Floating Raft Hydroponic System Using Spray Bars Pumps On Pakcoy Cultivation Growth (Brassica rapa L.)

Puspitahati*, Fehbi Andica
{puspitahati@fp.unsri.ac.id}

[1]Agricultural Engineering Study Program, Department of Agricultural Technology,
Faculty of Agriculture, Sriwijaya University
Indralaya, Ogan Ilir, South Sumatera

Abstract. The research objective is to know Pakcoy Cultivation Growth (Brassica rapa L.) on Floating Raft Hydroponic System Using Spray Bars Pumps. This research has been carried out in December 2022 to the month of Mei 2022 at the Greenhouse Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Sriwijaya University, Indralaya, South Sumatra. The research method used was designed to modify the floating raft using DFT pipes in the oxygen circulation system using a spray bars type venturi pump. The results showed that the design of spray bars pumps can minimize oxygen deficiency in floating raft pakcoy plants with a DO level value of 4.2 mg / l, plants with the highest average stem was found in L2 which was 25.4 cm. The average number of leaves are the most in L2, which were 16 strands. The longest average root is in L2 which was 42.6 cm. The highest average fresh weight was found at L2 which was 70.2 g.

Keyword: Floating Raft Hydroponic, Spray Bars Pumps, Pakcoy Cultivation Growth

1. Introduction

Hydroponics is a plant that is grown by utilizing water media without using soil media, but emphasizes on meeting the nutritional needs of plants to be able to grow (Masduki, 2018). Hydroponic floating raft system is one of the cultivation techniques in the form of plants placed in the holes of a floating device that floats on the surface of a solution of water and nutrients (Yunindanova et al., 2018).The advantages are in its application with a simple concept, easier and cheaper installation water, and optimization of space (Fadhlillah et al., 2019). There are many types of horticultural commodity plants that are often cultivated with a floating raft hydroponic system, one of which is the pakcoy plant.

Pakcoy (Brassica rapa L.) is a leaf vegetable plant belonging to the same genus as mustard and one of the plants has a short lifespan. As well as being one of the plants that has high nutritional content and economic value, therefore it is necessary to increase the production of pakcoy plants (Wahyuningsih dan Fajriani, 2016).

The dose of the nutrient solution and the dissolved oxygen content in the water must be in accordance with the needs of the plant because this greatly affects the growth of hydroponic plants (Utomo et al., 2014). Given the problem in previous studies, namely the lack of dissolved oxygen content. Efforts to overcome this problem are carried out using a spray bar

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type venturi pump. Considering that oxygen is very important for plants, because if plants lack oxygen it will cause plants to wilt easily and inhibit the absorption of water and nutrients so that plant productivity is not uniform and optimal.

The venturi pump functions as a nutrient water circulation device and can spray air on hydroponic media with the addition of a spray bar type pipe design, which aims to create a lot of flow and oxygen to the surface of the water. The value of dissolved oxygen or Dissolved Oxygen (DO) has a good value at a level of 8 mg/l, but plants can survive quite well at a value of 4 mg/l (Ningrum et al., 2014) .The design of a floating raft using spray bar type is one of the efforts so that the problems of water and oxygen circulation can be resolved so that the results of plant productivity will be optimal. In order, the purpose of this research is to know Pakcoy Cultivation Growth (Brassica rapa L.) on Floating Raft Hydroponic System Using Spray Bars Pumps.

2. Research Implementation

This research was conducted from January 2022 to April 2022 at the Plant House, Department of Agricultural Technology, Faculty of Agriculture, Sriwijaya University, Indralaya.

The tools used in this research were stationery, drilling machine, scissors, saw, hygrometer, camera, TDS Ec meter, grinding machine, meter, netpot, Ph meter, punch, ruler, venture pump, DO meter.The materials used in this research were planting tubs, PVC pipe glue, AB Mix nutrition, L and T pipe connectors for two 1/2″ PVC pipes, 1/2″ PVC pipes, 1/2 dua two PVC pipe hubs. fruit, A5 plastic tarpaulin 250 cm long 150 cm wide, nails, rockwool, Panel cloth, pakcoy seeds, taso mild steel, mild steel battens, black net, UV plastic, mild steel bolts, grinding bits, nylon rope, cement.

