Vol. 22 · October 2015
Print ISSN 2012-3981 • Online ISSN 2244-0445
doi: http://dx.doi.org/10.7719/jpair.v22i1.337
Journal Impact: H Index = 2 from Publish or Perish

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by AJA Registrars, Inc.

Potentials of Home-made Concoction as Nutrient Solution in a Modified Hydroponic System

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ABSTRACT

A Hydroponic System is a technique that is widely used in Agriculture especially in growing plants in urban areas. A study was conducted to determine the responses of lettuce grown under a modified hydroponic system to different organic solutions at Cebu Technological University – Barili Campus, Philippines. The treatments used in the study are T0 – commercial organic amino acid, T1 – Home-made concoction, T2 – Inorganic fertilizer and T3 - coconut water. Results showed that on the number of leaves, lettuces that were applied with home–made concoction had 10.13% and 15.23% more leaves than inorganic fertilizer and commercial organic amino acid applied treatments respectively (4^{th} week). No significant difference were observed among commercial organic amino acid, home-made concoction and inorganic fertilizer, in terms of leaf length from the 2^{nd} week to 4^{th} week having. Furthermore, comparable results were observed between lettuce applied with home-made concoction and inorganic fertilizer on its leaf width on the 2^{nd} week having 7.03 cm and 6.30 cm respectively. Moreover, comparable effects were also observed on commercial organic amino acid and home-made concoction in plant height having an average length of 17.03 cm and 17.00 cm, respectively. At harvesting, lettuces that were applied with home-made concoction had the heaviest weight having 43.23 g or 20.12% heavier than those applied with commercial organic amino acid and 23.67% heavier than inorganic fertilizer. Therefore, the home-made concoction is the best organic nutrient source in growing lettuce in a modified hydroponic system.

Keywords – Agriculture, modified hydroponic system, organic liquid solution, experimental research, Cebu Philippines

INTRODUCTION

Nowadays, farmers and companies that are producing agricultural products are dependent on using inorganic fertilizer to meet the growing needs of people for food consumption worldwide. One of the major concerns of today's world is the pollution and contamination of soil (Kumari, Kumar & Rao, 2014). The impact of chemical fertilizer application on agricultural land is seen not only in terms of the soil quality, but also on the survival of soil organisms dwelling there in (Rai, Ashiya & Rathore, 2014). Excessive use of synthetic fertilizers and pesticides has indirectly caused tremendous harm to the environment as well affects human population (Kumar et al., 2014).

Lettuce (Lactuca sativa) is an annual plant of the family Asteraceae. It is most often grown as a leaf vegetable, but sometimes for its stem and seeds. In the Philippines, lettuce is considered as one of the most important salad crops. Hydroponically grown agricultural products continue to grow in popularity most especially in the urban areas wherein the area for planting is limited. Hydroponic crop production has significantly increased in recent years worldwide as it allows a more efficient use of water and fertilizers, as well as a better control of climate and pest. Furthermore, hydroponic production increases crop quality and productivity, which results in higher competitiveness and economic income (Trejo-Téllez & Gómez-Merino, 2012). The hydroponic system does not require soil in growing plants; it only needs the right solution that contains all essential nutrients that the crop needs for survival. A nutrient solution for a hydroponic system is an aqueous solution containing mainly inorganic ions from soluble salts of essential elements for higher plants. Eventually, some organic compounds such as iron chelates may be present (Steiner, 1968). An essential element has a clear physiological role, and its absence prevents the complete plant life cycle (Taiz & Zeiger, 1998). Without these nutrients in the hydroponic system, it will result to rapid plant death. Hence, it is necessary to know the best sources of nutrients for plants that can be used to apply in a hydroponic system.

Studies on the use of organic materials as fertilizers have gained popularity not just because of its ever increasing price, but also the effects of using commercial fertilizers to human health and the environment. Moreover, increased consumer awareness of food safety and environmental concerns have contributed to the development of organic farming over the last few years (Worthington, 1998;

Worthington, 2001; Relf, McDoniel & Tech, 2002). Farm income will also improve when farmers use less money on fertilizers and pesticides for growing crops (Vernon, 1999) and the market for organic produce continues to expand (Thompson, 2000).

