

Giving Liquid Organic Fertilizer (POC) Chicken Manure on Lettuce (*Lactuca sativa L.*) Hydroponically with the Wick System

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ABSTRACT

The aims of this study were: 1. To find out whether nutritions derived from liquid organic fertilizer (POC) of chicken manure can be an alternative to AB Mix nutritions in supporting the growth and yield of lettuce using the wick hydroponic system. 2. To find out the effect of administering various nutrition concentrations of chicken manure liquid organic fertilizer on the growth and yield of lettuce using *wick* hydroponic system. 3. To find out the exact and appropriate concentration of chicken manure liquid organic fertilizer in supporting the growth and yield of lettuce using *wick* hydroponic system. This experiment used Completely Randomized Design (CRD) with 6 nutritional treatments of Chicken Manure POC (N) as follows: N₀: Nutrition AB Mix 900 ppm (Control) ; N₁: Chicken Manure POC Nutrition 50 ml ; N₂: Chicken Manure POC Nutrition 100 ml ; N₃: Chicken Manure POC Nutrition 150 ml ; N₄: Chicken Manure POC Nutrition 200 ml ; N₅: Chicken Manure POC Nutrition 250 ml. Each treatment was repeated 4 (four) times to obtain 24 experimental units. The results of this study were: 1) Nutrition derived from chicken manure POC with concentration of 150 ml (N₃) can be used as an alternative of AB Mix nutrition in supporting the growth and yield of lettuce using *wick* hydroponic system. 2) The POC of chicken manure affected the growth in height and number of leaves as well as yield components, both wet stover weight and root weight of lettuce using *wick* hydroponic system. 3) The exact and appropriate concentration of liquid organic fertilizer to support the growth and yield of lettuce using the wick hydroponic system is at concentration of 150 ml (N₃) with an average weight of wet stover was 49.25 g, while the lowest wet stover is found in N₁ treatment which yields only 18.25 g.

Keywords: *Lettuce, POC, chicken manure, wick hydroponic system*

INTRODUCTION

Lettuce (*Lactuca sativa L.*) is a horticultural commodity that has commercial value and good prospects. Growing crops using hydroponics has recently been popular and is in great demand by many people, especially for growing vegetables. This is because the hydroponic method does not require large areas of land like conventional farming. For urban people who live in housing with very limited yards, they can still do hydroponic farming (Arsela, 2018).

Hydroponic plant cultivation always uses AB Mix nutrients. In accordance with Aini's opinion (*in* Safi, 2020), hydroponic cultivation is very dependent on the availability and balance of AB mix nutrients which are composed of several chemicals. Even though there are other nutrients that can replace AB Mix nutrition, namely natural nutrition that we can make ourselves at a very low cost. According to Suhastyo *et al.* (*in* Mawaddah, 2021), that hydroponic cultivation of plants requires macro and micro nutrients to support plant growth. These nutrients are also found in chicken manure liquid organic fertilizer. By using AB Mix nutrition, we have to buy it and it also has inorganic properties. If AB Mix nutrients can be replaced with liquid organic fertilizer, it will have economic benefits and support the cultivation of environmentally friendly plants and can reduce the use of inorganic fertilizers.

RESEARCH METHODS

Time and place

The research was conducted for 3 months, from October to December 2022, in Palangka Raya City, Central Kalimantan Province.

Materials and Tools

The materials used in this study were lettuce seeds, ice cream cups, water, rockwool, flannel, AB Mix nutrition, buckets as nutrient media, granulated sugar, chicken manure, stale rice and EM4.

The tools used are TDS, ruler, digital scale, scissors, stationery, camera, bucket, large gallon (10 L) for POC chicken manure, plastic bags, tea filters, hand sprayer.

Research methods

This experiment used a Completely Randomized Design (CRD) with 6 nutritional treatments of POC Chicken Manure (N) as follows:

N₀: Nutrition AB Mix 900 ppm (Control)

N₁: Chicken Manure POC Nutrition 50 ml

N₂: Chicken Manure POC Nutrition 100 ml

N₃: Chicken Manure POC Nutrition 150 ml

N₄: Chicken Manure POC Nutrition 200 ml

N₅: Chicken Manure POC Nutrition 250 ml

Each nutritional treatment was repeated 4 (four) times so that there were a total of 24 experimental units.

