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Growth Response and Yield of Pakchoy Plants (Brassica rapa) On the Wick System of Hydroponic Systems with Various Concentrations of Abmix Fertilizer and Liquid Organic Fertilizer

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Abstract

The research aims to determine; (1) Effect of interaction between AB Mix Concentration and Liquid Organic Fertilizer on growth and yield components of Pakchoi Plants on axis hydroponic system, and (2) Optimum AB Mix concentration for each administration of POC concentration which gives the best pakchoi yields on axis hydroponic system. The research was conducted in Rancasari Village, Subang Regency, from March to April 2021. The research was carried out with an experimental approach using a factorial randomized block design (RAK) consisting of two factors, namely the first factor was AB Mix fertilizer with three levels (5 ml/l, 10 ml/l and 15 ml/l), and the organic fertilizer factor. three levels of liquid (0 ml/l, 3 ml/l and 6 ml/l) so that in each replication there were 9 treatment combinations and repeated three times. To determine the effect of the treatment of AB Mix fertilizer and liquid organic fertilizer, analysis of variance through the F test was used, with further tests using the Duncan's Multiple Range Test at a significance level of 5 percent. The results showed that: (1) there was an interaction effect between AB mix nutrients and liquid organic fertilizer on plant fresh weight. AB mix fertilizer independently affected plant height, number of leaves per plant, leaf area, chlorophyll index, number of shoots and stomata density. Liquid organic fertilizer independently affects plant height, number of leaves per plant, leaf area, chlorophyll index, number of shoots and stomata density, and (2) AB Mix concentration of 15 ml/l and liquid organic fertilizer 6 ml/l gives plant fresh weight. the highest pakchoy was 388.27 g per plant

Keywords: AB Mix, Liquid Organic Fertilizer, Pakcoy Plant Response

Abstract

Penelitian bertujuan untuk mengetahui ; (1) Pengaruh interaksi antara Konsentrasi AB Mix dan Pupuk Organik Cair terhadap komponen pertumbuhan dan hasil Tanaman Pakchoi pada hidroponik sistem sumbu, dan (2) Konsentrasi AB Mix optimum pada setiap pemberian Konsentrasi POC yang memberikan hasil pakchoi terbaik pada hidroponik sistem sumbu. Penelitian dilaksanakan di Desa Rancasari, Kabupaten Subang, mulai dari bulan Maret sampai dengan bulan April 2021. Penelitian dilaksanakan dengan pendekatan eksperimen menggunakan Rancangan Acak Kelompok (RAK) pola faktorial yang terdiri dari dua faktor yaitu faktor pertama adalah pupuk AB Mix sebanyak tiga taraf (5 ml/l, 10 ml/l dan 15 ml/l), dan faktor pupuk organik cair tiga taraf (0 ml/l, 3 ml/l dan 6 ml/l) sehingga setiap ulangannya terdapat 9 kombinasi perlakuan dan diulang tiga kali. Untuk mengetahui pengaruh perlakuan pupuk AB Mix dan pupuk organik cair, digunakan analisis varian melalui uji F, dengan uji lanjutan menggunakan Uji Jarak Berganda Duncan pada

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taraf nyata 5 persen. Hasil penelitian menunjukkan bahwa : (1) terdapat pengaruh interaksi antara nutrisi AB mix dan pupuk organik cair terhadap bobot segar tanaman. Pupuk AB mix secara mandiri berpengaruh terhadap tinggi tanaman, jumlah daun per tanaman, luas daun, indeks krolofil, jumlah setomatan dan kerapatan stomata. Pupuk organik cair secara mandiri berpengaruh terhadap tinggi tanaman, jumlah daun per tanaman, luas daun, indeks krolofil, jumlah setomatan dan kerapatan stomata, dan (2) Konsentrasi AB Mix 15 ml/l dan pupuk organik cair 6 ml/l memberikan bobot segar tanaman pakchoy tertinggi yaitu 388,27 g per tanaman.

Key words: AB Mix, Pupuk Oganik Cair, Respon Tanaman Pakcoy.

1. Introduction

Vegetables are one of the important horticultural commodities in meeting nutritional needs. Leaf vegetables are vegetables that contain lots of nutrients, because these vegetables are rich in vitamins and minerals. The most important nutritional needs for the Indonesian population are vitamins A and C, as well as minerals, iron and calcium. The demand for vegetables is increasing as the population continues to increase but the condition of agricultural land is decreasing. The sustainability of the vegetable farming sector is being faced with a serious threat, namely the area of agricultural land which continues to shrink due to the massive conversion of productive agricultural land to non-agricultural use. Farmers' land holdings are increasingly narrow, making efforts to improve farmers' welfare difficult. In 2012, the area of land control per farmer was 0.22 hectares and is estimated to be 0.18 hectares in 2050 (Ministry of Agriculture, 2015).

