Hydroponically Planting Ipomoea Aquatica Vegetables Using Planting Media from Used Goods

M A Nurwahyudi, H Hatta*
Research and Development Agency of South Sumatera Province, Demang Lebar Daun Street No.4864, Palembang, Indonesia
Email: hendrixonhatta@gmail.com

Abstract. This study aims to determine the growth of ipomoea aquatica plants using hydroponic techniques with planting media treatment. Ipomoea aquatica is a plant that is a type of vegetable that is easy to obtain, easy to cultivate, processed consumptive and quite economical. Media for seeding, nursery, used cup as a media for plants, which is used is water to facilitate the growth process. Harvesting is carried out in about 25 days. Maintenance of kangkung plants includes controlling and measuring pH. The research method used is to test the hypothesis using the t-test. From the results of this study, it was found that there was a significant difference in the height of the kangkung plants to the treatment of the planting medias. Uneconomical planting medias / industrial business scale plants have an average height growth of ipomoea aquatica plants which is better and more economical than the use of economical planting medias.

Keywords: ipomoea aquatica, hydroponics, economical, used goods

1. Introduction
The demand for agricultural products, especially vegetables, continues to increase in line with the increasing population. Also, the growing public awareness of the importance of nutrition and food safety has made the demand for quality vegetables even higher. However, this followed by an increase in the amount of vegetable production, especially in South Sumatra. This vegetable opens up market opportunities for increased vegetable production, both in quantity and quality. Until now, consumers' need for high-quality plants has not to be fulfilled by conventional farming systems [1]. Hydroponics comes from the Greek "hydro," which means water and "ponos," which involves work. In general, it means that hydroponics is a method of cultivating plants that do not use soil as a growth medium. Hydroponic techniques can also take advantage of the house yard [2]. According to [3], the term hydroponics has first introduced in 1936, Dr. W.F. Gerick, an agronomist from the University of California America. Introduced the hydroponic method after successfully conducting experiments by growing tomatoes as high as 3 meters in water, given a solution to the nutrients the plants need. Furthermore, this technology is developing in various parts of the world as an alternative to producing food, especially vegetables. Hydroponics is an alternative technology in sustainably producing high-quality vegetable products with high quantity and quality. Hydroponics means planting in water containing a mixture of nutrients. In its development, many people do not know clearly how to do it and what the benefits are. The hydroponic method can improve the quality and yield of plants that can do in greenhouses and narrow land. Cultivation of hydroponic system plants can be done in a cramped room, outside or inside the house, such as in the yard, kitchen, and garage [4].
Hydroponics is a plant cultivation system without using soil as a medium for growing plants with additional nutrients for growth [1]. The advantages of cultivating hydroponic systems are that the cleanliness of plants is easier to maintain, no need for land management and weed control, sterile planting media. The use of water and fertilizers is very efficient. Plants can be cultivated continuously without depending on the season, can be done on a narrow land, and protected from rain and direct sun.

The growing media used in hydroponics does not contain the nutrients needed by plants. The addition of nutrients is necessary to cultivate hydroponic system plants, both macro, and micro essential nutrients. Hydroponic nutrients are available in the market, which can be used directly and which farmers usually use for plant fertilization. The nutritional solution provided consists of macro and micro salts, which are prepared in-stock solutions A and B. The absorption of plant nutrients is influenced by the planting media. The intake of plant nutrients is controlled by the planting media [5];[6];[7].