Research Implementation

1. Making Screen House and Planting Media

Making a screen house with size of 5 x 3 m, with a roof using UV plastic cover, the dividing wall using paranet, while the shelves for placing treatment pots are made of boards with a length of 2.5 m with a shelf height of 50 cm from the ground surface.

Preparation of the planting medium includes making an axis of flannel measuring 2 x 10 cm which will later be used as an axis for hydroponic nutrient flow. Then make holes evenly on each part of the ice cream glass as well as holes on the bottom of the ice cream glass with a diameter that is adjusted to the size of the flannel cloth.

2. Seedlings of Lettuce Seeds

Prepare the lettuce seeds for use by selecting good seeds with characteristics such as uniform growth, high productivity and high genetic quality. The seedbed is a plastic tray (30 x 30 cm) with rockwool (2 cm x 2 cm) as the seedling medium. Insert 1 lettuce seed into the rockwool using a toothpick, then place the seed in a dark place for 4 - 5 days and cover it with transparent plastic. When the sprouts have appeared, then move them to a place that is not exposed to direct sunlight. Spray water using a hand sprayer regularly until the lettuce seedlings have ± 3 - 4 leaves and are ready to be transferred to the treatment medium.

3. Preparation of AB Mix Solution

Preparation of the AB mix nutrient solution by preparing 2 plastic jerry cans with a volume of 2 liters, then filling them with 1 liter of water, then adding nutrient solutions A and B to each jerry can filled with water, then stirring until dissolved, labeled for each -Each jerry can with the letters A (macro nutrition) and B (micro nutrition) (Pohan and Oktojournal, 2019).

4. Making POC from Chicken Manure

The stages of making liquid organic fertilizer from chicken manure include:

- a) Prepare 2 kg of chicken manure and dry it in the sun for 3 days with the aim of reducing the water content in the chicken manure.

- b) Mix 2 L of water and 200 g of sugar with EM-4 at a concentration of 12 ml/L of water, then mix all the ingredients and put it in a 10 L gallon.
- c) Ferment the material for ± 15 days.
- d) Filter the ingredients using a tea strainer
- e) POC is ready to be used as a nutritional substitute for AB Mix.

5. Providing Various Concentrations of Chicken Manure POC Nutrition

Table 1. Administration of Various Concentrations of Nutrients (N)

No.	Treatment Code	Early Planting	7 DAP	14 DAP	21 DAP	28 DAP
1.	N ₀	500 ppm	600 ppm	700 ppm	800 ppm	900 ppm
2.	N ₁	10 ml	20 ml	30 ml	40 ml	50 ml
3.	N ₂	20 ml	40 ml	60 ml	80 ml	100 ml
4.	N ₃	30 ml	60 ml	90 ml	120 ml	150 ml
5.	N ₄	40 ml	80 ml	120 ml	160 ml	200 ml
6.	N ₅	50 ml	100 ml	150 ml	200 ml	250 ml

Observational Variables

Observation of growth and yield variables was carried out for all plants, including: 1. Plant height (cm); 2. Number of plant leaves; 3. Head fresh weight (g); 4. Root weight (g); 5. Root length (cm).

Data analysis

To determine the effect of the treatment, an analysis of variance (F test) was carried out at the α 5% and α 1% levels. If the results of the analysis of variance show a significant or very significant effect, then proceed with the BNJ Test at the α level of 5%.

RESULTS AND DISCUSSION

1. Plant Height

The results of the analysis of variance (Appendix 2) showed that the POC treatment of chicken manure had a very significant effect on the observed height of the lettuce plants (14, 21 and 28 days after planting), while the 7 DAP observations showed relatively the same plant height between treatments (not significantly different). The effect of giving various nutrient concentrations on the height growth of lettuce plants can be seen in Table 2. At the age of 14 days after planting, it was seen that treatment N1 (giving POC chicken manure with the lowest concentration of 50 ml) had the lowest plant height until the end of the observation 28 DAP, whereas in treatment N0 (administration of AB Mix 900 ppm), showed the highest growth of lettuce plants but not significantly different from N3 (administration of POC chicken manure 150 ml). In the 21 DAP observations, there was no significant difference in the POC treatment at doses of 100 ml to 250 ml (N2, N3, N4 and N5). At 28 DAP, it was seen that the highest lettuce plants were in the N0 and N3 treatments (900 ppm of AB Mix nutrition and 150 ml of chicken manure POC nutrition).