This is indicated by the increasing number of restaurants and hotels that serve food as well as supermarkets that provide foreign vegetables such as pakchoy. According to the Central Statistics Agency (2017), in 2016, the average weekly consumption of pakchoy vegetables reached 0.064 kg person-1. Therefore, pakchoy is starting to become popular and can be found in many supermarkets in Indonesia. Pakchoy is a type of green vegetable that is in the same group as mustard greens. Pakchoy is also often called spoon mustard greens because its shape resembles a spoon. Pakchoy is often called sweet mustard greens or beef mustard greens because its base is soft and thick like meat. Pakchoy is usually used as an ingredient in soup or as a food garnish (Alviani, 2015).

Pakchoy plants can be cultivated using hydroponic techniques. Cultivating vegetables using a hydroponic system can be an alternative solution to increase the availability of vegetables, including pakchoy. In a hydroponic system, environmental influences per plant can be regulated so that it can produce good production. In a hydroponic system, nutrients are provided in solution form that is easily available to plants. The nutrition provided contains all the essential nutrients that plants need for optimal growth. The success factor for cultivating vegetables hydroponically is the nutrients used. Nutrition is very important for success in growing hydroponically, because without nutrients plant growth will be hampered and can produce yields and vegetable production that are not optimal.

Nutrients are macro and micro nutrients that must be present for plant growth. Each type of nutrition has a different composition. AB Mix nutrition is a nutrient used for growing hydroponically. AB Mix nutrition is made in two different packages, namely Mix

A and Mix B, Mix A contains calcium elements, while Mix B contains sulfate and phosphate. The three must not be mixed in a concentrated state so as not to cause a precipitate, because if the calcium cation (Ca) in Mix A meets the sulfate anion (SO2-) in Mix B, a precipitate of Calcium Sulphate (CaSO4) will occur so that the Ca and S elements cannot absorbed by the roots and if the calcium cation (Ca) in Mix A concentrate meets the phosphate anion (PO 3-) in Mix B, calcium phosphate (Ca3(PO4)2) precipitates will occur, so that the Ca and P elements cannot be absorbed by the roots. root. In order to meet these nutritional needs, hydroponic plants require a nutrient solution or fertilizer (Sastro and Nofi, 2016).

Apart from using AB Mix, the use of liquid organic fertilizer (POC) in hydroponic vegetable cultivation needs to be a big concern to reduce the use of inorganic fertilizers. Liquid organic fertilizer (POC) contains various types of nutrients and substances that plants need. These substances come from the organic materials used in its manufacture. This substance consists of minerals, both macro and micro amino acids, growth hormones and microorganisms. Liquid fertilizer is more easily absorbed by plants because the elements in it have been decomposed. The advantage of liquid fertilizer is that the nutrient content varies, namely containing macro and micro nutrients, nutrient absorption occurs more quickly because it has been dissolved (Febrianna et al, 2018).

2. Materials and Methods

This research is quantitative research. This research uses a quantitative experimental research approach, namely applying control principles to things that influence the course of the experiment. This method is to test the influence of one or more variables on other variables.

The research was carried out in Rancasari Village, geographically located at an altitude of 6 m above sea level with an average rainfall of 180.6 mm, which has 2 wet months, 4 humid months and 6 dry months, while the physical land is 100% flat and 0 % wavy, ultisol soil type (red yellow podzolic) with black and reddish color, clay texture, slightly crumbly clay structure, has a processing depth of 4-5 m and a maximum temperature of 27°C, minimum temperature of 23°C.

The research was carried out for 1 (one) month, starting from March 2021 to April 2021. The tools used in this research were 27 Wick system installations with 4 holes in each installation, measuring instruments (meter, ruler), glass objects, insulation, glass. measuring, millimeter paper, scales, 10 liter bucket, camera, pH meter, TDS meter, chlorophyll meter, measuring cup, and stationery.

The materials used in this research were pakchoy seeds of the Nauli F1 variety, AB Mix nutrition which uses the Dramaga trademark. The liquid organic fertilizer (POC) used in this research is POC with the Trademark Felo 04 Aminosong. The experimental design used was a factorial Randomized Block Design (RAK), consisting of two treatment factors, namely the AB Mix Concentration and POC Concentration factors and was repeated three times.

