

Conference Paper

Study of the Use of Probiotics in Provision of Nutrition of Kale Plant (*Ipomoea aquatica*) in Aquaponic Planting Systems

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Abstract

Cultivation of urban vegetables using the aquaponic system can be taken into consideration in future agriculture because fish manure and fish food residues can become nutrients for plants after being modified by probiotics. The study aims to analyze the ability of various probiotics in decomposing fish droppings into nutrients available for growth of kale plants (*Ipomoea aquatica*) in aquaponic cultivation systems. The study was conducted at the Greenhouse UPN Veteran in East Java using a completely randomized design with four treatments: 1) without probiotics (A1), 2) A2, 3) A3, and 4) A4, and each treatment was repeated three times. Control is carried out by planting kale on soil media. The results showed 1). Kale plants planted with aquaponic systems have poor growth compared to those planted using soil media. 2). Probiotics used in the treatment for catfish farming do not affect kale plants. 3) The use of Probiotics (A2, A3, and A4) affects the growth of fish weight better than without the administration of probiotics (A1)

Keywords: probiotics, nutrition, kale

Introduction

Aquaponics is a culture of combining fish and plants into a general system where the nutrients produced from the fish system can provide all the nutrients needed by the system plan. Rakocy (1997) is often recognized as the first person to introduce the integration of fish farming with vegetable hydroponics in a recirculation system. Such designs have been well described (Rakocy, 1997; Adler *et al.*, 2000; Danaher *et al.*, 2011). Fish and vegetable farming provide profitable opportunities for urban business activities due to limited land availability.

The limited area of food production (agriculture-fisheries) has encouraged the cultivation of agriculture on narrow land / limited containers by considering modern aquaculture cultivation, various types of aquaculture systems such as recirculation aquaculture systems, aquaponics, and biofloc systems were established to preserve and minimize water use and to optimize water use and to optimize production. In modern aquaculture, wastewater is reused after proper treatment and conditioning. This is one of the most attractive strategies for intensifying aquaculture production while reducing waste (Klinger and Naylor, 2012). This is in line with the statement of Boyd and Gross, (2000) this business activity provides benefits to reduce water demand and minimize waste problems.

For synergy to support one another, limited aquaculture will be better if combined with agriculture, this can certainly increase efficiency at the production stage so that it can be said of low-input cultivation,

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because cultivated plants do not need to be fertilized to support growth and fertility, due to waste from fish ponds in the form of manure and fish food residues already contain macro and microelements needed by plants. Likewise, the presence of plants can reduce toxins in pond water as research results *Gumelar et al.* (2017) increase the total ammonia concentration over time, but the increase that occurs can be suppressed by the presence of plants

The problem is whether the availability of nutrients from fish dung sources can meet the needs for the growth of vegetable plants grown with aquaponic systems. Efforts to provide nutrients to be available to plants can be done by adding probiotics so that the process of decomposition of fish droppings and leftover food can take place quickly. The results of the decomposition of dissolved nutrients can be used as a source of plant nutrition

The addition of probiotics in aquaponic system cultivation because it can increase the growth rate and survival rate of fish (Primashita *et al.*, 2017) besides that it can be a solution to maintain water quality because microbes contained in probiotics can increase the change of nitrite to ammonium nitrate, so plants can be utilized kale in obtaining nutrients during its growth and does not poison the fish that are kept.

Probiotics contain most of the microorganisms *Lactobacillus*, *Bacillus*, *Nitrosomonas*, and *Nitrobacter* which can increase waste decomposition and can improve water quality (Tambunan *et al.*, 2010). Provision of probiotics in the aquatic environment is expected to increase the immune response to disease, improve the digestive system of fish, improve water quality because it can change toxic compounds into non-toxic, such as ammonia and nitrite compounds through the process of nitrification (Ghouse, 2015),

Commercial probiotics are currently being produced, especially those used for the cultivation of freshwater fish with different bacterial content, so it needs to be studied about the effectiveness of using commercial probiotics. On this basis, it is necessary to research the effect of giving different probiotics to the growth rate and survival rate of catfish culture media using the aquaponic system

Research Method

Kale cultivation research with aquaponic system uses a completely randomized design with four treatments, namely: 1) Without probiotics (P0), and commercial probiotics consisting of: 2) P1, 3) P2, and 4) P3 and repeated three times quiz. As a comparison of the aquaponic growing system of kale plants also planted using soil media Observations made were: Total dissolved salt, pH of nutrient availability (ammonium, nitrate, phosphorus), kale plant yield (growth and chlorophyll content).