This study uses the design method and the observation method to modify the floating raft using a DFT pipe on an oxygen circulation system using a spray bar type venturi pump. The observation method was to observe floating raft hydroponics and then collect information about the response of pakcoy plants to floating raft hydroponics to the dissolved oxygen content in water and nutrient water.

Which,

T1 = Plant number one L1 = Gutters one
T2 = Plant number two L2 = Gutters two
T3 = Plant number three L3 = Gutters three
T4 = Plant number four L4 = Gutters four
T5 = Plant number five L5 = Gutters Five
L6 = Gutters six

2.1 Design Approach

The approach used in this research design is functional design and structural design.

2.2 Functional Design

The following is the design of functional tools and systems:

1. The venturi pump type spray bar design functions as a producer of oxygen and circulation of nutrient water.
2. The 1/2″ PVC pipe serves as a conduit for water from the pump to the spray bars.
3. The T pipe connector serves to connect the pipe from the pump to the spray bars.
4. The L pipe connector serves to connect the pipe used as a pump line
5.
6. 4 PVC pipe serves as a floating medium.
7. PVC pipe 2 serves as a helper for floating on floating media.
8. Plastic tarpaulin serves as a layer of the tub so that it can hold water.
9. The tub serves as a container for water and nutrients as well as a growing medium.

2.3 Structural Design

The structural design of the tool is as follows:

1. The venturi pump used is the Aquila P1800 model, 28 watts, and has a capacity of 1500 liters/hour.
2. The PVC pipe used is 1/2″ PVC type C.
3. The PVC pipe connector used is the L and T pipe connector.
4. The plastic tarpaulin used is type A5.
5. The PVC pipes used are PVC 4 and PVC 2 type C.

3. Result and Discussion

The relative humidity (RH) for hydroponics is around 70%, if the RH is more than 70% it will result in reduced root absorption and evapotranspiration, while if the RH is less than 70% then evapotranspiration will be faster and cannot be balanced with water supply by the roots which causes plants to grow dead (Susilawti, 2019). The average temperature observation value is 33.60C . High temperatures can inhibit plant growth and oxygen is not available if the temperature is too hot (Susilawti, 2019). Observation of the average pH value is 6.6. The desired pH for hydroponic plants is 5.5 – 7.5 (Susilawati, 2019).

The EC value in nutrients shows the nutrients contained in the nutrient solution with an electrical conductivity indicator. The EC value for vegetable crops was 2,5 mS/cm or 2500 $\mu S/cm$ (Sesanti and Sismanto, 2016). Based on the results of measurements of pakcoy plant nutrients every week that the nutritional requirements at 1 WAP are 100-200 ppm, at 2 MST it is 300-400 ppm, at 3 MST it is 500-600 ppm and at 4 MST it is 700-800 ppm.

3.1 Stem Heihgt

The observation of the growth of pakcoy stem height was calculated from 1 WAP (Week After Planting) to 4 WAP (Week After Planting) and is presented in Figure 3.1.

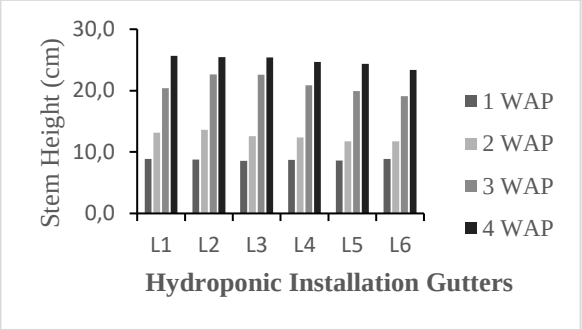

Figure 3.1 Average stem height of pakcoy (cm).

The results of the measurement of the highest value on the stem height of pakcoy plants 1 WAP to 4 WAP were found at L2, which was 25.7 cm and the lowest value was at L6, which was 23.4 cm. The stem height of the pakcoy plant was calculated from 1 WAP (Week After Planting) to 4 WST (Week After Planting) at L2 (Gutter 2) as shown in Figure 3.2.

