DOI: http://dx.doi.org/10.25181/jppt.v22i3.2769 **pISSN 1410-5020**
Jurnal Penelitian Pertanian Terapan Vol. 22(3): 279-286 **eISSN 2407-1781**
Website: http://www.jurnal.polinela.ac.id/JPPT

Produktivitas Air Pada Sistem Irigasi Tetes Untuk Tanaman Hidroponik Caisim *(Brassica chinensis var. Parachinensis)* Dengan Berbagai Ukuran Polybag Dan Media Tanam Yang Berbeda

Water Productivity In Drip Irrigation System For Hydroponic Caisim Plant (Brassica chinensis var. Parachinensis) With Various Polybag Sizes And Different Planting Media

I Gde Darmaputra[1]*, Muhammad Idrus[1], and Suprapto[1]

[1]Lampung State Polytechnic
*E-mail : igde_dp@polinela.ac.id

ABSTRACT

his research was conducted in a plastic house at the Lampung State Polytechnic from June to October 2022. The study was a factorial experiment consisting of two factors with a randomized block design. The first factor is the type of planting media with 4 kinds, such as cocopeat, husk charcoal, sand, and soil. The second factor is the polybag size, such as small, medium, and large sizes. Each factor or treatment was repeated 3 times. The tools and materials used are drip irrigation, digital scales, polybags, pearl NPK fertilizer and caisim seeds. The objectives of the study were (1) to measure the growth and production of caisim plants on various planting media and polybag sizes, (2) to measure the amount of irrigation water used, and (3) to calculate the water productivity of caisim plants. The observed variables included crop production, amount of water use, and water productivity. Data analysis using ANOVA at the 5% significant difference test level. The results showed that there was no interaction between the type of planting media and the size of polybags, but the response in the treatment between types of planting media and between polybag sizes was significantly different. The type of media significantly affected the number of leaves, plant height, production, and water productivity of hydroponic caisim plants using a drip irrigation system. Polybag size did not significantly affect the number of leaves, plant height, production, and water productivity of hydroponic caisim plants using a drip irrigation system. In hydroponic caisim cultivation using drip irrigation, cocopeat growing media gave an average number of 9.8 leaves, plant height 34.4 cm, production 97.1 g, and water productivity 6.18 kg/m^3 and was not significantly different from soil medium.

Keywords: *Water, Drip Irrigation, Hydroponic, Planting Media.*

Disubmit : 21 Desember 2021; **Diterima:** 14 Februari 2022; **Disetujui :** 20 November 2022;

INTRODUCTION

Caisim plants **(***Brassica chinensis var. Parachinensis)* include leaf vegetables from the Cruciferae family or cabbage plants that have high economic value because they are rich in fiber, high nutritional content, and also this plant is believed to have medicinal properties. The part of the caisim consumed is the young leaves. Caisim leaves as a vegetable food does have various benefits and uses in people's lives. Caisim leaves besides being used as a vegetable ingredient, it can also be used as a therapy for various diseases.

Given the benefits and uses of the caisim plant, it is necessary to develop it in an effort to participate in maintaining public health.

Hydroponics is a technique for cultivating plants by utilizing water and without using soil as the main medium and emphasizing the addition of nutritional needs for plants. The water requirement for hydroponic plants is less than the water requirement for cultivation using soil as the main medium. Hydroponics uses water more efficiently, so it is very suitable to be applied to areas that have a limited water supply.

Many hydroponic techniques are carried out on a small scale for hobbies among the community because they do not need to require a large area of land, it is also suitable nowadays as an alternative to adding activities that require people to stay at home. In choosing the type of plant to be cultivated, it must be considered because not all agricultural products have economic value. As research material, caisim plants were chosen to be planted using hydroponic techniques with drip irrigation applications.

Drip irrigation is a method of providing water with a low discharge (Sumarna, 1998). The drip irrigation system can save water use, because it can minimize water loss that may occur due to percolation, evaporation and runoff, making it suitable for application in areas with limited water sources. The advantages of drip irrigation are that it can save water, energy, management costs, use the right fertilizer, energy and can control plant diseases and can be used for uneven and narrow land (Poerwanto and Susila, 2014).