Planting media is a place where plant roots absorb the nutrient elements needed by plants. A suitable planting medium is a medium that can support plant growth and life. Supporting the success of the hydroponic cultivation system is a medium that is both porous and aerated as well as adequate nutrition for plant growth [8]. Plants that are often planted in hydroponic systems are vegetable plants because vegetable stems are not too big and bulky. Besides providing productive benefits, hydroponics can also be placed on the terrace for decoration because it looks visually beautiful. Vegetables are a food source that offers complete nutrition for the benefit of the body as well as in the process of breeding plants; they require adequate nutrition [9]. Vegetables that are a source of food that have proper nutrition for the body are kangkung. Kangkung is a vegetable that is popular and favored by the people of Indonesia. Kangkung plant originated from India around 500 M, which then spread to Malaysia, Burma, Indonesia, South China, Australia, and Africa. The Latin name for kangkung is Ipomoea Reptans. In Indonesia, kangkung has regional titles, namely kangkung (Sumatra), Kaneko (Sulawesi), and Utangko (Maluku). Kangkung is highly nutritious and complete with real ingredients. Such as calories, protein, fat, carbohydrates, fiber, calcium, phosphorus, iron, sodium, potassium, vitamin A, vitamin B, vitamin C, carotene, hentriakontan, and sitosterol. The chemical compounds in kangkung are saponins, flavonoids, and proliferous [10].

Ipomoea aquatica or called kangkung for the rest of this article is a useful plant dan popular among farmer because of very easy to planted. Kangkung has a compound that can be used for the treatment of people with insomnia. The fiber in kangkung is perfect for preventing constipation so that it can prevent stomach cancer. Carotenoid in the body will be converted into vitamin A and high chlorophyll. Both of these compounds act as antioxidants which are useful for preventing aging and preventing genetic mutations that cause cancer [11]. According to [12] there are several types of kangkung, namely land kangkung (ipomoea reptans) and water kangkung (ipomoea aquatic). Kangkung has features such as a slightly dark green hue, slightly purple flowers, and somewhat blunt leaf tips. The report discusses kangkung.

This kangkung is also tried to be cultivated hydroponically. There are many advantages of hydroponic cultivation systems compared to soil cultivation. Douglas 1985; Jensen 1990; Resh 1985 stated that hydroponic cultivation systems were cheaper and more practical. The possibility of plants to die is minimal because food is guaranteed. Besides, the use of fertilizers is more controlled and more efficient. Giving nitrogen with high concentrations will result in low absorption [13]. This happens because the high level will cause the nutrient solution to become more concentrated beyond the density of the cell fluid so that it cannot be absorbed by the roots to the maximum because the osmotic pressure of the cells becomes smaller than the osmotic pressure outside the battery so that there is a possibility of backflow of fluid from plant cells. Or plasmolysis [14]; [6].

From several previous studies, there is no research that compares explicitly the economical use of planting media to the growth of kangkung vegetables using hydroponic techniques. This experiment was conducted to determine whether there were differences in the height of kangkung plants that received different treatments from commercial planting media and uneconomical planting media.

2. Methods
This research was conducted in an experimental way. The observation time was carried out for 25 (twenty-five) days in a hydroponic installation with DFT System (Deep Flow Technique) and Wick System (Static Technique) with a pump machine as a nutrient channeler that flows from each pipe. The type of plant chosen is kangkung, and plant height measurements are carried out every day or every 3 (three) days of observation. Treatment of kangkung plant net pot is carried out in 2 (two) ways, namely net pot A using cheap materials and net pot B using expensive materials / industrial scale. Based on the irrigation system used in hydroponics, it's divided into open systems where the solution is given cannot be reused, and a closed system where the answer is given can be recirculated. Meanwhile, based on the media used according to [7], this system is divided into 1\textsuperscript{st} substrate system, which is a hydroponic system that uses planting media to help plant growth, including sand culture, gravel culture, rockwool, and bag culture; 2\textsuperscript{nd} bare root system, which is a hydroponic system that does not use planting media to help plant growth, although block rockwool is usually used at the beginning of planting.

The Deep Flowing Technique System is a media-free hydroponic system, in the form of a long, shallow pond or container filled with nutrient solution and aerated. In this system, the plants are planted on a paneled tray (flat tray) made of styrofoam material that floats on the pond, and the roots develop in a nutrient solution [15]. The Static Technique (Wick System) is a planting system with the help of an axis to supply nutrient water to the plant roots. Media that can be used, such as used plastic bottles, jars, and food media [16].