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Table 1. Combination of AB Mix and POC Concentration Treatments

AB Mix Concentration (ml/l)	POC Felo 04 concentration (ml/l)		
	p1	p2	p3
a1	j1 u1	j1 u2	j1 u3
a2	j2 u1	j2 u2	j2 u3
a3	j3 u1	j3 u2	j3 u3

Table 2. List of Variety Prints

Diversity Source	DB	J K	KT	F_{count}
Deuteronomy (r)	2	□Xi..2/t – X... 2/rt	JKr/DBr	KTr/KTg
Treatment (t)	8	□X.jk2/r – X... 2/rt	JKt/DBt	KTt/KTg
AB mix (a)	2	□Xj2/rj – X... 2/rt	JKa/DBa	KTj/KTg
Cons. POK (p)	2	□X..k2/rb – X... 2/rt	JKp/DBp	KTb/KTg
Interaction (ap)	4	JKt – JKj – JKb	JCap/DBap	KTjb/KTg
Error (g)	16	JKT – JKr - JKt	JKg/DBg	
Total (T)	26	□Xijk2 – X... 2/rt		

Source: Vincent Gaspersz (2009)

3. Results and Discussion

Plant Height

The results of the analysis of variance showed that there was no interaction effect between the concentration of AB mix and liquid organic fertilizer (POC) on plant height in each observation period.

Table 3. Effect of AB Mix Concentration and Liquid Organic Fertilizer on Plant Height at 10, 15, 20, 25 and 30 Days After Planting

Treatment	Plant height (cm)				
	10 p.m	15 hst	20 hst	25 hst	30 hst
1. AB Mix Concentration					
a1 (5ml/l)	10.86 a	16.59 a	21.00 a	24.42 a	26.53 a
a2 (10ml/l)	11.59 a	17.98 a	21.56 a	26.39 b	28.94 b
a3 (15ml/l)	11.66 a	18.31 a	22.36 a	26.89 b	29.34 b
2. Liquid Organic Fertilizer					
p1 (0 ml/l)	11.47 a	17.64 a	21.94 a	25.62 a	27.61 a
p2 (3 ml/l)	12.04 a	18.23 a	21.89 a	25.77 a	27.77 a
p3 (6 ml/l)	10.59 a	17.00 a	21.08 a	26.28 a	29.44 b

Note: The average number followed by the same letter indicates that it is not significantly different based on Duncan's Multiple Range Test at a significance level of 5%.

Based on Table 5 above, it shows that at the age of 10, 15 and 20 days after planting independently applying the AB Mix concentration did not have a real effect on plant height. However, using an AB mix concentration of 15 ml/l resulted in higher plant height compared to a lower AB mix concentration. At the age of 25 and 30 days after planting independently, applying the AB Mix concentration had a real effect on plant height. The AB Mix concentration treatments of 10 ml/l and 15 ml/l were not significantly different, but the two treatments were still significantly different from the 5 ml/l treatment. At 30 days after planting, it showed that the 6 ml/l liquid organic fertilizer treatment gave the

highest plant height and was significantly different from the 0 ml/l and 3 ml/l organic fertilizer concentration treatments.

Number of Leaves per Plant

The results of the analysis of variance showed that there was no interaction effect between the concentration of AB mix and liquid organic fertilizer (POC) on the number of leaves in each observation period.

Table 4. Effect of AB Mix Concentration and Liquid Organic Fertilizer on the Number of Leaves at 10, 15, 20, 25 and 30 Days After Planting

Treatment	Number of leaves (pieces)				
	10 p.m	15 hst	20 hst	25 hst	30 hst
1. AB Mix Concentration					
a1 (5ml/l)	6.00 a.m	7.44 a	11.89 a	16.00 a	19.89 a
a2 (10ml/l)	6.22 a	8.00 a.m	12.22 a	16.33 a	20.11 a
a3 (15ml/l)	6.44 a	8.22 a	12.33 a	17.44 b	21.67 b
2. Liquid Organic Fertilizer					
p1 (0 ml/l)	6.00 a.m	7.67 a	12.22 a	16.44 a	19.78 a
p2 (3 ml/l)	6.11 a	8.00 a	12.22 a	16.00 a	20.44 a
p3 (6 ml/l)	6.56 a	8.00 a.m	12.00 a	17.33 b	21.44 b

Note: The average number followed by the same letter indicates that it is not significantly different based on Duncan's Multiple Range Test at a significance level of 5%.

