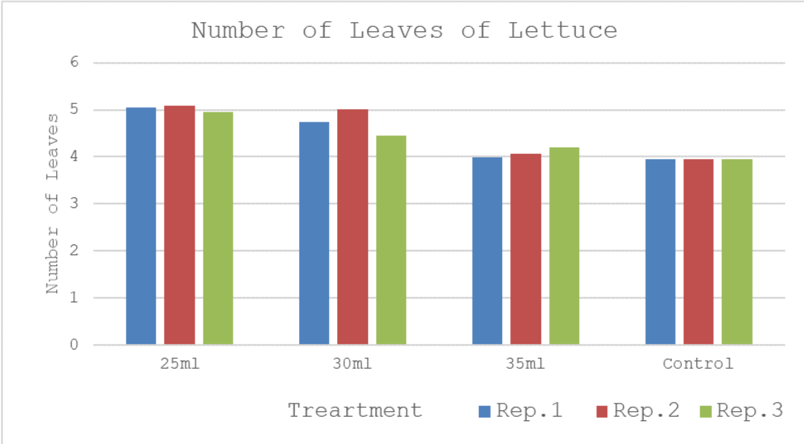

FIGURE 4 Number of leaves of Lettuce at 27th day.

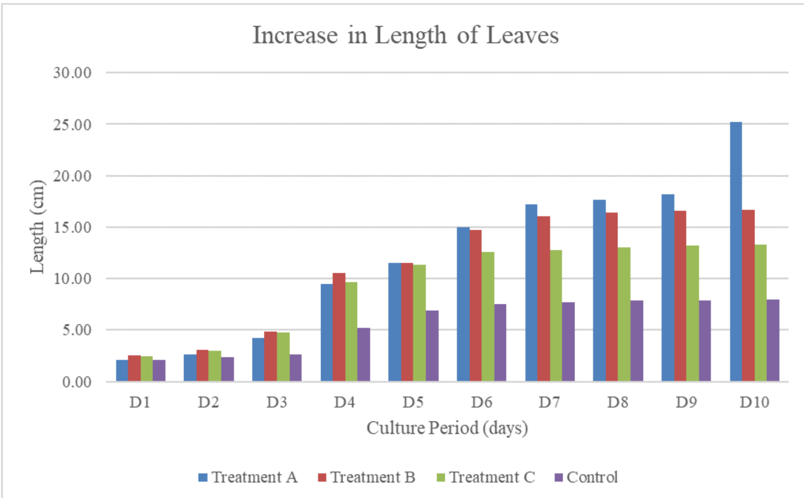

FIGURE 5 Increase in length of leaves from day 0 to 27th day.

3.2.3 | Length of Lettuce Leaves

The results of a study on the overall length of lettuce leaves range from 7.74 cm to 22.5 cm. Treatment A (25ml) was observed with the highest mean among others, with a 22.5 cm length compared to treatment B (30ml) with 16.70 cm, treatment C (35ml) with 13.32 cm and treatment D (control) with only 7.94 cm. The results on the overall length of leaves were manifested by the results on the rate of increase in the leaves of lettuce. This revealed that treatment A had the nutrient level enough for optimum growth of lettuce in terms of the length of the leaves, and the increase in SNAP solution mixture did not have the ideal effect on the length of leaves, as shown in figure 1b. The results of the analysis on the overall length of leaves revealed a highly significant difference among treatments. Figure 6 shows the graph on the length of lettuce leaves.

3.2.4 | Increase in Width of Lettuce Leaves

The result of a study on the increase in the width of lettuce leaves ranges from 0.32 cm to 1.04 cm. Treatment B (30ml) was observed with the highest mean rate of increase in the width of leaves compared to treatment A (25ml) with 0.82 cm, treatment C (35ml) with a 0.74 cm rate of increase in the width of leaves and treatment D (control) with only 0.31 cm. The results showed that treatment B had the level of nutrients that gave an optimum rate of increase in the width of leaves during the early stages of lettuce development. Figure 7 shows the graph in the increase of width of leaves of lettuce. The results of the analysis of the increase in width of leaves revealed no significant difference among treatments.