The location of this experimental research was carried out at Balitbangda of South Sumatra Province. The materials used in this study were packaged kangkung seeds/seeds, rockwool, styrofoam, used cups, flannel cloth, and nutrition. The tools used are a cutter, tweezers, plastic container, measuring cup, hand soldering iron, pH measuring instrument, TDS-EC, scissors, and 1500 ml water bottle. The location of this research was chosen with an installation facing the morning sun because it is very suitable for plant growth, and to avoid pests so that the plants can be adequately maintained [17]. In hydroponics, the use of nutrients needed by plants is given in the right amount so that nutrient efficiency can be carried out. Errors in the use of these nutrients have an effect on production failure. The data taken in this study included plant height, initial PPM of water, PPM addition, final PPM of water, and water level in styrofoam. Data collection was taken for 25 DAS (days after sowing) from July to August 2019. Both of these treatments were then carried out by data processing with hypothesis testing. The data analysis was carried out by testing the hypothesis with the following notation:

- $H_0$: There is no difference in plant height on the net pot material treatment.
- $H_1$: There are differences in plant height on the net pot material treatment

For each treatment, A and B used 27 (twenty-seven) each net pot has measured the height of kangkung plants, then the measurement results were analyzed to prove $H_0$ by testing the hypothesis using the t-test. We also calculated cost and profit of each treatment A and B for choosing the best way of treatment used good or industrial material.

### 3. Result and discussion

To get this result on this case, we must maintain dan find out several things such us initial start part per million (PPM) of water, final PPM of water, and volume water level in styrofoam see table 1 as follow :

| Date      | Start (PPM) | End (PPM) | Nutrition Added (ml) | Start Volume Water (liter) | End Volume Water (liter) |
|-----------|-------------|-----------|-----------------------|----------------------------|-------------------------|
| 31-Jul-19 | 68          | 491       |                       | 15                         | 0                       |
| 04-Aug-19 | 150         | 366       | 150ml A               | 0                          | 10                      |
| 07-Aug-19 | 314         | 566       | 150ml B               | 0                          | 15                      |
| 12-Aug-19 | 227         | 587       |                       | 0                          | 15                      |

Results of observations made on the height of kangkung plants for 25 (twenty-five) days after transplanting (DAT), the following results were obtained:
Figure 1. Comparison of plant height Ipomoea aquatica during observation for each plant net pot

The height of kangkung plants during the observation in this study showed that the treatment of net pot planting A and net pot planting B in Figure 1 shows a difference in the average plant height between net pot A and net pot B seen in the graph on the last 4 (four) days of observation, namely day 22 DAT (Days After Transplanting), 23 DAT, 24 DAT, 25 DAT it was obtained that net pot A plant height had higher plant height than net pot B. Height compared to the height of the kangkung net pot plant A. The height of the kangkung plant which is the object of observation has a fluctuating plant height for each economic treatment (A) and uneconomical (B). If we look further, the average height of the economic kangkung plants has an average value of 13.2 cm, while the average height of kangkung plants for uneconomical net pots is 14.2 cm. This means that the average observation height of kangkung for uneconomical net pot is 1.0 cm higher than the height of kangkung plants that get economical net pot treatment. For each treatment, A and B 27 (twenty-seven) net pots were used. The height of the kangkung plant, which is the object of observation, has a fluctuating plant height for each economic treatment (A) and uneconomical (B). In this study, the uneconomic average height of kangkung plants had a value of 0.7 cm higher than the height of kangkung plants that received economic treatment. In testing the hypothesis carried out by this study, it resulted in rejecting H0, meaning that there were differences in plant height on the treatment of plant net pot material. Furthermore, hypothesis testing is carried out to determine the treatment carried out by the t-test with the results that can be seen in table 2 as follows:

