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Hydroponically grown lettuce (*Lactuca satica*) varieties using Simple Nutrient Addition Program (SNAP) hydroponic technology for enterprise development

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Abstract

The study was conducted from January to March of 2017 and 2018 at Cagayan State University, Sta. Maria, Lal-lo, Cagayan to determine the growth and yield performance of different lettuce (*Lactuca satica*) varieties using simple nutrient addition program (SNAP) through hydroponic technology for enterprise development. Specifically, it aimed to determine which variety of lettuce gives best result in terms of: (a) height of plants (cm), (b) length of roots (cm), (c) number of leaves, (d) weight of plant(g), (e) biomass (g), and (h) return of investment (ROI%). The experiment was laid out in Completely Randomized Design (CRD) with three lettuce varieties as treatments, replicated three times. They were grown in fruit boxes with ten samples per variety per treatment labeled to gather data. The treatments were as follows: T1- Greenwave (Romaine type); T2- NRBL-2 (Loose leaf type); and T3- Emperor (head type). Data were gathered at 7 days interval from 10 days to 28 days after transplanting. Result of the study revealed significant differences in all the treatments in terms of plant height while other parameters such as length of roots, number of leaves, weight of the plant and biomass perceived to be equal which shows no significant differences. However, in terms of the cost and return analysis the study showed that 120 hills of emperor variety gave the highest net income of P 1214.24.

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Introduction

Hydroponics is an alternative system of growing plants without soil. An inert media is used, instead of soil, into which a nutrient solution containing essential elements is added to a plant's normal growth and development.

Simple Nutrient Addition Program (SNAP) hydroponic is a low-cost, hydroponics system for soil-less vegetable production. The SNAP nutrient solution is used for non-circulating hydroponic system, encouraging the use of recycle materials like fruit styro boxes This technology that was developed by the University of the Philippines-Los Banos, is best for home-based vegetable production and ideal for small spaces typical for urban area, landless or problematic, i.e., floody or drought land area.

This SNAP hydroponic is simple to set-up, maintain and operate since it only requires enough sunlight, air movement and protection from rain, compare to traditional hydroponics technology that needs green house, a sophisticated set-up that may need big amount of investment. This low-cost, low-maintenance hydroponics system is highly suited for household level- and small - scale commercial vegetable production. The system employs passive aeration of a nutrient solution and the ability of the vegetable crop to adapt waterlogged conditions and lettuce have been successfully grown using SNAP hydroponics all over the country SNAP hydroponics for commercial lettuce production, an initial investment of P66,925 in a 200 m^2 can be recovered within 2 years at 10 croppings per year (Santos, PJ 2012).

However in Lal-lo, Cagayan, hydroponic system has never been explored for enterprise development, thus, an attempt to adopt this Simple Nutrient Addition Program (SNAP) hydroponics for a household level and small scale commercial lettuce production was made to find out the growth an yield performance of different lettuce varieties using SNAP hydroponics. The verification study would create awareness on the advantages of a low-cost and simple hydroponic system that could be adapted to local conditions which will make growing crop hydroponically possible anywhere and anytime even under an urban environment and unfavorable condition (Gapasin & Salas, 2019; Balinado *et al.*, 2019), resulting to a consistent year-round yield and income (Peña Jr, 2017; Gapasin, & Salas, 2019; Dickson & Fisher, 2019).

Objectively, the study aimed to evaluate the growth and yield performance of lettuce varieties using SNAP hydroponic technology. Specifically, the study aimed to find out which variety of lettuce grown in SNAP (Simple Nutrient Addition Program) hydroponic culture that would give the best result in terms of the following parameters. (a) height of plant (cm), (b) length of roots (cm), (c) number of leaves, (d) weight of the plant (g), (e) biomass (g), (f) rate of increase and (g) return of investment (ROI).

Materials and methods

Experimental Design

The study was conducted at Cagayan State University, Sta. Maria, Lal-lo, Cagayan from Oct to December of 2017 and January to March of 2018. The Complete Randomized Design (CRD) was used in the study with the following treatments:T1- Variety 1 Greenwave (Romaine); T2- Variety 2 NRBL-2 (Loose leaf) and T3- Variety 3 Emperor (Head type)

Nutrient Solution Preparation, Hydroponic System Set-Up and Seed Sowing

Two (1 L) bottled purified water were used, one for nutrient concentrate A and the other for concentrate B. The solutions contained in Concentrate A: were Nitrogen (Nitrate with 140.13ppm) and Potassium (210.11ppm), Nitrogen (Ammonium 14.01ppm) and Calcium (103.79ppm), Iron (2.00ppm). While the Concentrate B: were Phosphorus (31.04ppm) and Potassium (210.11ppm), Magnesium (30.01ppm), N- Ammonium (14.01ppm), Boron (0.40ppm), Manganese (0.25ppm), Zinc 0.12ppm), Copper (0.12ppm), Molybdenum (0.08ppm) and Non Mineral Colorant. These concentrates were thoroughly dissolved one after the other. The seeds of lettuce were directly sown to the seedling plug with culture pots. The seedlings were regularly watered. 7-10 days after germination.

