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# GROWTH OF LETTUCE (Lactuca sativa) HYDROPONICALLY IN SIMPLE WICK SYSTEM ON VARIOUS TYPES OF NUTRIENT COMPOSITION

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## ABSTRACT

The supply of hydroponic nutrients needs to consider economic, practical and resource saving aspects. It is necessary to know the best composition and type of nutrients that can be used in a hydroponic system. The use of liquid organic fertilizers (POC) as an alternative to hydroponic nutrients, especially in the wick system, has already begun including widely available alternative fertilizers such as NPK + Gandasil and utilizing chicken feather waste that has been made in the form of fertilizer. This research is expected to provide an overview of the potential for alternative nutrient sources for hydroponic growing media by utilizing the available resources. The study was started from June to August 2020, using a single randomized block design (RBD) consisting of 5 (five) treatment levels, namely: K0 = AB mix (control) 50 ml / 10 L water, K10 = 10 g NPK + 5g Gandasil / 10L water. K11 = 1/2 dose of Abmix + ½ dose of NPK + Gandasil, K12 = ½ dose of NPK + Gandasil + 4800ml / POC of chicken feathers / 10L of water, K13 = 1/2 dose of Abmix + 4800ml / POC of chicken feathers / 10L of water. The results showed that the type of nutrient media composition had no significant effect on plant height in weeks 1,2,3 and 4, leaf length weeks 1 and 2 and number of leaves weeks 1,2,3 and 4. The type of nutrient media composition had a significant effect on leaf length weeks. 3rd and 4th week.The best treatment was obtained at K0. (Abmix), which was significantly different from k10 and k12 treatments, and not significantly different from all k11 and 13 treatments.At week 4, the best leaf length was also obtained at different k0 treatments. real with all other treatments. There is potential for alternative nutrient utilization, because it is able to approach growth using standard nutrients for variables of plant height and leaf number.
**Keywords**: hydroponic nutrients, hydroponic wick system, lettuce

## INTRODUCTION

The demand for fresh vegetables is currently increasing. The pandemic condition causes interest in healthy food to increase. One of them is lettuce that is provided in fresh form (Hayati & Mertha, 2021; Frasetya, Taofik, & Firdaus, 2018). Lettuce (Lactuca sativa L.) is a self-pollinating herbaceous perennial plant of the *Asteraceae* family. It is grown worldwide for consumption, most commonly raw, as a salad green (Armas, Pogrebnyak, & Raskin, 2017). In addition, lettuce is the commodity of preference dedicated for urban farming activities such as hydroponics. The hydroponic system is growing at this time, due to limited land, especially in urban areas as Purwaningsih (2020) conducted researcн on the combination of types and number of axes on the growth and crop yield of

red lettuce (*Lactuca sativa* l. Var. Red rapid) in wick hydroponic systems. (Bella & Dita, 2020) have also seen the effect of the Combination of AB Mix Nutrients and Azolla Liquid Organic Fertilizer on the Growth and Crop Yield of Lettuce (Lactuca sativa L.) in Axis Hydroponics.

High fertilizer efficiency is illustrated by the increasing number of nutrients that can be absorbed by plants (Ginting, Rahutomo, & Sutarta, 2018). There are many choices of hydroponic cultivation systems. One of them is the wick system. Wick System Hydroponics is the simplest hydroponic system. In principle, this wick system only requires an axis that can combine the nutrient solution with plants (Rulyansah A, 2019). While plant container of this system of planting is a passive system which means there are no moving parts and the supply of nutrients will be directly absorbed by plant roots (Hayati & Mertha, 2021). Therefore, the wick system is the simplest wick hydroponic system and its application is quite widespread. Mix nutrients and planting media affect the growth and production of lettuce (Lactuca sativa) hydroponically with a wick system (Manullang, Hasibuan, & Mawarni, 2019). Likewise, rabbit urine has also been tested for hydroponics lettuce of wick system (Cahyani, Hasibuan, & CH, 2018). The use of POC in several previous studies has the potential to be used as a substitute for mixed nutrient. Based on this, it is necessary to know and study other nutrient combinations involving dissolved solid synthetic fertilizers and also the use of POC from waste to be utilized in the Wick system of hydroponic.