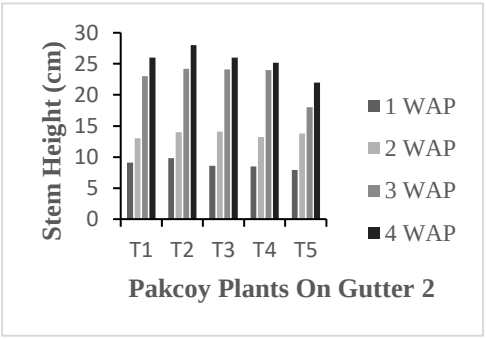

Figure 3.2. Average height of pakcoy stems (cm) (cm) on gutters 2

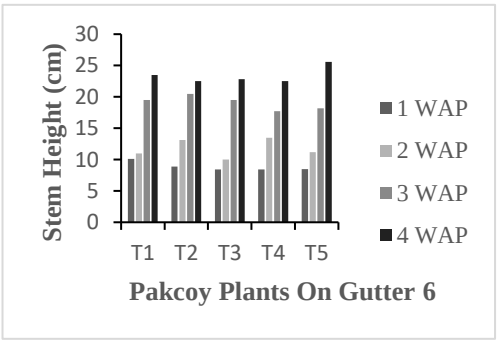

Figure 3.3. Average height of pakcoy stems gutters 6.

Plants at L2 (Gutter 2) are plants with the highest average plant stems. It because the growth of L2 stem height at 2 WAP to 3 WAP significant growth and uniform height values due to the evenly distributed oxygen demand. Virha et al, (2020) stated that high dissolved oxygen can facilitate plant roots in binding oxygen so that it can produce energy and respiration becomes smooth which can help absorb more nutrients so plant growth is better. Plants at L6 (Gutter 6) werw the plants with the lowest average plant stems. The results of the L6 measurement from 1 WAP to 4 WAP showed that the highest value in the stem height of the pakcoy plant was at T5, which was 25.6 cm and the lowest value was at T2 and T4 which had the same value, which was 22.5 cm.

3.2 Number Of Leaves

The number of pakcoy leaves was counted every week starting from 1 WAP (Week After Planting) to 4 WST (Week After Planting) and is presented in Figure 3.4.

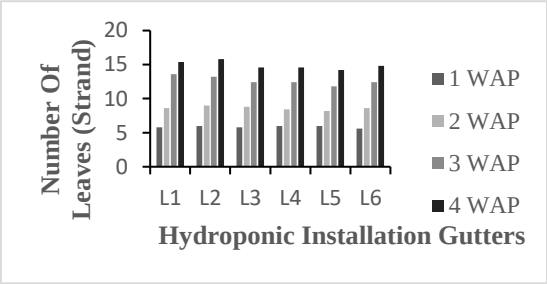

Figure 3.4. The average number of leaves of the pakcoy plant (strand).

The number of leaves of pakcoy plants increased from 1 WAP to 4 WAP. The results of observations from 1 WAP to 4 WAP showed that the number of leaves of the pakcoy plant in L2 experienced the highest average with a value of 16 strands, in all of the L2 gutters the addition of the number of leaves experienced a stable increase because the plant received sufficient oxygen demand from the spray bars pipe, at L5 experienced the lowest average because there were plants that were embroidered due to pest attacks.The number of pakcoy leaves was counted from 1 WAP (Week After Planting) to 4 WAP (Week After Planting) at L2 (Gutter 2) as shown in Figure 3.5 and at L5 (Gutter 5) as shown in Figure 3.6.

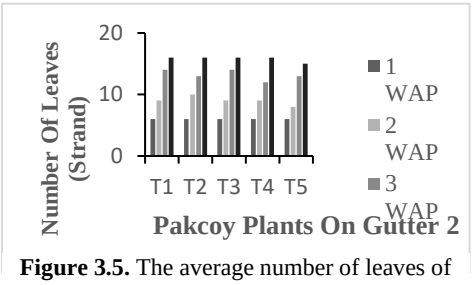

Figure 3.5. The average number of leaves of thepakcoy plants (strand) in gutters 2.