Preparation of Culture Pots, Plugs and Coconut Coir

Styrofoam fruit boxes were used as a growing culture pots and served as container for solution. The bottom part of the box was lined with a plastic sheet to prevent the solution from draining off. On the lid or box cover, 8 holes equidistant from one another was cut-off. Fifteen (15) liters of water were mixed with 60 ml of each concentrates to achieve cultured water. Ten days after sowing, the plugs are ready to stand in the culture pot. The bottom part of the plastic cups or plugs was also cut off into small holes for roots. The coconut coir was laid for solarization.

Shade Construction and Maintenance

The nursery was covered by screening vents to avoid insect pests that may affect the growth of the crop. Plants were protected from too much heat by putting coconut leaves and a plastic cover to protect from heavy rain fall. Plants were inspected daily for signs of disease, insects and mites. The pH and temperature were monitored and maintained throughout the study.

Harvesting, Packing and Marketing

The yields were harvested 30 days after sowing. Harvested lettuce were packed properly and it was sold to faculty and staff of the campus and outside the campus. Plant samples were harvested first for data gathering.

Gathering of Data and Analysis

Plant samples were examined weekly after transplanting. The following data were gathered: (a) plant height (cm); (b) length of roots (cm); (c) Number of Leaves; (d)Fresh weight of the plant; and (e) Biomass. The data gathered were analyzed using the analysis of variance (ANOVA) of the Completely Randomized Design (CRD).

Results and discussion

Plant height (cm), root length (cm) and number of leaves at 1-4 week after transplanting (WAT) is presented in Table 1.

Plant Height (cm)

The height of lettuce plant, one to fourth week after transplanting (WAT) reveals a consistent result that the Emperor- Crisphead produced the tallest lettuce with a mean of 8.4 to 29cm, followed by Greenwave-Romaine with a mean of 7.6-29.7cm, and the shortest is NRBL-2 – Loose leaf with a mean of 4.2cm to 19.6cm. The result of the study shows that Emperor (Crisphead) variety was able to significantly use the nutrients available in the solution as manifested by its height that is significantly higher than Greenwave (Romaine) and NRBL-2 (Losseleaf). Ideally, the temperature requirement of Emperor variety to head formation is ranging from 16-to 18°C. In the experiment, the temperature was observed to reach from 26°C to 37°C with an average of 32°C within the duration of the experiment. This might the reason for stem elongation instead of head formation as a response to high temperature.

Table 1. Plant height (cm), root length (cm) and number of leaves at 1-4 week after transplanting (WAT).

Lettuce Variety	Plant Height (cm)				Root Length (cm)				Number of Leaves			
	1	2	3	4	1	2	3	4	1	2	3	4
Greenwave (Romaine)	7.6b	17.3a	25.4a	29.7a	8.4	13.8b	19.9	34.22	5.3 ab	6.3	7.1b	8.73
Nrbl-2 (Loose leaf)	4.2c	10.9b	16.4b	19.6b	9.5	16.3b	20.7	33.77	4.93b	6.3	7.7 b	8.00
Emperor (Crisphead)	8.4a	14.3ab	23.8a	29.3a	11.5	20.2a	26.7	34.55	5.47a	6.7	9.6 a	10.10

*All means followed by the same letter in a column are not significantly different at 5% level (LSD).

Lettuce Roots Length (cm)

The result of the length of roots in one to fourth week after transplanting shows that Emperor (crisphead) produced the longest roots with a mean of 11.8cm-34.55cm followed by NRBL2 (looseleaf) with a mean of 9.66cm to 33.77cm while the shortest is Greenwave (Romaine) with a mean of 8.3cm to 34.22cm. Analysis of variance showed significant difference among the treatments tested. This finding means that the performance of different lettuce varieties under simple nutrient addition program through hydroponic technology reveals using Least Significant Test of Comparison among means that Emperor-Crisphead is significantly different to Greenwave-

Romaine and Nrbl-2-Loose leaf but Emperor-Crisphead is not significantly different to Nrbl-2-Looseleaf, in terms of length of roots from second week. While no significant differences among the treatments tested. From first, third and fourth week after transplanting. This means that any of the lettuce variety can be grown in a soilless medium, specifically using the SNAP solution.

Number of Leaves of Lettuce

The result of the length of roots in one to fourth week after transplanting shows that still its the Emperor (crisphead) produced the most number of leaves with a mean of 5.47cm to 10.10cm , followed by Greenwave (Romaine) with a mean of 5.26cm to 8.73cm, and the least is NRBL-2 (Looseleaf) with a mean of 4.93cm to 8cm, respectively. Analysis of variance showed significant difference among the treatments tested in first and third weeks after transplanting. This finding means that the performance of different lettuce varieties under simple nutrient addition program through hydroponic technology reveals that number of leaves influence by the solution.