The research carried out by providing four units of catfish ponds of 200 cm x 100 cm x 80 cm in each treatment. Each fish pond is equipped with 3 dm paralon pipes with a 200 cm length of 3. Paralon pipes are used to plant kale to bring water back to the catfish ponds. The way the recirculation system works in the following study. Wastewater from fish maintenance aquariums flows gravity through pipes to gutters that have been planted with kale (*Ipomoea aquatica*). The water in the pond is flowed back to the pond using a pump and so on. Catfish (*Clarias* sp.) Used in the study came from farmers in Jombang and acclimatized for one week in a tarpaulin pool. A total of 400 animals were given in each tarpaulin pond for each treatment with a size of 10 cm. Seaweed kale is carried out for one week on the planting medium. Plants are planted at the net pot in the paralon pipe using Rockwool media for planting the aquaponic system while using soil media is directly planted on the media.

Data Analysis Water quality measurements were carried out at the beginning before treatment and measured once a week during maintenance. Parameters observed were total dissolved salt, pH (pH meter), nitrate, ammonium, phosphorus, growth of kale plants, and chlorophyll content of kale leaves.

Result and Discussion

The results of observations of the development of spinach plants planted using aquaponic cultivation systems the results are still less satisfying compared to planting kale using the planting method using soil media. Growth of curved kale plant stalks followed by kale spinach plants also curled and the roots could not develop properly (see figure 1).

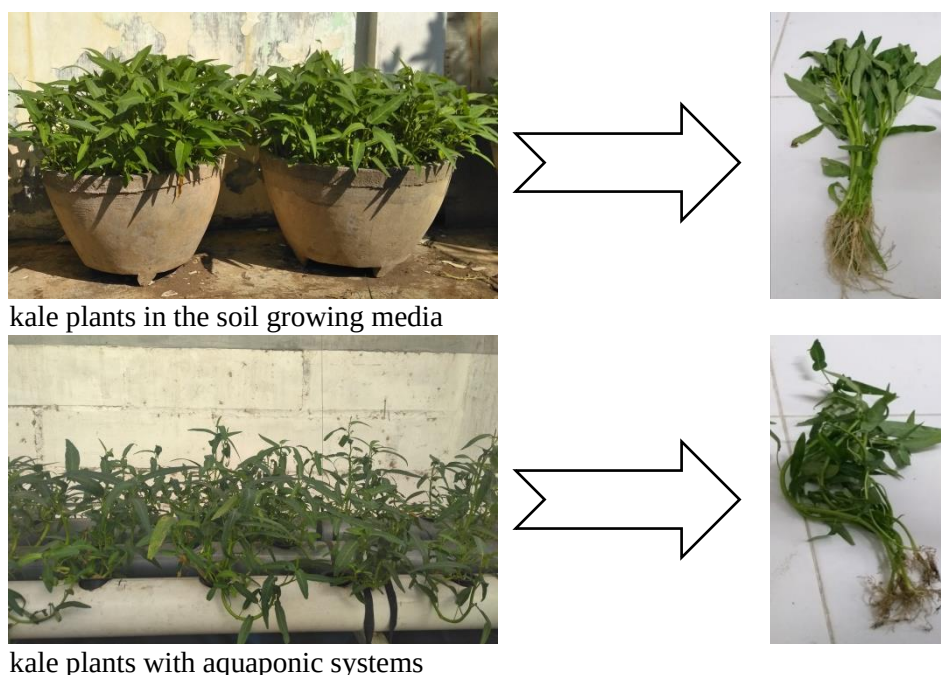


Figure 1. Kale yield using the Soil and Aquaponic Growing Media

Observation of the physical form of spinach plants planted with the aquaponic system above shows that kale plants have a poor ability, this is likely due to the salinity of the water content of catfish ponds used by dissolved salts increases with increasing planting time (Figure 2). The tolerance mechanism of NaCl salt solution in plants is determined by three things, namely the ability of osmosis, the ability to remove Na or Cl, and the ability of plants to high levels of Na Cl (Lauchli and Grattan 2014). Physically, all kale plants that are planted with the aquaponic system are physiologically disrupted as shown in all treatments (A1, A2, A3, and A4).