At the age of 10 dap, 15 dap and 20 dap, independently the AB Mix concentration treatment had no significant effect on the number per plant. However, using an AB mix concentration of 15 ml/l produced a greater number of leaves compared to a lower AB mix concentration. At the age of 25 and 30 days after planting independently, applying the AB Mix concentration had a real influence on the number of leaves per plant. The AB Mix concentration treatment of 15 ml/l gave the highest number of leaves and was significantly different from the AB Mix concentration treatment of 5 ml/l and 10 ml/l. At 25 and 30 days after planting, it showed that the 6 ml/l liquid organic fertilizer treatment gave the highest number of leaves per plant and was significantly different from the 0 ml/l and 3 ml/l organic fertilizer concentration treatments.

Leaf Area

The results of the analysis of variance showed that there was no interaction effect between the concentration of AB mix and liquid organic fertilizer (POC) on leaf area.

Table 5. Effect of AB Mix Concentration and Liquid Organic Fertilizer on Leaf Area

Treatment	Leaf Area	
1. AB Mix Concentration		
a1 (5ml/l)	9.79	a
a2 (10ml/l)	11.24	b

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a3 (15ml/l)	12.34	c
2. Liquid Organic Fertilizer		
p1 (0 ml/l)	10.94	a
p2 (3 ml/l)	10.76	a
p3 (6 ml/l)	11.68	b

Note: The average number followed by the same letter indicates that it is not significantly different based on Duncan's Multiple Range Test at a significance level of 5%.

Independently, the application of AB Mix concentration had a real influence on leaf area. The AB Mix concentration treatment of 15 ml/l gave the highest leaf area and was significantly different from the AB Mix concentration treatment of 5 ml/l and 10 ml/l. Independently, liquid organic fertilizer has a significant effect on leaf area. The 6 ml/l liquid organic fertilizer treatment gave the highest leaf area and was significantly different from the 0 ml/l and 3 ml/l organic fertilizer concentration treatments.

Chlorophyll Index

The results of the analysis of variance showed that there was no interaction effect between the concentration of AB mix and liquid organic fertilizer (POC) on the chlorophyll index.

Table 6. Effect of AB Mix Concentration and Liquid Organic Fertilizer on the Chlorophyll Index

Treatment		Chlorophyll Index
1. AB Mix Concentration		
a1 (5ml/l)	1.29	a
a2 (10ml/l)	1.49	b
a3 (15ml/l)	1.64	c
2. Liquid Organic Fertilizer		
p1 (0 ml/l)	1.45	a
p2 (3 ml/l)	1.42	a
p3 (6 ml/l)	1.55	b

Note: The average number followed by the same letter indicates that it is not significantly different based on Duncan's Multiple Range Test at a significance level of 5%.

Independently, the application of AB Mix concentration had a real influence on the chlorophyll index. The AB Mix concentration treatment of 15 ml/l gave the highest chlorophyll index and was significantly different from the AB Mix concentration treatment of 5 ml/l and 10 ml/l. Independently, liquid organic fertilizer has a significant effect on the chlorophyll index. The liquid organic fertilizer concentration of 6 ml/l gave the highest chlorophyll index and was significantly different from the 0 ml/l and 3 ml/l treatments.

Number of Stomata and Stomata Density

The results of the analysis of variance showed that there was no interaction effect between the concentration of AB mix and liquid organic fertilizer (POC) on the number of stomata and density of stomata.

Table 7. Effect of AB Mix Concentration and Liquid Organic Fertilizer on Stomatan Number Index and Stomata Density

Treatment	Number of Stomata	Stomata Density
1. AB Mix Concentration		
a1 (5ml/l)	5.13 a	263.53 a
a2 (10ml/l)	5.64 a	285.43 a
a3 (15ml/l)	6.82 b	354.76 b
2. Liquid Organic Fertilizer		
p1 (0 ml/l)	5.58 a	283.12 a
p2 (3 ml/l)	5.79 a	301.02 b
p3 (6 ml/l)	6.22 b	319.58 c

Note: The average number followed by the same letter indicates that it is not significantly different based on Duncan's Multiple Range Test at a significance level of 5%.