Hydroponic vegetable cultivation usually uses various planting media in polybags whose sizes vary from small, medium and large sizes. To increase the efficiency of using nutrient water, it is necessary to have the right polybag size for certain types of planting media. Therefore, research is needed on the size of polybags for certain plant media in hydroponic caisim cultivation using a drip irrigation system. The objectives of the study were (Bahzar and Santoso, 2018) to measure the production of caisim plants on various planting media and polybag sizes, (Charitsabita, *et al*, 2019) to measure the amount of irrigation water used, and (Clemmens and Molden, 2007) to calculate the water productivity of caisim plants.

Hendri Yanto, H., et al. has conducted research on the application of drip irrigation on cauliflower plants in a greenhouse using a nutrient solution of AB mix and growing media of sand and husk charcoal (Umar, *et al*, 2016). Furthermore, Ginanjar, M., et al., have conducted research on the production of kailan (Brassica oleracea var. alboglabra) hydroponic system using rice husk charcoal, skerwool, and cocopeat growing media (Ginanjar, *et al*, 2021). The use of planting media for cocopeat husk charcoal and moss in hydroponic cultivation of Pakcoy (Brassica rapa L.) has also been carried out (Charitsabita, *et al, 2019)*. Furthermore, Bahzar and Santoso have also conducted research on hydroponic pakcoy production using rice husk charcoal, sand, rockwool, cocopeat, and AB Mix nutrient solutions (Bahzar and Santoso, 2018). Rahman, A., et al. reported that the total wet weight of mustard plants for hydroponic systems, ornamental fish aquaponics, and consumption fish aquaponics were 77.08 g, respectively; 9.7 g; 28.6 g per plant with the amount of water used in a row 25 l; 20.4 l; and 24.7 l per plant (Rakhman *et al.*, 2015). The growth and yield of hydropinic caisim plants using AB mix fertilizer was still better than plants treated with liquid organic fertilizer (POC). Caisim plant height, number of leaves and wet caisim plant weight were 29.32 cm, 10.2 strands and 29.75 g/plant (Jehangis, *et al*, 2004) . Ngantung, J. A. B., et al., reported that the combination of inorganic and organic fertilizers gave the best response, that was the treatment of urea fertilizer 0.5 grams/pot, SP-36 0.375 grams/pot, and compost 50 grams/pot high yields. caisim plant 24.00 cm, the number of leaves of caisim plant 9 leaves, and fresh weight of caisim plant 67.50 grams (Milda, *et al*, 2017).

The frequency of giving good nutritional water in hydroponic caisim cultivation using roasted husk media is at the frequency of giving water 5 times per day, the average fresh caisim production is 78.22 g/plant (Hartono, *et al*, 2015). Furthermore, it was reported that the water productivity of the caisim plant with the frequency of giving nutrient water 5 times per day with manual watering was 7.45 kg/m3 which was

higher than the drip irrigation system with the frequency of giving water 1 time per day which was 5.77 kg/m3.

Water productivity is the ratio between production output and water used (Clemmens and Molden, 2007) (Yanto, *et al*, 2014). The production output parameters and the amount of water used in the calculation of water productivity need to be adjusted to the intended use of the water productivity value. Clemmens and Molden argue that the production output parameter can be in the form of the weight of the harvest or its economic value and the water quantity parameter can be in the form of water used or water supplied (irrigation and rain) (Clemmens and Molden, 2007). For the use of the analysis of an irrigation network individually with the aim of increasing the output/productivity of the network, the use of the parameter of the amount of water as supplied water is expected to be more appropriate (Clemmens and Molden, 2007).

Efficiency of water use is absolutely necessary in an effort to increase the economic value of irrigation water. Therefore, one strategy that can be done is to obtain the value of land productivity and product yields (commodity products) per unit area of land into water productivity, namely the yield per unit volume of water used, which can be calculated by the equation (Poerwanto and Susila, 2014):

WP = GY / W
With :
WP = Water productivity (kg/m3)
GY = yield (kg/ha)
W = irrigation water (m3/ha)

RESEARCH METHEODS

The research will be carried out at the Lampung State Polytechnic's plastic house from June to October 2022.

Materials and tools. The materials used in this study were caisim plants, NPK fertilizer, urea, polybags, husk charcoal, cocopeat and sand and soil. The tools used in this research are water pumps, nutrient tanks, drip irrigation pipelines, buckets, pest sprays, and others.