Lettuce plant weight (g) and Plant biomass of the plant in grams (g)at maturity stage

Result of the weight of the plant at maturity is shown in Fig. 1. Emperor- Crisphead significantly produced the heaviest weight with a mean of 759.33g followed by Greenwave- Romaine with a mean of 295.00g, and the least is NRBL-2- Looseleaf with a mean of 194.33g. The result of the pl;ant biomass shows that Emperor- Crisphead significantly produced the heaviest biomass with a mean of 838.00g followed by Greenwave- Romaine with a mean of 489.67g, and the least is NRBL2- Looseleaf with a mean of 211.00g.

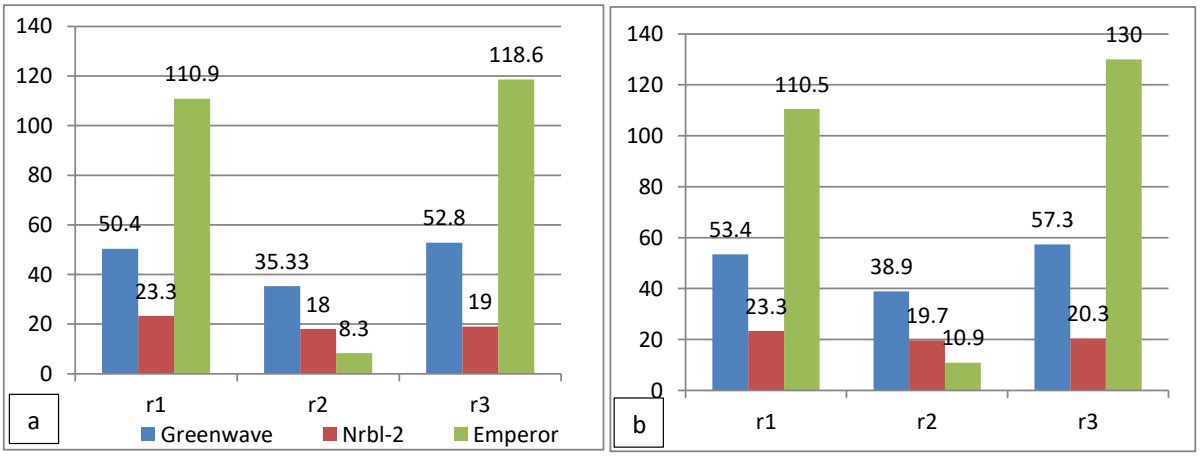

Fig. 1. (a) Weight (g) of Plant at maturity stage and (b) Biomass of the plant in grams (g).

Table 2. Cost and return of lettuce grown using SNA Phydroponic technology for enterprise development.

Lettuce Variety	Gross Income Php/ treatment	Cost of production Php/ treatment	Net Income	ROI (%)
Greenwave	1266.00ab	354.6	911.40ab	85.67
NRBL-2	867.00b	354.6	512.40b	48.00
Emperor	1568.84a	354.6	1214.24a	114.12
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*All means followed by the same letter in a column are not significantly different at 5% level (LSD).

Cost and Return Analysis

Table 2 presents the cost and return analysis of growing lettuce using SNAP hydroponic technology. Emperor gave the highest net return of Php 1214.24 with an ROI of 114. 12%, followed by Greenwave with net return of Php 911.4 and ROI of 85.6%, NRBL-2 with Php5122.4 net return and ROI of 48%. The selling price per kilo is, Greenwave Php 260.00/k, NRBL-2 Php 300.00/k and Emperor Php 260.00 /k. The differences in price per kilo were due to the variety preference and quality. In terms of cost of production, all treatments are equal to the fact that the management is also the same. However in terms of yield, emperor gave the highest yield hence the highest net income. Therefore, the calculated return above cost of production after 30 days growing of

lettuce were in order: emperor (Php 1214.24), Greenwave (Php 911.14) and NRBL-2 (512.4). in general, Emperor was highest in ROI than the other two lettuce varieties.

Conclusion

All varieties of lettuce can be grown in simple Nutrient Addition Program (SNAP) solution under hydroponic technology for enterprise development. However, in terms of plant height, Greenwave responds to the SNAP solution than other varieties. However, on a per plant basis, the highest yield was obtained from Emperor (162 g) the lowest from NRBL-2 (14 g). As a result on the return of investment, the emperor produced the highest percentage of return with 114.12% or 1: 1.14 in every cycle. Despite the high low-cost greenhouse temperature (26-30°C) at noon time, it recovers during night time with a temperature of 18-21°C and is still favorable for the growth of the lettuce since these are semi-temperate crops.

Recommendation

Based from the study, SNAP hydroponic for growing lettuce is recommended under nursery management or on small scale production of lettuce. This low-cost, low-maintenance hydroponics system is highly suited for household level- and small - scale commercial vegetable production. It could be recommended as part of agro-tourism project for urban vegetable production. A follow-up study is also recommended to arrive for more valuable results.

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