As compared to soil-based production systems, hydroponic systems require much less water; are easier to treat for pests and diseases; have high, stable yields; and reduce potential nutrient pollution (Resh, 2004). Thus, the study aimed to determine the responses of lettuce grown under a hydroponic system applied with the different organic hydroponic solution.

MATERIALS AND METHODS

Research Site

Green House experiment on Lettuce (Lactuca sativa) was conducted at Cebu Technological University- Barili Campus, Barili, Cebu. The area was cleaned and cleared before the conduct of the study. Twenty-four (24) growing containers were prepared and arranged. It was divided into three (3) replications with a distance of thirty centimeters (30cm) per replication. The distance between each growing container per replication was ten centimeters (10cm). Each container was covered by an illustration board with five (5) holes to hold the Styrofoam cups in place with a diameter of seven centimeters (7cm).

One hundred twenty-four (124) perforated Styrofoam cups were used with a height measurement of 8.2 centimeters, opening diameter of 7.4 centimeters and a bottom diameter of 4.8 centimeters (Figure 1).

Figure 1. Experimental area of the study

Medium Preparation

A 1:1 ratio of garden soil and vermicast was used in the study. A composite soil sample was achieved before they were placed in styrofoam cups.

Sowing

Lettuce seeds were in a seedling trays.

Transplanting

Seedlings were carefully taken from the tray and transplanted to the styrofoam cups one (1) week after emergence.

Treatments and Application

The treatments used were as follows:

T_0- Commercial Amino Acid (12ml Solution A + 12ml Solution B per 3000ml of water)

T_1- Home-Made Concoction (20ml home-made per 3000ml of water)

T_2- Inorganic Fertilizer (600mg per 3000 ml based on recommended rate)

T_3- Coconut Water (750ml of coconut water per 2250ml of water)

Application of treatments was done on a weekly basis following the formulated concentration of the treatments in the study. Each treatment in each replication has a total number of 10 samples.

The Home-made concoction is composed of chopped organic farm waste products from cauliflower, tomatoes and papayas, and Japanese snails that were attacking the papaya plants in the area. Twenty kilograms of farm waste products plus snails were placed in a drum and mixed with 2 kilograms of brown sugar and fermented for 1 month before using.

Data Collection

Data collection involves the growth, development, and yield of lettuce as affected by the different treatments. This includes the following:

Number of Leaves - This was done 1 week after transplanting until harvesting by counting all true leaves of lettuce once a week.

Leaf Length -This was done weekly by measuring from the base to the tip of the leaf.

Leaf Width - This was done weekly by measuring the diameter of the leaf.

Plant Height - This was done during harvesting by measuring from the bottom up to the tip leaf of the plant.

Above Ground Fresh Weight - This was done during termination day by cutting the base of the plant and weigh the entire plant using a one-kilogram weighing scale.

Root Length - This was done by cutting the tip of the root and measure it in centimeters using a ruler during harvesting.

Statistical Techniques

Analysis of Variance (ANOVA) for Randomized Complete Block Design (RCBD) was used in analyzing any significant difference on the parameters gathered. Comparisons among treatment means were done using the Tukey HSD to determine the specific significant differences.

RESULTS AND DISCUSSION

Yield and yield components of lettuce show that the no. of leaves, leaf width, plant height and fresh weight were significantly affected by the treatments (see Figure 2).

