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The Effects of Various Planting Media and Organic Fertilizers on the Growth and Yield of Purslane (Portulaca Oleracea L.)

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Abstract: Purslane has many benefits as food or raw material for medicine. It is rich in beneficial compounds, such as omega-3 and vitamins. However, it has not been cultivated yet. Organic input in cultivation is essential to ensure food safety for humans. Using organic inputs can avoid the yield from chemical and biological contaminants that can threaten health. Thus, the source of growing media and fertilizer must be considered. Because the use of synthetic chemicals has residues that are harmful to the environment and human health. This research sought to identify the best combination of growing media and organic fertilizer to increase purslane yield. The experiment was conducted with a randomized block design with 2 factors and 3 replications. Organic fertilizers (guano, cow urine, and rabbit urine) and planting media (soil, soil + husk charcoal, soil + compost, and soil + husk charcoal) were the treatments assessed. The observation variables were planting media analysis, the number of leaves and branches, growth diameter, and fresh weight. The results show that the planting medium and organic fertilizer did not significantly affect the measured growth parameters. The single variable of organic fertilizer made a difference in growth diameter and fresh weight. Rabbit urine produced in the highest growth diameter, and guano produced in the highest fresh weight The single variable of organic fertilizer made a difference in growth diameter and fresh weight. Rabbit urine produced in the highest growth diameter, and guano produced in the highest fresh weight The single variable of organic fertilizer made a difference in growth diameter and fresh weight. Rabbit urine produced in the highest growth diameter, and guano produced in the highest fresh weight

Keywords: Organic fertilizers; Organic media; Portulaca; Purslane

Introduction

Purslane is an annual weed that can grow in many locations. The plants that are called "purslane" encompass several species, including Portulaca oleracea, Portulaca grandiflora, Portulaca quadrifida, and others. Because it is widespread, purslane has been used for various purposes. In Indonesia, purslane is consumed as a side dish. It has been applied in traditional medicine because it has many benefits. According to various studies, purslane has useful chemical compounds and pharmacological properties.

The compound oleracone, an alkaloid found in purslane, has an anti-inflammatory effect (Srivastava et al., 2021). Portulaca oleracea has medical and pharmacological properties that suggest it could be used as an antidiabetic, anti-obesity, anti-inflammatory, and anticancer drug (Almashad et al., 2020).

Purslane has not been cultivated intensively. The goal of purslane cultivation is to provide important raw materials to improve the nutritional quality of food and medicines. Increasing the biomass created entails cultivation management. The use of a suitable planting medium will support growth and allow the sustainable cultivation of purslane. The planting medium provides

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space for root growth and provides the plant with a variety of nutrients and water. A planting medium that is easy to obtain and environmentally friendly is necessary to support sustainable agriculture and guarantee consumers' safety in the future. The ideal planting medium would be derived from organic materials that support purslane growth.

Furthermore, the ideal planting medium has a loose texture and supports good aeration (Bachtiar et al., 2018). Compost, manure, and husk can be used as planting media (Annisa et al., 2016). Fertile soil has a large carrying capacity for plant growth and productivity. Compost is organic material that remains after plants, animals, and organic waste have undergone decomposition. Charcoal husk has good porosity, allowing it to absorb and store nutrients (Agustin et al., 2014).

To increase growth, additional nutrients are needed, especially to increase cell growth. To do so, fertilizer is given to support purslane's growth and harvest weight. Organic fertilizers were chosen to ensure the supply of organic raw materials for safer food and medicines.

The main nutrients that plants need are nitrogen, phosphorus and potassium. These three nutrients play an important role in the process of plant growth (Puspadewi et al., 2016). A combination of optimized planting medium and organic fertilizer will offer better growth results than cultivation without administered organic matter (Augustien et al., 2016). Guano is an organic fertilizer that comes from deposits of bat droppings that have been mixed with decomposition bacteria and soil in caves. Guano fertilizer, compared to artificial phosphorus fertilizer, does not contain residue (Asfar et al., 2020). The advantages of cow urine include its higher nutrient content than cow feces. Rabbit urine has a relatively high nutrient content compared to other livestock urine (Azizah, 2017).

This research sought to find the best combination of growing medium and organic fertilizer to increase purslane growth. The most suitable combination presents an opportunity for mass purslane cultivation.

Method

This study was conducted in the experimental garden of the Faculty of Agriculture, UPN "Veteran" East Java, Surabaya, Indonesia in 2022. This study aims to identify the best combination of growing media and organic fertilizers to increase purslane growth and yield. The experiment used a randomized block design. The treatment consists of 2 factors; planting medium (soil, soil + husk charcoal, soil + compost, and soil + husk charcoal) and organic fertilizers (guano, cow urine, and rabbit urine). Each treatment was replicated 3 times, and there were 36 unit observations. The planting polybags were 30 cm x 30 cm. The guano fertilizer was applied by sowing it on the planting medium at a predetermined dose of 6 g/polybag. Cow urine and rabbit urine were applied at a rate of 6 ml/polybag. Fertilizer was applied from 3–5 pm.

Planting material was derived from stem cuttings. The cuttings used were healthy seedlings that were 10 cm in height. The selected cuttings were ready to be transferred to polybags containing the analyzed planting media according to the selected treatments. Seedlings were transferred in the afternoon or when the sky was overcast. Each polybag was planted with three cuttings, and the polybags were arranged at a spacing of 40 cm x 40 cm.