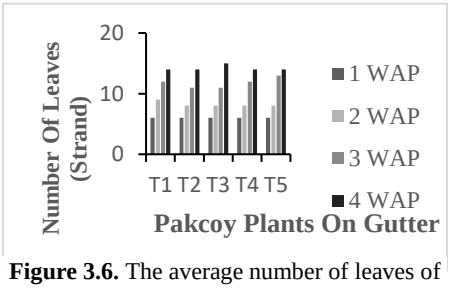

Figure 3.6. The average number of leaves of the pakcoy plants (strand) in gutters 5.

Plants at L2 (Gutter 2) are plants with the highest average plant stems. The results of observations from 1 WAP to 4 WAP showed that even oxygen made the growth of the number of leaves of the pakcoy plant uniformly found at T1, T2, T3, and T4 had the same number of leaves, namely 16 strands and the lowest value at T5 was 15 strands. The comparison of the average number of leaves in this study is better than the previous study (Lestari, 2021) with a value of 11 leaves.

Plants at L5 (Gutter 5) are the plants with the lowest average plant stems. The results of observations from 1 WAP to 4 WAT showed that the highest value on the number of leaves of the pakcoy plant was found at T3 which had 15 leaves and the lowest value at T1, T2, T4 and T5 had the same number of 14 leaves.

3.3 Root Length

The observation of pakcoy root length was calculated every week starting from 1 WAP (Week After Planting) to 4 WST (Week After Planting) and is presented in Figure 3.7.

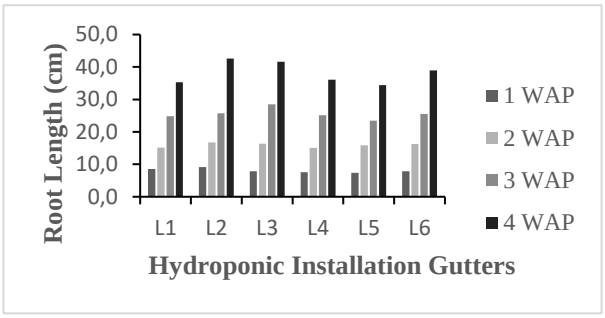

Figure 3.7. Pakcoy plant root length average (cm).

Plants at L2 (Gutter 2) are the plants with the longest average roots. Pakcoy root length increased from 1 WAP to 4 WAP. The results showed that the root length of the pakcoy plant at T2 experienced the longest root addition of 10 cm to 50 cm, at T5 the shortest root was 7 to 31 cm. Pakcoy root growth was not uniform during the growth of 1 WAP to 4 WAP. The comparison of the average root length in this study is better than the previous study (Lestari, 2021) with the longest mean value of 47.6.

Plants at L5 (Gutter 5) are the plants with the lowest root averages. Pakcoy root length increased from 1 WAP to 4 WAP. The results showed that the root length of the pakcoy plant at T1 experienced the longest root addition of 9 cm to 48, at T5 the shortest root was 6 to 23.5 cm.

3.4 Fresh Weight

Pakcoy plant weight is influenced by the amount of increase in plant wet weight related to other growth such as plant height, number of leaves, number of roots and chlorophyll content (Rizal, 2017).

Fresh weight of plants is calculated by weighing after the plants are harvested or when the water content in the plants has not been reduced and is presented in Figure 3.8.