Table 2. Average Lettuce Plant Height Due to Nutrition at Various Ages (cm)

Nutrition Treatment	Plant Height (cm)			
	7 DAP	14 DAP	21 DAP	28 DAP
N ₀	8,53	12,08 d	15,63 c	21,20 c
N ₁	7,63	8,35 a	10,03 a	11,60 a

N ₂	8,15	9,90 ab	12,60 b	13,88 ab
N ₃	8,43	11,80 cd	13,45 b	19,50 c
N ₄	7,93	10,03 b	12,93 b	14,78 b
N ₅	7,88	10,20 bc	12,45 b	13,65 ab
BNJ (0,05)	tn	1,67	1,99	3,06

Note: Numbers followed by the same letter at the same plant age are not significantly different at the 5% level ($BNJ_{0,05}$)

Based on the results of statistical analysis showed that the highest lettuce plants were in the control with an average plant height of 21.20 cm and not significantly different from N₃ (chicken manure POC nutrition concentration 150 ml) with a plant height of 19.50 cm, while the lowest lettuce plants were in the lowest concentration of chicken manure POC treatment was 50 ml (N₁). Provision of AB Mix nutrition 900 ppm is the most appropriate concentration (optimum) for the growth of lettuce plants. This is based on several research results, namely the use of AB Mix nutrient concentrations in the cultivation of lettuce and mustard greens which are generally used and give the best results in the range of 800 to 1000 ppm. Ainina and Arsyanti Nur (2017), stated that the provision of AB mix nutrition of 1000 ppm showed the best plant height and fresh weight of red lettuce plants. Supported by Mas'ud (2009) that the nutrient combination AB mix 900 ppm and sand media gave the highest results in observing the number of leaves, plant height, root length, leaf area, crown fresh weight and shoot dry weight in lettuce plants.

The height growth of lettuce plants with AB mix nutrient treatment showed a very rapid increase in plant height compared to the POC nutrient treatment of chicken manure. This is because the nutrients contained in AB mix nutrition have a special formula composition for hydroponic cultivation. AB Mix consists of two fertilizer components, namely fertilizer A and fertilizer B. One package of AB Mix hydroponic fertilizer contains 12 chemical elements. AB Mix consists of two fertilizer components, namely fertilizer A and fertilizer B. One package of AB Mix hydroponic fertilizer contains 12 chemical elements. The elements contained in AB Mix nutrition are N (21,6 %), P (8,6 %), K (34,7 %), Ca (17,3 %), Mg (6,5 %), S (14,4), Fe (3,35 %), Mn (1,7 %), Bo (0,7 %), Cu (1,7 %), Zn (0,6 %), dan Mo (0,02 %) (Pohan, 2019).

The N₃ treatment (150 ml POC chicken manure nutrition) was not significantly different from the N₀ treatment (900 ppm AB Mix nutrition), this was due to the 150 ml chicken manure POC concentration being the most suitable for growth and increasing the height of lettuce plants. Chicken manure POC contains lots of macro and micro nutrients so that plants can use it to form vegetative organs such as increasing plant height. Stem elongation rate is influenced by internal and external factors. Internal factors are heredity and hormones, while external factors are influenced by the environment, namely the addition of nutrients and their absorption levels.

The increase in plant height is due to the presence of apical meristem cells which are always dividing. Cell division causes an increase in the size of the plant. Plant height is much influenced by the element nitrogen. Nitrogen is the main component of various important substances in plants. Lakitan (1996), giving nitrogen at the right dose will increase plant growth, as well as increase plant metabolism, so that the formation of proteins, carbohydrates and starch is not hampered, resulting in increased plant growth and production. Nitrogen is required in relatively large amounts for each plant growth, especially during the vegetative growth stages, such as the formation of shoots or the development of stems and leaves. If the plant is deficient in nitrogen, the plant will experience slow and stunted growth (Jumiati, 2009).