Plants that were applied with home-made concoction have the highest recorded no. of leaves on the 3rd week and 4th week (see Table 1) with an average of 7.96 on the 3rd week and 11.16 on the 4th week respectively. Although, no significant difference were observe between the three treatments (commercial organic amino acid, home-made concoction and inorganic fertilizer) but this implies that home-made concoction is a good alternative to inorganic fertilizer to increase the no. of leaves of lettuce in a modified hydroponic system. This finding is in agreement on what was reported by Pascual, Jarwar and Nitural (2013) that a pechay that was applied with fermented swamp cabbage juice produces higher number of leaves. Amino acids such that of golden snails promote the growth of beneficial microorganisms (The Gardeners Network, 2008). Moreover, this may also be true with Fermented Swamp Cabbage Juice from Ipomoea aquatica; leaves are also very rich in proteins, carotenes and amino acids like aspartic acid, threonine, serine, glutamic acid, proline, glycine, alanine, leucine, tyrosine, lysine, histidine and arginine (Prasad, Shivamurthy & Aradhya, 2007).

Figure 2. Growth and Development of Lettuce (Lactuca sativa) at harvest as affected by the different Hydroponic solutions

Table 1. Number of leaves of lettuce as affected by different hydroponic solutions

Hydroponic Solution	Number of Leaves			
	Week 1	Week 2	Week 3	Week 4
T0 – commercial organic amino acid	4.33	5.56	7.96[a]	9.46[ab]
T1 – home-made concoction	4.80	5.53	7.96[a]	11.16[a]
T2 – inorganic fertilizer	4.03	5.46	7.83[a]	10.03[a]
T3 – coconut water	4.40	5.46	6.73[b]	8.10[b]
Mean	**4.39**	**5.50**	**7.62**	**9.69**
C.V (%)	**10.19**	**5.90**	**5.89**	**7.26**

Means within the same column followed by a common letter are not significantly different from each other at 5% level using the Tukey HSD

Significant differences were also observed 14 days after planting on the leaf length of lettuce as affected by the different treatments. Having an average of 8.46 cm in length on the 2nd week, plants applied with Home-made concoction have 23.17% longer leaves than lettuce applied with coconut water (Table 2). This supported the findings of Pascual, Jarwar and Nitural (2013) that pechay applied with Fermented Swamp Cabbage Juice alone produced the longest leaves. However, on the 3rd week, plant applied with commercial organic amino acid surpass the performance of the home-made concoction by 2.2% and 1.9% on the 4th week, respectively but still the response of the plants applied with home-made concoction are still comparable as to the performance of the plants applied with inorganic fertilizer and commercial organic amino acid. Pascual et al. (2013) also reported that leaf length of pechay was increased 1.77 times when applied with fermented activators and EM solution. Both of which are known to contain a substantial amount of amino acid as reported by Catubis et al. (2013).

Table 2. Leaf length of lettuce as affected by different hydroponic solutions

Hydroponic Solution	Leaf Length			
	Week 1	Week 2	Week 3	Week 4
T0 – commercial organic amino acid	4.23	8.33[ab]	12.13[a]	14.03[a]
T1 – home-made concoction	4.00	8.46[a]	11.86[a]	13.76[a]
T2 – inorganic fertilizer	3.96	8.26[ab]	11.70[a]	13.30[a]
T3 – coconut water	3.90	6.50[b]	9.26[b]	10.13[b]
Mean	**4.0**	**7.89**	**11.24**	**12.81**
C.V (%)	**8.94**	**4.82**	**3.38**	**4.49**

Means within the same column followed by a common letter are not significantly different from each other at 5% level using the Tukey HSD

As shown (see Table 3), significant difference was observed two weeks after transplanting of lettuce in its leaf width. With an average leaf width of 7.03 cm, plants applied with home-made concoction shows 13% wider leaves than plants applied with commercial organic amino acid, and 21% wider than coconut water. Furthermore, it was observed that on the 4th week, plants that were applied with home-made concoction are 24% wider than lettuce applied with coconut water.