Research design. This study is a factorial experiment with a randomized block design. The first factor is the type of planting media with four levels, namely coco peat, husk charcoal, sand, and soil. The second factor is the size of polybags with three levels, namely small polybags (size 30 cm x 15 cm), medium size (35 cm x 20 cm), and large size (size 40 cm x 25 cm). Each treatment combination was repeated 3 times. The observed variables included plant growth and production, total water use, and water productivity. Data analysis using ANOVA at the 5% significant difference test level.

Preparation of planting media and nurseries. Preparation of planting media includes filling of husk charcoal, sand, cocopeat, and soil into polybags. The nursery media uses organic fertilizer from rice straw which is inserted into the seedling tray. Caisim seeds are sown in trays of 3 seeds per hole in the tray that already contains the seedling media. Caisim seedlings that had grown in trays were maintained for 12 days using NPK pearl fertilizer with a nutrient concentration of 400 ppm.

Planting. Seedlings that are ready for planting on the tray are planted directly into polybags that have been filled with planting media. One polybag planted two caisim seeds with uniform growth. The layout of the polybag is in accordance with the treatment plan. Each polybag is installed with one drip irrigation emitter.

Fertilization and pest and disease control. The fertilizer used was blue pearl NPK dissolved in water with a concentration of 400 ppm for the maintenance of seedlings, a concentration of 800 ppm for caisim plants that had been planted in polybags for up to 14 days, and a concentration of 1,000 ppm for plant ages 15 days after planting until harvest. Every weekend the caisim plants were given a nutrient solution of urea

fertilizer with a concentration of 800 ppm for the end of the first and second weeks. At the end of the 3 th, 4 th and 5th weeks the plants were given a nutrient solution of urea fertilizer with a concentration of 1,000 ppm. Pest control is carried out in case of pest attack using decis at a dose of 2 ml per liter of water.

Irrigation . Irrigation application with nutrient solution is done by drip irrigation system. Irrigation application was carried out 3 times a day, namely at 07.00—08.00, 11.00-12.00, and 16.00-17.00. Volume by giving water (nutrient solution) 400 ml/day/polybag plant age 1-26 days after planting (DAP) and 600 ml/day/polybag at age 27 DAP until harvest.

Harvest. Harvest data were taken from the entire population of the research plant. Harvesting is done in the morning. Harvesting is done manually by removing the caisim from the planting medium, then removing the roots and weighing the fresh caisim stems and leaves.

RESYLTS AND DISCUSSION

Number of leaves. The average number of caisim leaves in the 4th week before harvest for each treatment can be seen in Table 1.

Table 1 . The average number of caisim leaves at week 4.

Factor A					
	Factor B	**Block (K)**			**Average**
Growing media	**Polybag size**	**1**	**2**	**3**	
Coco Peat	Small	11,0	8,5	8,5	9,3
	Medium	10,5	8,5	10,8	9,9
	Big	9,8	10,3	10,3	10,1
	Average				**9,8 a**
Husk Charcoal	Small	9,8	8,0	10,5	9,4
	Medium	7,5	8,5	5,8	7,3
	Big	6,5	6,8	7,5	6,9
	Average				**7,9 b**
Sand	Small	8,0	6,3	7,8	7,3
	Medium	9,3	6,5	8,8	8,2
	Big	10,3	8,0	9,0	9,1
	Average				**8,2 ab**
Soil	Small	9,5	7,8	11,0	9,4
	Medium	10,5	7,5	12,5	10,2
	Big	9,5	8,8	10,0	9,4
	Average				**9,7 ab**

Description: Size of small polybag 30 cm x 15 cm, Size of medium polybag 35 cm x 20 cm, Size of big polybag 40 cm x 25 cm

The results of the analysis of variance on the number of leaves at weeks 1, 2, 3 and 4 showed that there was no interaction between treatments, as well as between polybag sizes not significantly different ($P > 0.05$), but significantly different between treatments type of planting media ($P < 0.05$). The average number of leaves in the treatment of cocopeat, sand, and soil planting media was not significantly different but significantly different when compared to rice husk charcoal growing media (Table 1). The low number of caisim leaves in the rice husk charcoal planting media can be caused by the lower air supply in the growing media because the husk charcoal has turned into a lot of dust so that the husk charcoal particles easily condense when given a nutrient solution and push some of the air out of the media. The average number of

caisim leaves on husk charcoal growing media was 7.9 leaves lower than that of cocopeat, sand, and soil, which was 8.2-9.8 leaves per plant.