| t-Test: Two-Sample Assuming Equal Variances | Variable 1 | Variable 2 |
|--------------------------------------------|------------|------------|
| Mean                                       | 12.59      | 13.71      |
| Variance                                   | 1.95       | 1.44       |
| Observations                               | 24         | 24         |
| Pooled Variance                            | 1.69       |            |
| Hypothesized Mean Difference               | 0          |            |
| df                                         | 46         |            |
| t Stat                                     | -2.96      |            |
| P(T<=t) one-tail                           | 0.002      |            |
| t Critical one-tail                        | 1.68       |            |
| P(T<=t) two-tail                           | 0.005      |            |
| t Critical two-tail                        | 2.01       |            |

For each treatment, A and B 27 (twenty-seven) net pots were used. The height of the kangkung plant, which is the object of observation, has a fluctuating plant height for each economic treatment (A) and uneconomic (B). In this study, the uneconomic average height of kangkung plants had a value of 0.7 cm higher than the height of kangkung plants that received economic treatment. If seen in table 1, it is found that the P-value (T <= t) of two tails 0.005 (0.5%) has a significant difference. Hypothesis testing carried out by this study resulted in rejecting H0, meaning that there were differences in plant height on the treatment of plant net pot material.
height on the treatment of plant net pot material. Furthermore, in this study, the calculation of fixed expenses for hydroponic installations and variable costs that must be incurred in conducting this research was carried out. The fixed costs that must be incurred include, among others, the purchase of a pump machine, water reservoir, ½ inch pipe, 2x2 square iron, PE hose, PH meter, electricity costs, ABmix fertilizer, and employee wages of IDR. 3,301,750 and variable costs for net pots A of IDR. 8,100 and net pot B of IDR. 28,836. The difference in treating planting media for net pot A uses plastic cups and used a t-shirt while treating planting net pot B uses a special hydroponic net pot and flannel material. The total results of calculating fixed costs and variable costs for net pot treatment A and B can be seen in table 3 as follows:

| No. | Equipment                  | Quantity A&B | Material A | Unit Price A (IDR) | Material B | Unit Price B (IDR) | Price A (IDR) | Price B (IDR) |
|-----|----------------------------|--------------|------------|-------------------|------------|-------------------|---------------|---------------|
| 1.  | Planting Container         | 27           | Plastic cups | 300               | Netpot     | 1,000             | 8,100         | 27,000        |
| 2.  | Fabric                     | 27           | Used t-shirt | -                 | Flanel     | 68                | -             | 1,836         |
| 3.  | Fertilizer                 | 150          | Abmix       | 25                | Abmix      | 25               | 3,750         | 3,750         |
| 4.  | Hydroponic installations   |              |             |                   |            |                   | 3,298,000     | 3,298,000     |
|     | **TOTAL PRICE**            |              |             |                   |            |                   | **3,309,850** | **3,330,586** |

From table 2, it is obtained that the difference between the total price for net pot A and net pot B treatment is IDR. 20,736. If it is seen that the procedure carried out on net pot B has a higher cost than the cost to make net pot A, but it is necessary to know that for net pot A treatment it can only be a maximum of 3x (three times) planting in a hydroponic installation, while for net pot B it can be used for planting in hydroponic facilities more than 21 times (twenty-one times). So, if the cost is calculated for a 7x (seven times) planting period, it is found that the use of planting media B (IDR. 27,864) is more profitable than planting media A.

4. Conclusion

The results of this study prove that hydroponically growing kangkung vegetables can be done with two planting container treatments which give different plant height yields. So if farmers are still in the hobby scale stage in growing kangkung vegetables with hydroponic technology, it is advisable to use an economical container treatment. Conversely, if farmers switch to making kangkung vegetable crops into a source of income or business to be run, it is advisable to treat planting media that are not economical or on an industrial scale.

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