Table 3. Leaf width of lettuce as affected by different hydroponic solutions

Hydroponic Solution	Leaf Width			
	Week 1	Week 2	Week 3	Week 4
T0 – commercial organic amino acid	2.30	6.10[b]	10.76[a]	13.13[a]
T1 – home-made concoction	2.20	7.03[a]	11.43[a]	13.30[a]
T2 – inorganic fertilizer	2.26	6.30[ab]	11.23[a]	12.96[a]
T3 – coconut water	2.13	5.50[b]	8.83[b]	10.23[b]
Mean	**2.22**	**6.23**	**10.56**	**12.41**
C.V (%)	**12.88**	**6.43**	**4.84**	**6.55**

Means within the same column followed by a common letter are not significantly different from each other at 5% level using the Tukey HSD

During harvesting, significant difference was observed on the height of lettuce as affected by different hydroponic solutions. Plants applied with commercial organic amino acid has the tallest plants among all samples having an average plant height of 17.03 cm equivalent to 14.85% higher than inorganic fertilizer and 41.51% higher than coconut water (Figure 3).Catubis et al., (2013) reported that the application of amino acid significantly influenced shoot growth and the application of amino acid provides a promising beneficial effect especially on shoot growth without negatively affecting root growth and development of leaves. Rai (2002) also reported that amino acid such as proline accumulation aids in K^+accumulation in Vignaradiata cultures. The use of mixed amino acids solutions as alternative part of nitrate fertilization has successfully sustained lettuce plant growth and yield in soilless growing systems (Gunes, Post, Kirkby & Aktas, 1994). However, there is no significant difference among lettuce applied with commercial organic amino acid, home-made concoction and inorganic fertilizer. This implies that home-made concoction is a good substitute

for inorganic fertilizer to increase the height of lettuce plants grown under a modified hydroponic system. Furthermore, lettuce applied with coconut showed the shortest plants among the treatments.

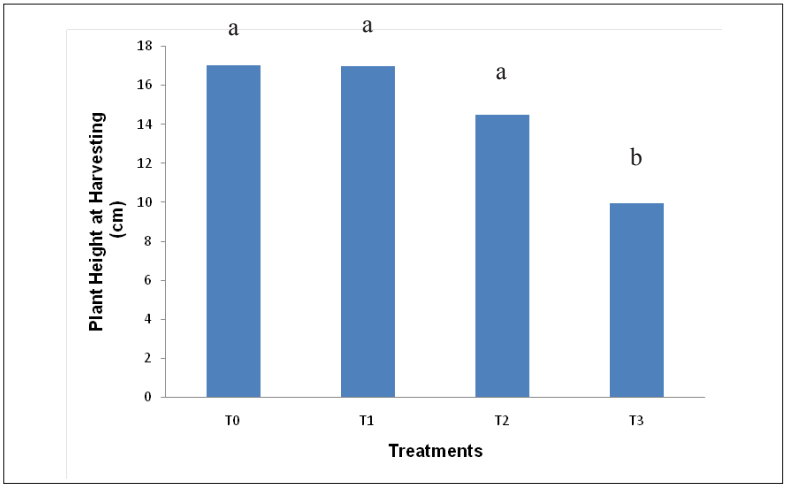

Figure 3. Height of Lettuce as affected by different hydroponic solutions

Lettuce applied with commercial amino acid showed longer root length after harvest with an average of 10.73 cm, equivalent to 21.71% higher than inorganic fertilizer and 11.46% higher than lettuce applied with coconut water. However, no significant difference were observed among the treatments (Figure 4). This implies that to increase root length of lettuce, application of amino acid or home-made concoction is already enough, and the application of inorganic fertilizer and coconut water is not anymore necessary if you are aiming to increase the root length of your plants. Dick and Gregorich (2004) also reported that application of organic matter remains the key component in the development and maintenance of a high-quality soil because it affects many soil properties like buffering capacity, soil consistence, and soil erodibility, and provides a healthy environment for the community of soil microorganisms.