The alternative chosen is to use fertilizers that are easily available such as NPK and gandasil as well as liquid organics (POC) as alternatives. Liquid organic fertilizer is a solution from the decomposition of organic materials derived from plant residues, animal waste, and humans which contain more than one nutrient element. The advantages of this liquid organic fertilizer are that it can quickly overcome nutrient deficiencies, has no problem in nutrient leaching, and is able to provide nutrients quickly (Nur, Noor, & Elma, 2018). The choice made is to utilize chicken farm waste that has been made in the form of fertilizer. organic (Kusmiadi, Khodijah, & Royalaitani, 2015). Furthermore, POC has also begun to be used for Pakcoy Plants (*Brassica rapa L*.) by giving chicken feather compost tea in a liquid hydroponic system (Rianti, Kusmiadi, & Apriyadi, 2019). Furthermore, it is necessary to further investigate the various nutrient compositions in lettuce by utilizing locally available fertilizers and POC from chicken feathers using the wick hydropodic method. This research is expected to provide an overview of the potential alternative nutrient sources for hydroponic growing media by utilizing effective and efficient resources for the growth of hydroponic lettuce using the wick system.

## MATERIALS AND METHODS

The research was started from June to August 2020, taking place in the greenhouse Garden of the Experimental and Research (KP2), Bangka Belitung University.

Media containers was prepared in the form of *styrofoam* with volume and capacity of 750 ml filled with 500 ml of nutrient solution. The nutrients used were AB mix, NPK (16; 16; 16) + gandasil, POC that is ready to use from chicken feather waste (Kusmiadi et al., 2015); (Rianti et al., 2019), lettuce seeds and *rockwool*. The hydroponic system applied is a wick system with a total media volume of 750ml. Nutrient volume is maintained daily, limited to 500ml. If it is reduced in the afternoon it will be added to the volume of 500 ml. Stock media was prepared according to the treatment of each type of media.

The study was structured using a single Randomized Block Design (RAK) consisting of 5 (five) levels of treatment, namely:

K0= AB mix (control) 50 ml/10 L water (called as standard dose1)

K10=10 g NPK+5 gGandasil /10 liters of water (called standard dose 2) K11=1/2

standard dose of Abmix + standard dose of NPK+Gandasil K12=½ standard dose of NPK+Gandasil + 4800 ml POC chicken feathers/ 10L water K13 = 1/2 standard dose of Abmix + 4800 ml POC chicken feathers / 10L water. Each was repeated 6 times. Each experimental box has 2 planting holes.

Preparation of planting material. Nurseries are carried out by planting 1 seed per hole of planting. Nurseries are carried out by planting seeds on rockwool media measuring 2cm x 2cm x 2cm with sufficient water flowing in the tube seedling pots. Seeds that are 2 weeks old are transferred to hydroponic media. planting. Planting is done when the seeds sown are 14 days old characterized by an average plant height of 5 cm and the number of leaves is 4. The selected seeds are transferred to a netpot that has been worn with flannel wick. Transfer of seeds is done by inserting 1 seed per 1 planting hole in rockwool media that has been prepared in the media. Cultivation. The treatment stage is carried out during the planting period, including embroidery and pest and disease control. Embroidery is done if the plant dies or grows abnormally within the first week after planting. Observed variables include; 1. Plant height (Cm) 2. Leaf length and 3. Number of leaves. All variables were measured at 7, 14, 21, and 28 days after planting. Data analysis was performed using DSAASTAT ANOVA Program, if it had a significant effect, it was continued with Duncan's multiple range test (p= 0.05).