2. Number of Leaves

Observation of the number of leaves of lettuce plants is based on their function as light receptors and where photosynthesis takes place. Based on the results of the analysis of variance in the number of leaves at the age of 7, 14 and 21 DAP (Appendix 3), the application of both POC chicken manure and AB Mix nutrition has not shown a significant effect on the number of leaves of lettuce plants (the number of plant leaves is relatively the same). The real effect was only seen at the end of the observation, namely at the age of 28 DAP.

Table 3. Average Number of Lettuce Plant Leaves Due to Nutrition at Various Ages

Nutrition Treatment	Number of Leaves			
	7 DAP	14 DAP	21 DAP	28 DAP
N ₀	6,0	8,25	9,5	13,5 c
N ₁	5,5	7,25	8,3	9,8 a
N ₂	5,8	7,5	8,5	11,0 ab
N ₃	6,0	7,75	9,0	12,5 bc
N ₄	5,8	7,5	8,5	11,3 abc
N ₅	5,8	7,5	8,5	10,8 ab
BNJ (0,05)	tn	tn	tn	2,38

Note: Numbers followed by the same letter at the same plant age are not significantly different at the 5% level ($BNJ_{0,05}$)

Observations on the number of leaves of lettuce plants did not show a significant effect until the age of 21 DAP. The number of leaves in each treatment was relatively the same in number, because the influence of genetic factors was more dominant than the nutritional treatment. The response of plants to the application of AB Mix nutrients and POC chicken manure was more visible in the leaf area of lettuce plants, namely the increase in leaf length and width. Differences in genetic composition is one of the factors causing the diversity of plant appearance. Where is the genetic nature of the plant that determines the metabolic ability of the plant itself.

At the end of the 28 DAP observations, differences in the number of leaves began to be seen between the treatments, where the least number of leaves was in treatment N1 (50 ml POC chicken manure) with an average number of leaves of 9.8, although not significantly different from the other treatments except the control (N0). The highest number of leaves was in treatment N0 (giving AB Mix nutrition 900 ppm) with an average number of leaves of 13.5 and not significantly different from N3 and N4 (giving POC chicken manure nutrition with concentrations of 150 and 200 ml). The number of leaves increased at the end of vegetative growth, namely the age of 28 DAP which is the maximum vegetative phase in lettuce plants, this occurs because at that age the absorption of available nutrients is also optimal. Differences in metabolic ability can affect plant growth and development (Wiraatmaja, 2017).

3. Fresh Weight of Plant Header

Based on the data analysis of variance (Appendix 4) it shows that the application of POC chicken manure has a very significant effect on fresh weight of lettuce plants crown. The highest plant canopy fresh weight was found in the 900 ppm AB Mix nutrition treatment and the 150 ml POC chicken manure treatment, with an average weight of 49.25 g and 57.25 g which were significantly different from the other treatments. The lightest canopy weight was found in treatments N1, N2, N4 and N5 (giving chicken manure POC nutrition with concentrations of 50, 100, 200 and 250 ml) (Table 4).

Table 4. Average Fresh Weight of Lettuce Plants at Harvest Due to Nutrition Treatment (g)

Nutrition Treatment	Fresh Weight (g)
N ₀	57,25 b
N ₁	18,25 a
N ₂	23,75 a
N ₃	49,25 b
N ₄	25,50 a
N ₅	23,50 a
BNJ (0,05)	14,48

Note: Numbers followed by the same letter at the same plant age are not significantly different at the 5% level ($BNJ_{0,05}$)

The fresh weight of the plant canopy is the weight of the plant when it is still alive and is weighed immediately after harvest before the plant loses water and wilts causing a decrease in weight. Fresh weight of plant canopy is affected by the amount

of water and nutrient uptake in a plant. Cell division in apical meristems and in leaf primordial cells causes an increase in the number of cells so that it will increase the fresh weight of the plant canopy. Increasing the number of cells will indirectly increase the water content and result in an increase in the fresh weight of the plant canopy (Lakitan, 1996).