L1 = Gutters one
L2 = Gutters two
L3 = Gutters three
L4 = Gutters four
L5 = Gutters Five
L6 = Gutters six

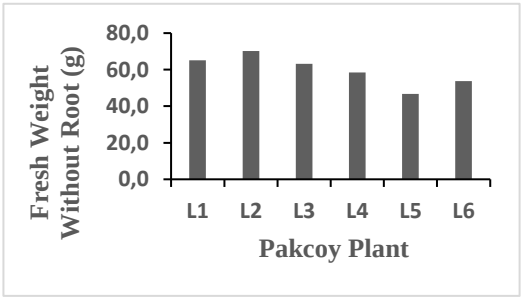

Figure 3.8. Pakcoy plant fresh weight average(g)

The results of observing the fresh weight of pakcoy plants during 4 WAP showed that the highest average fresh weight was located at L2, which was 70.2 g, while the lowest average fresh weight was at L5, which was 46.8 g. The comparison of the average fresh weight of the pakcoy plant in this study is better than the previous study (Lestari, 2021) with an average value of 64.4 g. Plant weight is influenced by leaf width and number of leaves because as a

medium for photosynthesis, photosynthesis affects plant growth, good plant yields are produced from good photosynthesis (Sagita et al., 2020). In accordance with the opinion of Suarsana et al, (2019) stated that the increase in plant fresh weight automatically increased when leaf area increased. This is because the leaves are organs that contain water, so the wider the leaf, the higher the water content and the fresh weight will increase.

3.5 Dysolved Oxygen (ml/g)

DO meter value is obtained by measuring 3 times repetition. Observations of dissolved oxygen in pakcoy plants were calculated starting before turning on the spray bar type venturi pump and after turning on the spray bar type venturi pump 1 MST (Week After Planting) to 4 MST (Week After Planting) and is presented in Figure 3.9.

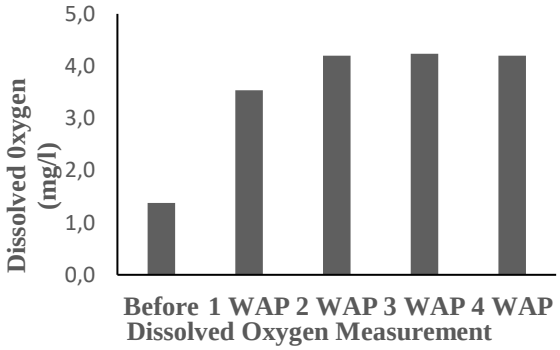

Figure 3.9. Average value of dissolved oxygen (ml/g).

The results of the measurement of dissolved oxygen content during 4 WAP showed that the highest and uniform average value at 2 MST, 3 MST and 4 MST was 4.2 mg/l, then the second highest average value was at 1 MST, which was 3.5 mg/l, while the lowest average value was before turning on the spray bar type venturi pump, which was 1.4 mg/l. Changes in DO levels occur by several factors including weather, temperature, and time of measurement. Changes in weather result in changes in temperature. Increased temperature changes cause lower DO levels, because the oxygen in the water was used for photosynthesizing plants. This is in accordance with the results of research by Paramitha et al, (2014), Which stated that the presence of dissolved oxygen in estuaries is influenced by atmospheric pressure, temperature, salinity, water turbulence, photosynthetic activity, respiration and waste entering water bodies. The use of a spray bar type venturi pump can increase the DO level.

4. Conclusions and Recommendations

4.1 Conclusions

The conclusions that can be drawn based on the research that has been done are as follows:

1. The design of the spray bar type venturi pump can minimize oxygen deficiency in floating raft pakcoy plants from 1.4 mg/l to 4.2 mg/l.
2. Plants with the highest average stem was found in L2 (gutter 2), which was 25.4 cm, the average number of leaves was mostly found in L2 (gutter 2), which was 16, the longest

average root was in L2 (gutter). 2) which was 42.6 cm, fresh weight with the highest average was at L2 equal to 70.2 g.

3. Plants with the lowest average stem was found at L6 (gutter 6), which was 23.4 cm, the lowest average number of leaves was at L5 (gutter 5), which was 14 strands, the lowest average root was at L5 (gutter 5).) which was 34.4 cm, fresh weight with the lowest average was at L5 equal to 46.8 g.
4. T1, T2, and T3 in each gutter were the highest growth, because they were located near the spray bar pipes. while T4 and T5 in each gutter were the lowest growth, because they were far away from the spray bars pipe.

4.2 Recommendations

Based on the results of the research that has been carried out, it is recommended that further research is needed to add spray bar pipes so that plant growth can be more uniform.

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