## RESULTS AND DISCUSSION

The results of the variance showed that the planting media treatment had no significant effect on plant height in weeks 1,2,3, and 4, leaf length in weeks 1 and 2 and the number of leaves in weeks 1,2,3, and 4. Planting media treatment had a significant effect on nutrients on leaf length variables in week 3 and 4 (Table 1.)


Picture 1. Condition of lettuce leaves on various types of media

Table 1. The results of the variance of the effect of planting media treatment on the growth variables of hydroponic lettuce with the wick system.

| Variable | ProbF | KK (%) |
|---|---|---|
| **Plant heigh weeks 1** | 0.044 tn | 8.95 |
| **Plant heigh weeks 2** | 0.099 tn | 10.47 |
| **Plant heigh weeks 3** | 0.236 tn | 9.60 |
| **Plant heigh weeks 4** | 0.192 tn | 9.09 |
| **Leaf length weeks 1** | 0.490 tn | 22.04 |
| **Leaf length weeks 2** | 0.636 tn | 12.17 |
| **Leaf length weeks 3** | 0.026* | 8.22 |
| **Leaf length weeks 4** | 7E-05* | 15.92 |
| **The number of leaves Weeks 1** | 0.054 tn | 9.32 |
| **The number of leaves weeks 2** | 0.477tn | 6.68 |
| **The number of leaves weeks 3** | 0.430 tn | 9.42 |
| **The number of leaves weeks 4** | 0.078 tn | 13.76 |

Information : (tn) = no significant effect and (*) = Significant effect at the 5% test level, KK = diversity coefficient (%)

Furthermore, further tests were carried out to see the best treatment on the leaf length variables (table 2) and depicted by histograms to see the highest results on the variables of plant height and number of leaves (figure 1 and figure 2).

### 1. Plant Height Growth

Plant height Growth and number of leaves from week 1 to week 4 of the media type treatment did not appear to have a significant effect. Plant height data are shown in Figures 1a and 1b. and the number of leaves are shown in Figures 2a and 2b.

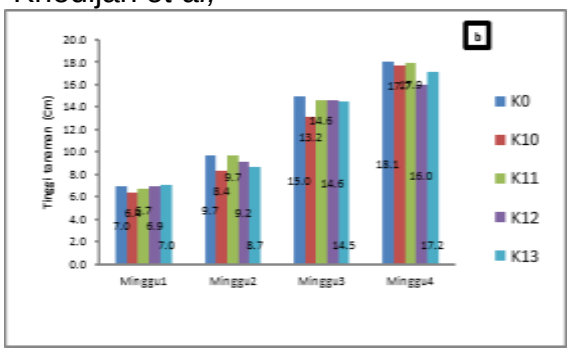


Figure 2. Plant height of hydroponic lettuce of wick system on the type of media composition treatment (2a) and plant height growth per week in each treatment (2b).

Plant height from week 1 to week 4, the highest increase in plant height was seen from week 2 to week 3, at the end of the 4th week observation it was seen that in general the lowest plant height was obtained in treatment k12 (Figure 2a). The first week to the fourth week the highest plant height was still found in the K0 treatment (standard dose Abmix) although the composition of other media except K12 was almost close to the plant height of K0 media (Figure 2.b).

In general, the potency of standard dose abmix was almost the same as that of other media compositions on plant height variables. K11. The use of half the dose of ABmix was substituted with NPK+Gandasil showing that it was not comparable to the treatment equivalent to K12. ½ dose of NPK+gandasil +480 ml POC/liter of water. This comparison informs that the use of POC as a substitute in abmix is also not maximized. Furthermore, if K12 treatment was compared with K13, where K13 (½ dose of abmix +480 ml POC/liter of water) was higher than K12. This also indicates that the ability of NPK + Gandasil is still not as maximal as that of abmix, but tabulated when it is seen from the plant height, the POC ability is higher than dose of NPK + Gandasil. The addition of POC was also carried out by (Ilhamdi, Khairuddin, & Zubair, 2020), using POC from agricultural waste with results that were almost equivalent to Abmix. According to (Wortman, 2015) there are other conditions that play a role in the uptake of hydroponic plant nutrients. Those are the conditions of Electrical Conductivity (EC) and the environment.