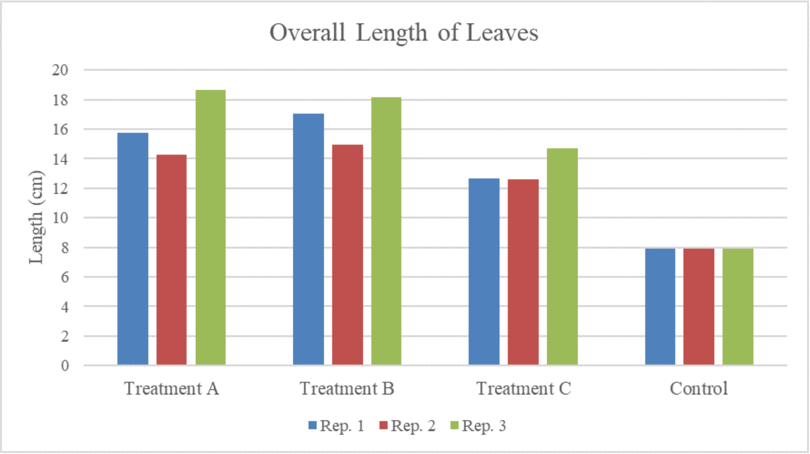

FIGURE 6 Overall length of leaves from day zero to 27th day.

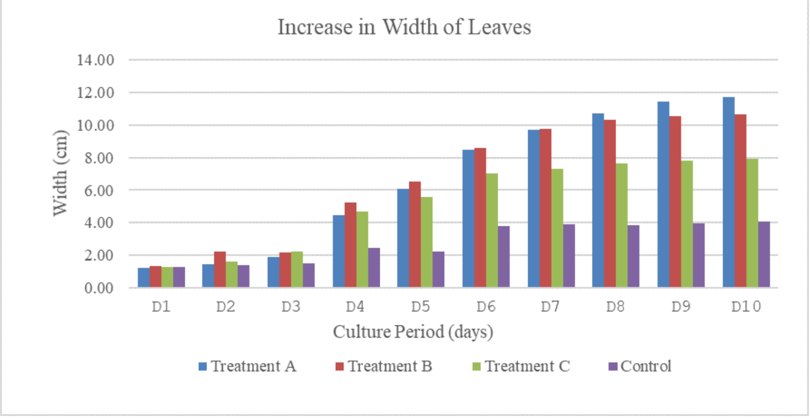

FIGURE 7 The increase in width of leaves from day 0 to 27th day.

3.2.5 | Overall Width of lettuce Leaves

After 27 days of observation, the result of the study on the overall width of lettuce leaves ranges from 4.07 cm to 11.72 cm. Treatment A (25ml) was observed with the widest leaves of 11.72 cm compared to treatment B (30ml) with 10.65 cm width, treatment C (35ml) with 7.92 cm and treatment D (control) with 7.04 cm width of the leaves. The results showed that treatment A (25ml) had the optimal nutrient level for lettuce to produce wider leaves and the increase in the SNAP solution level did not have a significant effect on the width of lettuce days before harvesting. The results of the analysis revealed an increase in the width of leaves that revealed a highly significant difference among other treatments. Figure 8 depicts a graph depicting the increase in lettuce width.

3.3 | Yield of Lettuce

The results of a study on the weight of lettuce per plant after 27 days ranged from 1.11 grams to 20.59 grams. Treatment A (25ml) yielded the most lettuce (20.59 grams), followed by treatment B (30ml) with 9.26 grams, treatment C (35ml) with 5.40 grams, and treatment D (control) with 1.11 grams. The results of the study indicated that Treatment A (25ml) had the potential to produce higher yields of lettuce, and the increase in the SNAP solution level of up to 35ml did not have a significant effect in terms of yield. Figure 9 shows the graph of the weight of lettuce per plant per replication in different treatments. The results of the analysis revealed a highly significant difference among each treatment.

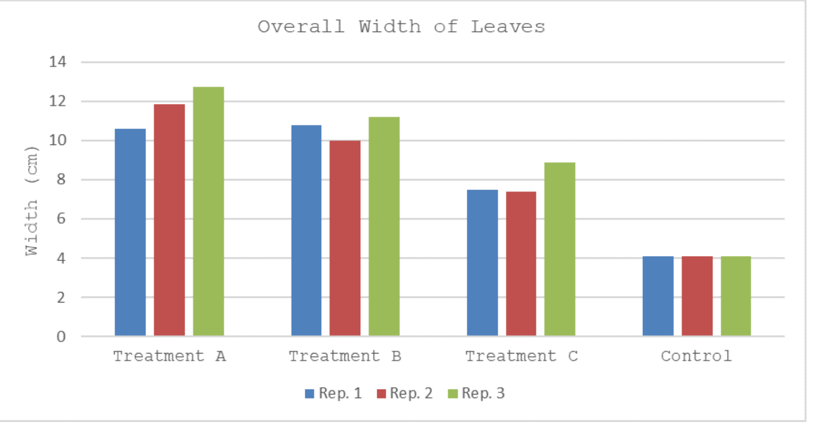

FIGURE 8 The overall width of leaves from day zero to 27th day.