Plant height. The average height of caisim plants in the 4th week before harvest for each treatment can be seen in Table 2.

Table 2. The average height of caisim (cm) for each treatment at week 4.

Factor A					
	Factor B	**Block (K)**			**Average**
Growing media	**Polybag size**	**1**	**2**	**3**	
Coco Peat	Small	33,5	28,5	37,8	33,2
	Medium	33,3	36,0	31,3	33,5
	Big	36,0	37,0	36,0	36,3
	Average				**34,4 a**
Husk Charcoal	Small	26,9	33,3	29,3	29,8
	Medium	29,3	28,2	21,7	26,4
	Big	23,8	21,1	23,3	22,8
	Average				**26,3 b**
Sand	Small	27,9	20,6	25,4	24,6
	Medium	31,4	25,3	29,3	28,7
	Big	28,5	32,6	27,4	29,5
	Average				**27,6 b**
Soil	Small	32,5	29,3	37,6	33,1
	Medium	31,5	34,6	33,4	33,2
	Big	37,5	33,4	36,7	35,8
	Average				**34,0 a**

Description: Size of small polybag 30 cm x 15 cm, Size of medium polybag 35 cm x 20 cm, Size of big polybag 40 cm x 25 cm

The results of analysis of variance on caisim plant height at weeks 1, 2, 3 and 4 showed no interaction between treatments, as well as between polybag sizes were not significantly different ($P > 0.05$), but significantly different between types of planting media ($P < 0.05$). The average height of caisim plants in the treatment of cocopeat growing media and soil was not significantly different but significantly different when compared to rice husk charcoal and sand growing media. The average plant height of caisim on coco peat and soil planting media ranged from 34.0-34.4 cm per plant, which was higher than that of husk charcoal and sand, which was 26.3-27.6 cm per plant. This is in accordance with research conducted by Milda et al. showing that rice husk charcoal growing media produced lower plant growth and yields compared to moss and cocopeat growing media (Jupry and Kurnia, 2020). The higher caisim plants in cocopeat and soil planting media could be caused by the ability to store nutrients better when compared to rice husk and sand charcoal growing media. The advantage of cocopeat is that it is a light planting medium, can store up to 73% water, and can store sufficient nutrients so that plants will not lack water and nutrients (Sumarna, 1998).

Caisim production. The average production of caisim plants (stems and fresh leaves) for each treatment can be seen in Table 3.

The results of analysis of variance on caisim production (stem and fresh leaves) showed no interaction between treatments, as well as between polybag sizes not significantly different ($P > 0.05$), but significantly different between types of planting media ($P < 0.05$). The average production of caisim plants on soil soil media treatment was not significantly different from the treatment of coco peat growing media, however, it was significantly different when compared to rice husk and sand charcoal growing media. The average yield

of caisim plants on soil planting media was 112.5 g/plant, which was higher than that of husk charcoal and sand, which was 71.1-76.6 g/plant, but not significantly different from cocopeat growing media which was 97.1 g/plant. The higher caisim plants in soil planting media could be caused by the ability to store nutrients better when compared to husk charcoal and sand growing media.

Table 3. Average production of caisim (g/plant) for each treatment.

Factor A					
	Factor B	**Block (K)**			**Average**
Growing media	**Polybag size**	**1**	**2**	**3**	
Coco Peat	Small	102,1	71,6	83,7	85,8
	Medium	104,5	98,2	96,7	99,8
	Big	81,5	106,5	129,5	105,8
	Rata-rata				**97,1 ab**
Husk Charcoal	Small	70,30	64,20	57,90	64,1
	Medium	79,50	62,50	65,50	69,2
	Big	99,50	96,70	93,10	96,4
	Rata-rata				**76,6 b**
Sand	Small	58,58	62,15	82,05	67,6
	Medium	76,52	70,52	88,70	78,6
	Big	71,32	78,42	51,65	67,1
	Rata-rata				**71,1 b**
Soil	Small	99,7	97,4	136,7	111,3
	Medium	96,4	110,2	96,3	101,0
	Big	136,7	149,7	89,5	125,3
	Rata-rata				**112,5 a**

Description: Size of small polybag 30 cm x 15 cm, Size of medium polybag 35 cm x 20 cm, Size of big polybag 40 cm x 25 cm

Water productivity. The average water productivity of caisim plants for each treatment can be seen in Table 4. The average amount of water usage (nutrients) during 34 days of maintenance is the same in all treatments, that is 15.72 liters per polybag.