## 2. Leaf Length Growth

Table 2 shows that the control treatment K0 (Abmix) was significantly different from K10 and K13 = 1/2 dose of abmix + 480ml/l POC feathers, but not significantly different from K11 = 1/2 dose of abmix + dose of npk+gandasil and K13.

Slightly better to treatment and almost equal to K0 in leaf length at week 3 were found in treatments k13= dose of abmix + 480ml/l of POC feathers and k11= dose of abmix + dose of npk+gandasil. But K0 was significantly different from all media treatments in week 4. This indicates that the increase in leaf length due to K0 treatment has not been matched by other treatments, although tabulated the highest plant height was found in K0 treatment. Other media that are used have the potential to match K0 on the plant height variable because statistically the effect of this type of media is not visible.

Table 2. Further test on the effect of media type treatment on lettuce leaf length variables in weeks 1,2,3, and 4.

| Treatment | Leaf Length (Cm) | | | |
|---|---|---|---|---|
| | week 1 | week 2 | week 3 | week 4 |
| K0 (abmix) | 1,96 | 6,71 | 9,33b | 15,08c |
| K10=NPK +gandasil | 2,10 | 6,58 | 8,17a | 9,05a |
| K11=1/2 dose abmix + ½ dose NPK +gandasil | 1,83 | 7,08 | 9,08b | 10,58a b |
| K12=½ dose NPK +gandasil + 480ml/l POC | 2,01 | 6,63 | 8,11a | 9,46ab |
| K13= 1/2 dose abmix + 480ml/l POC | 2,30 | 6,35 | 8,62a b | 11,07b |

Information: Numbers followed by the same letter in the same column means not significantly different from Duncan's multiple range test (p= 0.05)

Leaf length in week 1 and week 2 was not significantly different in all types of growing media (Table 2). There was a difference between treatments in week 3 and 4. In week 3, the best leaf length of K0 began to appear and it was not significantly different from treatment k13 and k11, but significantly different from

treatment k10 and k12.

Both k11 and k13 contain abmix in the media. The difference in k11 the mixture used is NPK+gandasil synthetic fertilizer and at k13 POC is added. While the treatment k10 and k12 also had similarities, each of which did not contain abmix and both contained NPK+gandasil, in K10 without additional POC while K12 media contained NPK with POC.

Table 2 treatments K10, K12 and K13 in week 1 had longer leaves than K0. However, in week 3, it was seen that the leaf length of K0 was significantly different from the treatment of K10 and K12, but not different from that of K11 and K12. Even, in week 4 the leaf length of K0 treatment was significantly different from all other treatments.This indicated that the replacement of AB mix half dose of with NPK+Gandasil was able to equal growth with full dose of abmix in week 3, but in week 4 the growth of leaf length did not increase much, in other treatments.

Therefore, the optimization of leaf length growth has not been achieved with nutrient replacement and substitution treatments. This is because the composition of abmix is relatively more complete because it has been formulated by the factory. The same thing was stated by (Roosta & Afsharipoor, 2012) where the absorption rate of N, P, K, Mg, Fe and Cu was higher in cucumber plants fed with inorganic nutrient solution than in plants fed organic fertilizers. This is possible because the availability and or release of nutrients from organics is lower and slower.

In addition, the solubility of nutrients in the media also needs to be considered. This factor is also predicted to contribute to the nutrient solubility of hydroponic media. Therefore, absorption tends to be better on the types of nutrients that have been formulated than solid nutrients (Andrian, Tantawi, & Rahman, 2019). Potential use of POC looks quite good on the variable number of leaves. The taller the plant, the greater the number of leaves formed (Manuhuttu, Rehatta, & Kailola, 2014), but this study did not show an increase in plant height followed by an increase in the number of leaves.