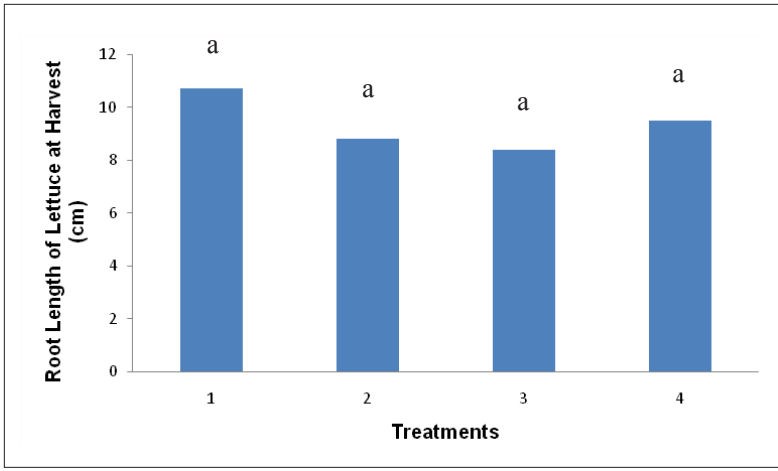

Figure 4. Root Length of Lettuce as affected by different hydroponic solutions

Data also showed significant difference among treatments on the above ground fresh weight. Plants applied with home-made concoction are the heaviest of them all with an average of 43.23 g equivalent to 63.24% than lettuce applied with coconut water (Figure 5). This shows that using home-made concoction alone is already a very promising alternative to increase the above ground fresh weight of lettuce grown under a modified aggregate hydroponic system. Furthermore, organic fertilizers (solid or liquid) contain essential elements and substances such as plant nutrients, vitamins, antibiotics, and a complex of black humus that contains billions of microorganisms, egg, and larvae of soil fauna (Ruiz, 1983). Pascual (2013) also reported that Fermented Cabbage Juice alone improve the nutrient contents (N, $P_2O_{3,}$ and K_2O) of the compost after four and eight weeks of composting.

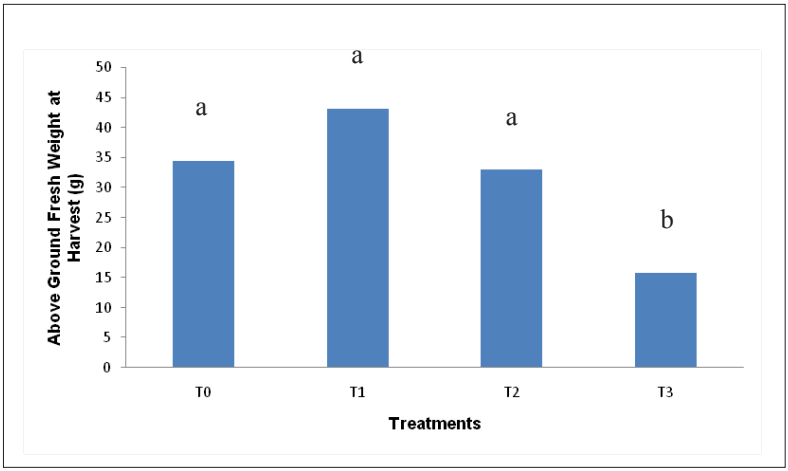

Figure 5. Above Ground Fresh Weight of Lettuce as affected by different hydroponic solutions

Bars within the same column affix by a common letter are not significantly different from each other at 5% level using the Tukey HSD. However, analysis for chemical and biochemical content of home-made concoction was not done due to the lack of facilities, equipment and money to perform the laboratory test.

CONCLUSION

Home-made concoction increases the number of leaves, leaf width and above ground fresh weight of lettuce. Therefore, the home-made concoction has the highest potential to increase yield and yield components of lettuce among all other organic nutrient solutions in a modified hydroponic system.

TRANSLATIONAL RESEARCH

The outcome of the study entitled "Potentials of Home-made Concoction as a Nutrient Solution in a Modified Hydroponic System" may be translated into use in the community by sending the information to the Philippine Association for Institutional Research Incorporated. Further analyses of other sources of nutrients in a modified hydroponic system will help identify areas in the procedure that can be improve to increase yield of lettuce.