Table 4. Average water productivity of caisim (kg/m^3) for each treatment.

Factor A					
	Factor B	**Block (K)**			**Average**
Growing media	**Polybag size**	**1**	**2**	**3**	
Coco Peat	Small	6,495	4,555	5,324	5,458
	Medium	6,648	6,247	6,151	6,349
	Big	5,184	6,775	8,238	6,732
	Average				**6,180 ab**
Husk Charcoal	Small	4,472	4,084	3,683	4,080
	Medium	5,057	3,976	4,167	4,400
	Big	6,330	6,151	5,922	6,134
	Average				**4,871 b**
Sand	Small	3,726	3,954	5,219	4,300
	Medium	4,867	4,486	5,642	4,999

	Big	4,537	4,988	3,286	4,270
	Average				**4,523 b**
Soil	Small	6,342	6,196	8,696	7,078
	Medium	6,132	7,010	6,126	6,423
	Big	8,696	9,523	5,693	7,971
	Average				**7,157 a**

Description: Size of small polybag 30 cm x 15 cm. Size of medium polybag 35 cm x 20 cm, Size of big polybag 40 cm x 25 cm

CONCLUSION

Bahzar, M.H.. and Santoso, M. (2018) 'The effect of nutrition and planting media on the growth and yield of Pakcoy (Brassica rapa L.var. chinensis) plants with the axis hydroponic system', *Journal of Crop Production*, 6(7).

Charitsabita, R.., Purbajanti;, E.D. and Widjajanto;, D.W. (2019) 'Growth Response and Yield of Pakcoy (Brassica rapa L.) Hydroponically with Different Types of Planting Media and Different Aeration', *Journal of Tropical Agriculture*, 6(2), pp. 270–278.

Clemmens, A.J.. and Molden;, D.J. (2007) 'Water uses and productivity of irrigation systems. Irrigation Sicence', in *Irrigation Sicence*, pp. 247–261.

Ginanjar, M., Rahayu;, A. and Tobing;, O.L. (2021) 'Growth and Production of Kailan (Brassica Oleracea Var. Alboglabra) Plants On Various Growing Media And Ab Mix Nutrient Concentrations With Substrate Hydroponic Systems', *Journal of Agronida*, 7(2).

Hartono, E.., Idrus;, M. and Raharjo;, I. (2015) 'The effect of the frequency of irrigation water on the productivity of hydroponic Caisim water using roasted husk media', *Scientific Journal of Agricultural Engineering*, 7(1).

Jehangis;, W.A., Turral;, H. and Masih;, I. (2004) 'Water productivity of rice crop in irrigated areas', in *Proceedings of the 4th International Crop science Congress*. Brisbane - Australia.

Jupry, R.. and Kurnia;, T.D. (2020) 'Growth and Yield of Green Mustard Plants in Hydroponic Floating Raft System on Concentration of Liquid Organic Fertilizer from Tofu Dregs Waste', *Journal of Agros Agriculture*, 22(1), pp. 61 – 70.

Milda, N.., Djukri;, A. and Suryadarma;, I.G.P. (2017) 'Effect of mosses (Bryophyta) as a composition of planting media on the growth and production of mustard greens (Brassica juncea L.)', *J. Perodi Biology*, 6(2), pp. 1 – 13.

Poerwanto, R.. and Susila, A.D.. (2014) *Series 1 Tropical Horticulture, Horticultural Technology*. Bogor.

Rakhman, A.. *et al.* (2015) 'Growth of Mustard Plants Using Hydroponic And Aquaponic Systems', *Journal of Agricultural Engineering Lampung*, 4(4), pp. 245–254.

Sumarna, A.. (1998) *Drip Irrigation in Chili Cultivation*. Vegetable Crops Research Institute, Horticulture Research and Development Center, Agricultural Research and Development Agency.

Umar, U.F., Akhmadi;, Y.N. and Sanyoto; (2016) *Good at Hydroponic Planting for Beginners*. Jakarta: Agromedia Pustaka.

Yanto, H.., Tusi;, A. and Triyono;, S. (2014) 'Application of Drip Irrigation System on Cauliflower (Brassica Oleracea Var. Botrytis L. Subvar. Cauliflora Dc) In Greenhouse', *Journal of Agricultural Engineering Lampung*, 3(2), pp. 141–154.