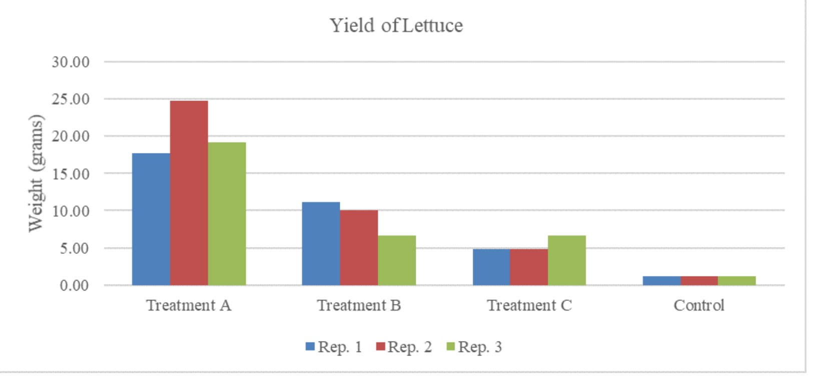

FIGURE 9 Weight of Lettuce per plant after 27th day.

3.4 | Water Consumption

3.4.1 | Water Consumption per Replication

The results of a study on water consumption per replication after 27 days ranged from 2.30 liters (li) to 8.90 li. Treatment A (25ml) had the highest water consumption with 8.90 li, followed by treatment B (30ml) with 6.47 li, treatment C (35ml) with 4.35 li, and the last was treatment D (control) with 2.30 li. The results indicated that the plants in treatment A (25ml) consumed more water for their growth and development than plants in other treatments. The results on growth show that the plants in treatment A efficiently utilized the water with a 25ml SNAP solution mixture. Additionally, this verified that the nutrient level at 25ml of SNAP solution mixture was highly absorbable and that if increased, the plant would not absorb more water. Figure 10 shows the graph of water consumption per replication in 4 different treatments. The results of the analysis of water consumption revealed a highly significant difference among each treatment.

3.4.2 | Water Consumption per Yield

The results of a study on water consumption per unit weight of lettuce (li per gram of lettuce) range from 0.44 li/grams to 2.07 li/grams. Treatment A (25ml) had the lowest water consumption with 0.44 li/grams of lettuce compared to treatment B (30ml) with 0.73 li/grams, treatment C (35ml) with 0.83 li/grams, and treatment D (control) with 2.07 li/grams. The results revealed the lettuce in treatment A (25ml) efficiently absorbed and utilized the water for its optimum growth. Furthermore, the results indicated that treatment A was the best mixture for optimum water absorption in lettuce production. Figure 11 shows the graph of water consumption per gram of lettuce per replication and per treatment. The results of the analysis of water consumption revealed a highly significant difference among each treatment.

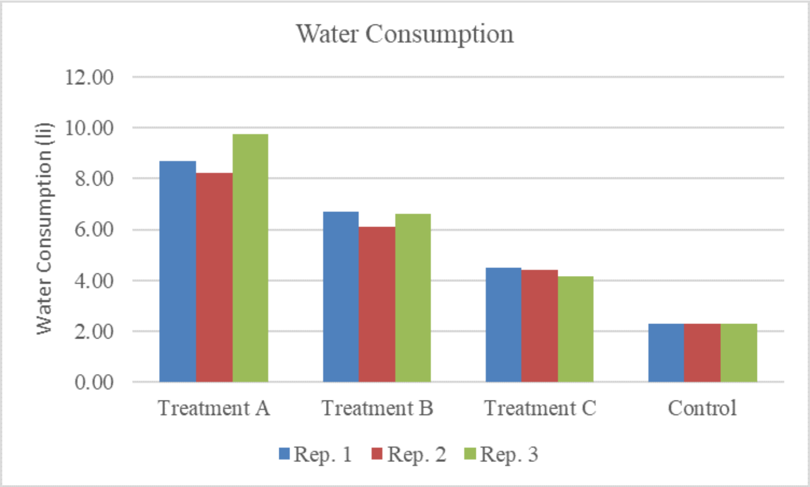

FIGURE 10 Water consumption per replication after 27th day.