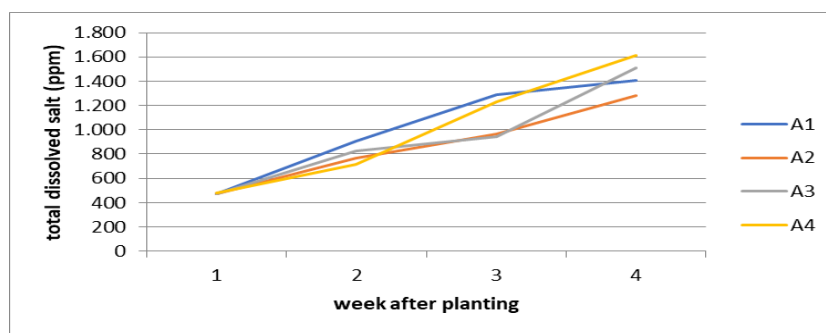


Figure 2. The magnitude of Dissolved Total Salt in Pond Water Due to Probiotics

The stunted growth of kale plants due to high salinity is due to the limited water content in the tissue due to low water absorption by plants which causes disruption of apical meristem activity in cell growth and development (Kurniasari *et al.* 2010). Plants that live with high salinity will form sugars and other important compounds to maintain cell turgor. The higher the concentration of the saline solution given, the salt content dissolved in the organs of the plant will be higher so that the sugar content in the organs of the plant is also higher. The formation of sugar in plant organs is a form of adaptation to the environment to form a change as shown by the circular stems and roots and leaves that are curled and small in size and darker in green.

Observation of growth of spinach plants planted with aquaponic systems treated with different probiotics showed that at weeks 1, 2, and 3 there were no significant differences, while at week 4 there were significant differences, on plant height parameters and the number of leaves observed. At plant height observations, at the beginning of growth, all probiotic treatments showed almost the same growth, but at the end of the observation the administration of probiotics (A2) showed higher plant height growth compared to A1 and A3, but with A4 showed no difference (Table 1).

The use of probiotics causes an increase in water pH, consequently causing suboptimal environmental conditions for the development of kale plants, while for fish growth is not a problem. Fish and another biota in water can grow well at pH 6-9. Conversely, plants can grow well at pH 5.5-7 because the process of absorption of nutrients from water can take place well (Lestari, 2013). Based on observations, it is suspected that plant growth is slow because the environmental pH is higher than the optimum pH for plant growth.

Besides affecting the growth of fish and plants, pH also affects the process of decomposition of organic matter in water. The results of observations on the pH of catfish pond water provide quite large results, ranging from pH values of 7.5 to 8.0 (Figure 3), this is an indicator of many nutrients present in pond water, many of which are not available and are not absorbed much by plants Kale. The pH value that gives good results for the growth of kale plants ranges from pH values 5-7.