The results of the Duncan multiple distance test of 0.05 showed that the AB Mix concentration treatment of 15 ml/l produced the highest number of stomata (6.82) which was significantly different from the AB Mix concentration treatment of 5 ml/l and 10 ml/l.Meanwhile in the concentration treatmentABmix 5 ml/l has the lowest number of stomata (5.13). The 6 ml/l liquid organic fertilizer treatment produced the highest number of stomata (6.22) which was significantly different from the 0 ml/l and 3 ml/l liquid organic fertilizer treatments.Meanwhile, in the liquid organic fertilizer treatment0 ml/l which has the lowest number of stomata (5.58).

Plant Fresh Weight

The results of the analysis of variance showed that there was an interaction effect between AB Mix nutrients and liquid organic fertilizer on plant fresh weight.

Table 8. Effect of AB Mix Nutrient Interaction and Liquid Organic Fertilizer on Plant Fresh Weight

AB Mix Nutrition	Liquid organic fertilizer (ml/l)		
	p0 (0 m/l)	p1 (3 ml/l)	p2 (6 ml/l)
a1 (5ml/l)	255.00 a A	263.47 a A	272.13 a A
a2 (10ml/l)	277.17 a A	301.93 b A	298.33 a A
a3 (15ml/l)	317.20 b A	358.80 c B	**388.27 b C**

Note: Average numbers accompanied by the same lower case letter in the row, or the same capital letter in the column, indicate that they are not significantly different based on Duncan's Multiple Range Test at a significance level of 5%

In the AB Mix concentration treatment of 15 ml/l (a3), it showed that the 6 ml/l liquid organic fertilizer treatment was significantly different from the 0 ml/l and 3 ml/l liquid organic fertilizers. In the treatment without liquid organic fertilizer/0 ml/l (p0), it showed that the 15 ml/l concentration treatment was significantly different from the AB Mix concentration treatment of 5 ml/l and 10 ml/l. In the 3 ml/l liquid organic fertilizer treatment (p1), it showed that the 15 ml/l concentration treatment was significantly

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different from the AB Mix concentration treatment of 5 ml/l and 10 ml/l. In the 6 ml/l (p2) liquid organic fertilizer treatment, it showed that the 15 ml/l concentration treatment was significantly different from the AB Mix concentration treatment of 5 ml/l and 10 ml/l.

Root Loss Ratio

The results of the analysis of variance showed that there was no interaction effect between the concentration of AB mix and liquid organic fertilizer (POC) on the root decay ratio.

Table 9. Effect of AB Mix Concentration and Liquid Organic Fertilizer on Root Pudding Ratio

Treatment	Root Loss Ratio	
1. AB Mix Concentration		
a1 (5ml/l)	5.16	a
a2 (10ml/l)	5.20	a
a3 (15ml/l)	5.63	a
2. Liquid Organic Fertilizer		
p1 (0 ml/l)	5.09	a
p2 (3 ml/l)	5.38	a
p3 (6 ml/l)	5.51	a

Note: The average number followed by the same letter indicates that it is not significantly different based on Duncan's Multiple Range Test at a significance level of 5%.

The AB Mix concentration treatment showed relatively the same root loss ratio. The absence of significant differences in phosphate fertilizer treatment on root volume and root loss ratio is thought to be due to plant genetics and optimal soil fertility conditions for plants so that it does not affect the rate of increase or decrease in root volume and root loss ratio. Independently, liquid organic fertilizer does not have a significant effect on the root loss ratio. The relative concentration of liquid organic fertilizer produces relatively the same root loss values. Even though it had no real effect, the liquid organic fertilizer concentration of 6 ml/l resulted in a relatively greater root loss ratio.

4. Conclusion

Based on the results of the research and discussion described above, the following conclusions can be drawn: There is an interaction effect between AB mix nutrients and liquid organic fertilizer on plant fresh weight. AB mix fertilizer independently influences plant height, number of leaves per plant, leaf area, chlorophyll index, number of setomats and stomata density. Liquid organic fertilizer independently influences plant height, number of leaves per plant, leaf area, chlorophyll index, number of setomas and stomata density. AB Mix concentration of 15 ml/l and liquid organic fertilizer of 6 ml/l gave the highest fresh weight of pakchoy plants, namely 388.27 g per rice plant.

Based on these conclusions, the following suggestions can be put forward: To improve the growth and yield of pakchoy plants, balanced fertilization technology can be used using AB Mix fertilizer combined with liquid organic fertilizer. To obtain a broader picture of the effect of AB Mix fertilizer and liquid organic fertilizer on the growth and

yield of pakchoy, further research is needed with superior varieties and different treatments of AB Mix fertilizer and liquid organic fertilizer.

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