The highest plant canopy fresh weight was seen in the administration of 900 ppm of AB Mix nutrition (control) and the POC treatment of chicken manure with a concentration of 150 ml, where in both treatments contained the most sufficient macro and micro nutrients and in accordance with the needs of lettuce plants so as to produce the most optimal canopy weight. The yield of lettuce plants is strongly influenced by the nutrients it absorbs, especially the nutrient Nitrogen, the element Phosphorus (P) which plays a role in the process of breaking down carbohydrates for energy. Storage and distribution to all parts of the plant in the form of ADP and ATP. Element P is useful in the formation of nucleic acids, phospholipids, ATP and several coenzymes needed for plant growth and development (Campbell *et al.*, 2003). Phosphorus also plays a role in cell division through the role of nucleoproteins in the cell nucleus (Leiwakabessy and Sutandi, 2004). Phosphorus also plays a role in increasing the amount of leaf chlorophyll so that it can photosynthesize properly and produce photosynthesis so that it can increase growth. (Tisdale *et al.*, 1985). The fresh weight of the lettuce plant canopy is closely related to the number of leaves. Element P can increase leaf area and leaf weight because element P can increase the system of macromolecular compounds in leaves (Gardner *et al.*, 1991).

Leaves are closely related to photosynthetic activity, the more the number of leaves, the more photosynthates are produced in the process of photosynthesis, so that more and more are translocated for the vegetative growth of plants, which in the end can produce the most optimal total plant wet weight. The growth and development of plant leaves is largely determined by the availability and adequacy of nutrients, where 150 ml POC chicken manure and 900 ppm AB Mix are very suitable for the needs of lettuce plants so that the highest number of leaves is produced. According to Sanusi (2008), the number of plant leaves is a factor that determines the amount of solar energy that can be absorbed by the leaves and will determine the amount of photosynthates produced. Giving POC chicken manure with a concentration of 150 ml and AB Mix 900 ppm is able to provide sufficient nutrition for lettuce plants, thereby increasing the growth of the number of leaves which play a very important role in the process of photosynthesis.

Lingga and Marsono (2013) stated that the nutrient potassium serves as a catalyst for the formation of carbohydrates in the process of photosynthesis, formation of proteins, translocation of sugars and proteins, helps in the process of opening and closing of stomata, increases the efficiency of water use, expands root growth, strengthens plant tissues and organs, so as not to fall off easily, increase plant resistance to pest attacks. In addition to the elements N and P, element K plays a very important role as a catalyst in the formation of flour, sugar and fat which can improve the quality of crop yields. The addition of the right potassium fertilizer can also help increase the absorption of other elements, especially N and P.



Documentation of Yield Components of Lettuce Plants

4. Root Weight

Analysis of variance (Appendix 5) showed that the application of nutrient solution had a very significant effect on the root weight of lettuce plants, where the 900 ml AB Mix (N0) treatment had the largest root weight but was not significantly different from the 150 ml POC chicken manure (N3) treatment but different significant with other treatments. Lettuce roots have relatively the same weight except for treatments N0 and N3 which have the largest root weight, namely an average of 14.75 and 17.00. The average weight of lettuce roots at harvest of 32 DAP can be seen in Table 5.

The function of plant roots in a hydroponic system is the same as those planted in soil, namely as an absorber of water and minerals for plants. Based on the results of statistical analysis of root weight at N0 and N3 significantly different from other treatments, this may be due to the macro element content contained in AB Mix nutrition which is more complex in nutritional content specifically intended for hydroponic cultivation when compared to nutrients from POC chicken manure.