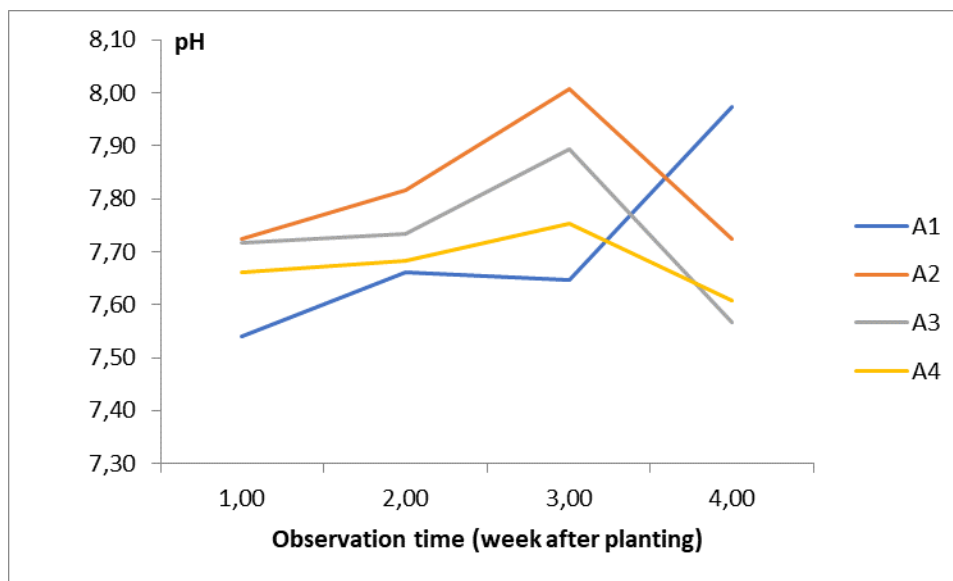


Figure 3. pH of Pond Water

Table 1. Effects of Probiotics on Growth in Kale Plants Height

Treatment	plant height (cm)			
	1 mst	2 mst	3 mst	4 mst
A1	6.44	13.44	16.44	20.78 a
A2	6.44	13.00	18.00	26.11 b
A3	6.22	13.00	16.00	21.33 a
A4	6.33	13.11	16.00	22.89 ab
BNT 5%	tn	tn	tn	3.532

Note: The average number in the same column and row means that it is not significantly different from the BNT test level of 5%

At the observation of the number of leaves (Table 2), at the beginning of the growth, the probiotic treatment did not show any real effect, but at the end of the observation the number of leaves in the A4 treatment showed a greater number of leaves than A1 and A3, but compared to A2 did not show the real difference.

Table 2. Effect of Probiotics on the Growth of Leaf Numbers of Kale Plants

Treatment	number of leaves			
	1 mst	2 mst	3 mst	4 mst
A1	6.78	8.33	9.44	10.78 a
A2	6.33	9.00	10.56	12.11 ab
A3	6.67	8.44	9.78	11.44 a
A4	6.67	8.33	10.44	13.11 b
BNT 5%	tn	tn	tn	1.513

Note: The average number in the same column and row means that it is not significantly different from the BNT test level of 5%

In the treatment of A2 and A4 with the addition of probiotics, the results of kale plant growth were better than those without probiotics (A1) and Probiotics (A3). This proves that A2 and A4 treatment with the addition of probiotics (*Lactobacillus*, *Nitrosomonas*, and *Bacillus*) in fish maintenance media can improve water quality so that it can support the growth of spinach plants better. Judging from the results of plant weight at the end of the observation (Table 3) administration of various probiotics does not affect the yield of plant weight.

Table 3. Effect of Probiotics on Fresh Weight of Kangkung Age 30 HS

Treatment	weight per plant (gram)	weight per pot (gram)
A1	4.36	21,78
A2	5.53	22,65
A3	4.99	24,95
A4	5.09	25,46
BNT 5%	tn	tn

Table 4 shows that giving probiotics gives more fish growth results than without giving probiotics. According to Gatesoupe (1999) in Zhou and Wang (2014), the addition of *Lactobacillus* bacteria through

water can also affect the digestive tract of fish. Lactobacillus bacteria works to increase the digestibility of fish to feed so that it can spur fish growth (Primashita *et al.*, 2017).

Table 4. Effect of Probiotics on the Growth of Weight of 10 Catfish Tails

Treatment	Weights 10 catfish (g)				
	0 mst	1 mst	2 mst	3 mst	4 mst
A1	536.00 a	678.67 ab	696.00 a	758.33 ab	773.67 a
A2	602.67 b	694.00 ab	748.67 b	794.67 b	885.67 c
A3	585.33 b	674.67 a	698.67 a	716.67 a	848.67 b
A4	512.00 a	711.33 b	766.67 b	772.67 ab	847.33 b
BNT 5%	42.010	33.018	25.318	63.229	16.862

Note: The average number in the same column and row means that it is not significantly different from the BNT test level of 5%

Conclusion

The results showed that the problem of miscarriage or brucellosis often occurs in cattle raised by breeders with a total of 5 tails from a sample of 300 productive females or with a percentage of 1.7%. Control activities carried out by veterinarians and field health workers are by conducting surveillance of brucellosis. Vaccination and test and slaughter have not been carried out due to limited resources.

Aquaponic plant systems conducted in the study can be concluded as follows:

1. Kale planted with aquaponic systems growth and yields are less good when compared to planted using soil media.
2. The use of probiotics used in the treatment for catfish farming does not affect the growth and yield of kale plants. The use of Probiotics (A2, A3, and A4) affects the growth of fish weight better than without the provision of probiotics (A1)

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