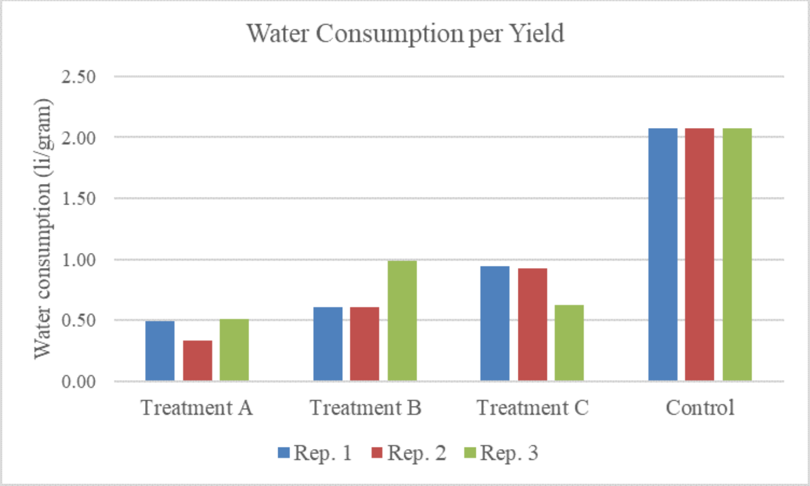

FIGURE 11 Water consumption per grams of lettuce at harvest.

4 | CONCLUSION

The results of the study on the different levels of SNAP solution showed a significant effect in terms of height and number of leaves, and a highly significant effect in terms of yield. In terms of the length of the leaves and the width of the leaves, the different levels have no significant effect. The analysis of the study on water consumption showed highly significant effects on lettuce production in terms of yield. Based on the summary of the findings, the SNAP solution has great potential in lettuce production. The different levels have a significant effect on height and number of leaves, and a highly significant effect in terms of yield. The different levels of SNAP solution greatly affect the amount of water consumed. The lettuce production in the SNAP hydroponics system needs 0.44 liters of water to produce 1 gram of lettuce inside the screen house in the summer season under DEBESMSCAT, Masbate conditions. The SNAP hydroponics system is very efficient in water use.

References

Bañez BP & FR Manipon. (2000). Crop production under greenhouse and soil-less media culture (Los Baños conditions).

Dos Santos, J. D., Lopes da Silva, A. L., Da Luz Costa, J., Scheidt, G. N., Novak, A. C., Sydney, E. B., & Soccol, C. R.

(2013). Development of a vinasse nutritive solution for hydroponics. *Journal of Environmental Management*, *114*, 8-12. Retrieved from https://www.sciencedirect.com/science/article/pii/S0301479712005506 doi: https://doi.org/10.1016/j.jenvman.2012.10.045

Food and Fertilizer Technology Center for the Asian and Pacific Region. (2004). Retrieved from https://www.fftc.org.tw/en/publications/detail/1485

Gonzales AT., J Pattung, & R Sawadan. (2020). Hydroponically Grown Lettuce (Lactuca satica) varieties using Simple Nutrient Addition Program (SNAP) Hydroponic Technology for Enterprise Development. *Journal of Biodiversity and Environmental Sciences (JBES)*, *16*(2220-6663), 52–56. Retrieved from http://www.innspub.net

Hassall & Associates. (1999). *The New Rural Industries – Financial Indicators. Hyde KW (ed), Publication 99/38 Rural Industries Research and Development Corporation, ACT*.

Hugh Fearnley - Whittingstall . (2013). River Cottage Veg: 200 Inspired Vegetable Recipes.

Katz, H.S. and Weaver W.W. (2003). *Encyclopedia of food culture* (Vol. 1).

Santos PJ. A & Ocampo ET. A. (2005). SNAP Hydroponics: Development & Potential for Urban Vegetable Production. *Philippine Journal of Crop Science (PJCS)*, *2*(30), 3–11.

Zohary, D., Hopf, M., & Weiss, E. (2012). *Domestication of plants in the Old World: the origin and spread of domesticated plants in Southwest Asia, Europe, and the Mediterranean Basin* (4th ed ed.). Oxford: Oxford University Press.

How to cite this article: E. C. Borres, E. B. Basulgan, R. M. L. Dalanon, (2022), Potentialities Of Lettuce (Lactuca Sativa L.) In Hydroponics System Under Simple Nutrient Addition Program (SNAP), *Vol. 2 No. 1*

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.