Table 5. Average Weight of Lettuce Plant Roots at Harvest Due to Nutrition Treatment (g)

Note:	Nutrition Treatment	Root Weight (g)	Numbers followed by same letter at same plant not significantly different at level (BNJ _{0,05})
the	N ₀	17,00 b	
the	N ₁	7,50 a	
age are	N ₂	9,75 a	
	N ₃	14,75 b	
the 5%	N ₄	10,00 a	
	N ₅	8,75 a	
	BNJ (0,05)	3,79	

Provision of a nutrient solution derived from POC chicken manure with a concentration of 150 ml is in accordance with the needs of lettuce plants, especially the macro nutrients N and P. Chicken manure has a high nutritional value because the liquid part mixes with the solid part. Chicken manure organic fertilizer contains three times more N than other manure (Hardjowigeno *in* Limbongan, 2015). The highest phosphorus levels are found in the center of growth, when plants lack phosphorus, the phosphorus present in old tissues is mobilized into young tissues. This is the main reason why POC chicken manure has the potential to be a nutritional substitute for AB Mix. The nutrients contained in POC chicken manure play an important role in the root growth process of lettuce plants.

Root weight is highly dependent on root volume and the number of roots of the plant itself. The weight of plant roots is the accumulation of photosynthetic results and the absorption of nutrients and water. The root weight value is related to the ability of the roots to absorb water, where the high wet weight of the roots generally has a high water content as well.

5. Root Length

Analysis of variance (Appendix 6) shows that the application of nutrients has a significant effect on the root length of lettuce plants. The average yield of lettuce root length by providing various nutrients can be seen in (Table 6). The longest roots of lettuce plants were found in the treatment of giving AB Mix 900 ppm nutrition and significantly different from other treatments, while the shortest roots were found in all treatments of giving POC chicken manure (N1, N2, N3, N4 and N5). The root length of the lettuce plant at N0 was 14.88 cm and the shortest root was only 8.50 cm.

Table 6. Average Root Length of Lettuce Plants at Harvest Due to Nutritional Treatment (cm)

Nutrition Treatment	Root Length (g)
N ₀	14,88 b
N ₁	8,70 a
N ₂	8,50 a
N ₃	11,00 a
N ₄	10,18 a
N ₅	9,95 a
BNJ (0,05)	2,796

Note: Numbers followed by the same letter at the same plant age are not significantly different at the 5% level ($BNJ_{0,05}$)

In addition to the element N, there are other elements that play an important role in the long growth of plant roots, namely the element phosphorus (P). The element phosphorus for plants is useful for stimulating the growth of young plant roots, as a raw material for the formation of certain proteins, helping assimilation and respiration (Lingga and Marsono, 2013). According to Lakitan (1996), that the nutrient phosphorus (P) is an essential nutrient that plays a role in stimulating root development. A good root development system will expand the nutrient uptake area, thereby increasing the amount of water and nutrient uptake. Phosphorus also plays an important role in root formation. The process of absorption of water and nutrients is closely related to the root system, if there is a lack of phosphorus, the plant will show symptoms such as slow and stunted growth so that it looks abnormal.

Liferdi (2010) said that the element of phosphorus can stimulate root growth and form a good root system, it also stimulates the growth of plant tissue which forms the growing point of plants and accelerates the harvest period. Phosphorus is an essential element of plants, there is no other element that can replace its function in plants, therefore plants must obtain adequate amounts of phosphorus for normal growth. While the function of phosphorus in plants is in the process of photosynthesis, transfer, respiration, and energy storage, cell division and enlargement and other processes in plants.

CONCLUSIONS

Conclusions

Based on the results of the research that has been done, the following conclusions can be drawn:

1. Nutritions derived from chicken manure POC at concentration of 150 ml (N3) can be used as an alternative to AB Mix nutritions in supporting growth and yield of lettuce cultivation hydroponically with wick system.
2. The POC concentration of chicken manure affects the growth in height and number of leaves as well as the yield components of lettuce cultivation, both wet stover weight and root weight in wick hydroponic systems.
3. The right and appropriate liquid organic fertilizer (POC) for chicken manure to support growth and yield of lettuce plants in wick hydroponic systems is at concentration of 150 ml (N3) with an average crown fresh weight of 49.25 g, while the lowest lettuce wet stover weight of 18.25 g was found in the N1 treatment (50 ml POC of chicken manure).

Suggestions

- Based on the results of the research that has been done, it is suggested that in making chicken manure POC nutrition it is better to use fresh chicken manure.
- Look for alternative types of organic nutrition that can replace the use of AB Mix nutrition.

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