LITERATURE CITED

Kumari, A. K., Kumar, R. K. N., Rao, N. C. H., 2014. Adverse Effects of Chemical Fertilizers and Pesticides on Human Health and Environment. Journal of Chemical and Pharmaceutical Sciences.Retrieved on November 16, 2015 from http://www.jchps.com/pdf/si3/34%20jchps%20si3%20addn%20K.Anitha%20Kumari%20150-151.pdf

Catubis, K. M. L., Granada, B. A., Morales, J. B., Alferez, R. R., Asentista, R. A., Pascual, P. R. L., & Saramosing, J. G. (2013). Application of Amino Acids on Philippine Native Tomato (Lycopersiconesculentum L.)Grown Under Flood Condition. JPAIR Multidisciplinary Research, 13(1).

Dick, W. A. and E. G. Gregorich. 2004. Developing and maintaining soil organic matter levels. In managing soil quality. Challenges Modern Agriculture, ed P. Schjonning, S. Elmholt, and B. T. Christensen Cambridge, MA: CAB International.

Gunes, A., W.N.K. Post, E.A. Kirkby and M. Aktas, 1994. Influence of partial replacement of nitrate by amino acid nitrogen or urea in the nutrient medium on nitrate accumulation in NFT grown winter lettuce. J. Plant Nutr., 17: 1929–1938

Pascual, P. R., Jarwar, A. D., & Nitural, P. S. (2013). Fertilizer, fermented activators, and EM utilization in pechay (Brassica pekinensis L.) production. Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences, 29(1), 56-69.

Pascual, P. R. L. (2013). Improved Composting Through Fermented Activators. JPAIR Multidisciplinary Research, 13(1).

Trejo-Téllez, L. I., & Gómez-Merino, F. C. (2012).Nutrient Solutions for Hydroponic Systems. Hydroponics–A Standard Methodology For Plant Biological Researches, 1.

Prasad, K. N., Shivamurthy, G. R., & Aradhya, S. M. (2008). Ipomoea aquatica, an underutilized green leafy vegetable: a review. International Journal of Botany, 4(1), 123-129.

Rai, N., Ashiya, P., Rathore, D. S., 2014. Comparative Study of the Effect of Chemical Fertilizers and Organic Fertilizers on Eiseniafoetida.International Journal of Innovative Research in Science, Engineering and Technology.Vol. 3.Pp 12991 to 12998.

Rai, V. K. (2002). Role of amino acids in plant responses to stresses. BiologiaPlantarum, 45(4), 481-487.

Relf, D., McDoniel, A., & Tech, V., (2002): Fertilising the vegetable garden. http://www.indiaagronet.com/indiaagronet/Manuers_fer tilizers/contents/inorganic_fertilizers.htm (21/08/2008)

Resh, H. M. (2012). Hydroponic food production: a definitive guidebook for the advanced home gardener and the commercial hydroponic grower. CRC Press.

Steiner, A.A. (1968). Soilless Culture, Proceedings of the IPI 1968 6th Colloquium of theInternacional Potash Institute, pp: 324-341, Florence, Italy. Retrieved from http://www.researchgate.net/profile/Yusuf_Genc/publication/233927805_Hydroponics_-_A_Standard_Methodology_for_Plant_Biological_Researches/links/0912f50d12847d387e000000.pdf#page=11

Taiz, L., & Zeiger, E. (1998).Plant Physiology, 2nd. Ed. Sinauer, Sunderland, Massachussets, 111-143.

The Gardeners Network. 2008. Organic Gardening – Liquid Fish Fertilizer and Fish Emulsion. Retrieved on January 26, 2011 at http://www.gardenersnet.com/ organicgardening/fishfertilizer.htm.

Thompson, G. (2000). International consumer demand for organic foods. HortTechnology, 10(4), 663-674.

Vernon, P. G. (1999). Sustainable Vegetable Production from Start-Up to Market. Cornell University. Ithaca, New York.

Worthington, V. (2001).Nutritional quality of organic versus conventional fruits, vegetables, and grains. The Journal of Alternative & Complementary Medicine,7(2), 161-173.

Worthington, V. (1998). Effect of agricultural methods on nutritional quality: a comparison of organic with conventional crops. Alternative therapies in health and medicine, 4(1), 58-69.