The use of POC will result in organically derived nutrients, although growth is slower when using conventional inorganic hydroponic solutions. However, it has not managed to match the growth of plant height and number of leaves. In general, hydroponic nutrients require suitable conditions.

Based on the study from (Wortman, 2015), in plants in an aquaponic system that is fertilized with waste is characterized by lower EC (less than 1 dS m pH 1) and pH close to 7.2. The same thing is also suspected to apply to the use of nutrients from waste looking for chicken feathers. Therefore, the K11 treatment has not been met in the NPK+gandasil and POC treatments. However, there is still potential to be able to replace half the dose of abmix with NPK+gandasi (k11) and half the dose of abmix with POC480ml/liter of water (k13).

**3. Growth of the number of leaves**

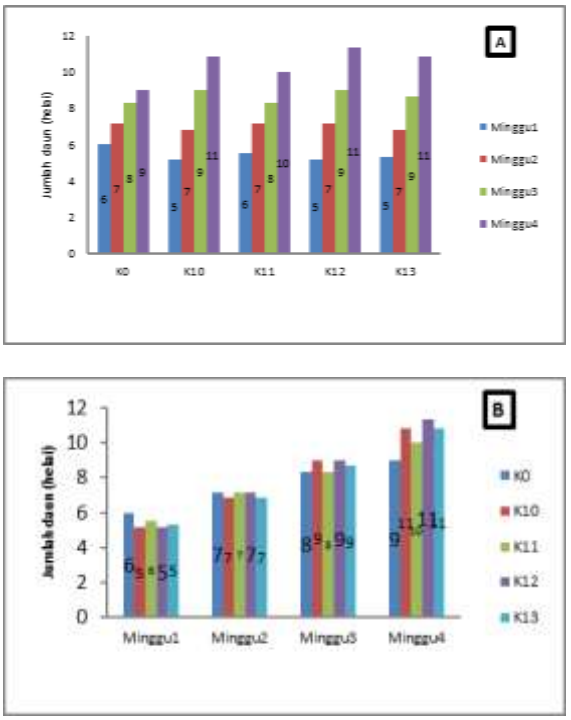


Figure 3. The number of leaves of lettuce on wick hydroponic system in the treatment of the type of media composition (3a) and the growth of the number of leaves each week in each treatment (3b).

The growth of the number of leaves increased in the first week to the fourth week can be seen Figure 3a. The number

of leaves was higher in the first and second weeks of K0. However, in weeks 3 and 4 the number of leaves of K12 and K13 was seen more than K0. Even in week 4 the number of K0 leaves was still lower than K11. Based on graph 3b, it can be seen that there is a potential for more leaves at k1o and k12 than other treatments.This indicates that there is a potential for substitution of abmix (k0) with NPK+Gandasil (K10) in increasing the number of leaves, although it has not been seen significantly. In the fourth week K12=½ dose of NPK+Gandasil + 480ml/l POC chicken feathers are more leaves than all treatments (figure 3b).

This indicates the potential for better nutrient absorption in NPK+Gandasil when followed by the addition of POC. This condition is possible because of the role of organic matter is better in supporting the growth of the number of leaves when compared to k11. The opposite condition of the plant height variables where the replacement of NPK with Abmix was more able to increase height gain than POC (Figure 2b), but the addition of POC was more able to increase the number of leaves that were not significantly.

## CONCLUSION

1. The type of composition of nutrient medium had no significant effect on plant height in weeks 1,2,3 and 4, leaf length in weeks 1 and 2 and leaf number in weeks 1,2,3 and 4.
2. The type of composition of nutrient medium had a significant effect on leaf length in week 3 and week 4. The best treatment was obtained at K0.(Abmix) which was significantly different from treatments k10 and k12, and not significantly different from all treatments k11 and 13. In weeks 4, the best leaf lengths were also obtained in the k0 treatment which was significantly different from all other treatments.
3. There is potential utilization for alternative nutrient, because it is able to approach growth using standard nutrients for variables of plant height and number of leaves.

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