Planting media analyzes were performed with the appropriate methods. Soil texture was measured with the pipette method; pH, potentiometry; N-total, the Kjeldahl method; C-organic, W. Black-Spectro; P-available, the Olsen method; K-interchange, Ca-interchange, and Mg-interchange, AAS incineration. The observation growth parameters were the number of leaves, number of branches, growth diameter, and fresh weight of purslane. All of these parameters were observed 3 months after planting. The collected data were analyzed with SPSS IBM Statistics 27 software. An analysis of variance (ANOVA) and Tukey's wholly significant difference (WSD) test at 5% were applied.

Result and Discussion

The planting media had different characteristics. Purslane can adapt to a wide range of environments, but a suitable planting medium for maximum growth and yield must be selected for cultivation. Both soil and mixtures of planting media have variable physical and chemical characteristics (Table 1).

All planting media had a dusty clay texture; soil texture is important because it determines how quickly water drains through. This texture is dominant in the media with the stated dust fractions and affects the infiltration rate of the planting media.

If clay dominates the soil composition, the soil pores will become tight, limiting water infiltration (Delima et al., 2018). However, clay has a large specific surface area, allowing the soil to hold water (Delima et al., 2018). Purslane has a large range of soil conditions and only required minimal water.

Chemical analysis showed that all of the planting media have pH values between 6.2 and 7.3, their N-total is low to medium, C-organic is low to very high, P-available is very high, K-interchange is very high, Ca-interchange is high to very high, Mg-interchange is very

high, and C/N ratio is low to very high. The planting medium supports and provides the necessary chemicals for plant growth. Differences in the physical and chemical character of planting media will affect the growth and yield of purslane. Purslane grows better with high nutrient levels; therefore, the addition of organic fertilizer will support its growth in cultivation.

Purslane is well-adapted to various environments. This characteristic gives purslane competitiveness over many other cultivated crops (Yadegari, 2018; Yazici et al., 2007). Purslane is also well-adapted to minimal water and poor soil during germination and emergence (Gonnella et al., 2010). Purslane is well adapted to poor soils, requiring a minimum amount of water during germination and emergence. Purslane is well adapted to poor soils, requiring a minimum amount of water during germination and emergence Purslane is well adapted to poor soils, requiring a minimum amount of water during germination and emergence.

Table 1.The Analysis of the Planting Media

Parameters	M1 (Soil)	M2 (Soil + Husk Charcoal)	M3 (Soil + Compost)	M4 (Soil + Husk Charcoal)
Textures	Dusty clay	Dusty clay	Dusty clay	Dusty clay
▪ sand	23	28	24	17
▪ Dust	65	52	61	67
▪ Clay	12	20	15	16
pH	6.5	7.3	7.1	6.2
N-total	0.07 (very low)	0.08 (very low)	0.37 (medium)	0.33 (medium)
C-organic	1.1 (low)	9.4 (very high)	9.7 (very high)	2.0 (medium)
P-available	56 (very high)	166 (very high)	202 (very high)	185 (very high)
K-interchange	1.20 (very high)	2.36 (very high)	2.03 (very high)	3.07 (very high)
Ca-interchange	20.36 (very high)	39.94 (very high)	35.04 (very high)	13.96 (high)
Mg-interchange	14.86 (very high)	14.1 (very high)	23.43 (very high)	12.99 (very high)
C/N ratio	15.71 (high)	117.50 (very high)	26.22 (very high)	6.06 (low)

Table 2. The Number of Leaves, Number of Branches, Growth Diameter, and Fresh Weight of Purslane

Treatments	Number of Leaves	Number of Branches	Growth Dia (cm^2)	Fresh Weight (g)
		-----Planting Media-----		
M1	142.89a	8.22a	10:07 p.m	13.28 a.m
M2	121.00 a.m	8.22a	16.84 a	8.13 a
M3	142.89a	9.11a	11:36 p.m	13.86a
M4	141.00 a.m	9.33a	20.08 a.m	11.80 a.m
		----Organic Fertilizer----		
P1	165.67a	9.33a	16.68 a	16.20 b
P2	134.25a	9.00 a.m	20.95 a.m	10.21a
P3	110.92a	7.83 a	24.15 b	8.89a

Note: Numbers in the same column followed by the same letter showed no significant difference in the 5% Tukey's b

The single effect of planting medium shows that this factor had no significant effect on purslane growth parameters (Table 2). This indicates that all growing media are suitable for purslane growth. The media used were organic, so they did not leave residue in the environment. The planting medium used can support growth; the mixture of soil and compost resulted in the highest growth, measured as the number of leaves, growth diameter, and fresh weight.

Compost is as additional organic matter to improve soil quality, such as physical, chemical and biological properties. Using compost can reduce the use of chemical fertilizers. Compost also improves soil structure, water infiltration rate, and water holding capacity (Jayasanka et al., 2016; Widowati et al., 2022).

The different treatments of organic fertilizer had no significant effect on the number of leaves and branches. However, the fertilizers did have different effects on the growth diameter and fresh weight of purslane (Table 2). The rabbit urine treatment resultedin the largest growth diameter. Purslane grows horizontally and spreads above the ground. The greater its diameter, the further the purslane has grown.

Rabbit urine can be used as a liquid organic fertilizer because it contains more nitrogen, phosphorus, and potassium than solid cow dung (Kristanto et al., 2019). Nitrogen plays an important role in chlorophyll and auxin formation. Nitrogen is also crucial for protein building and will increase plant growth. Cells will divide, differentiate, and become more numerous (Anastasia et al., 2014; Hartini et al., 2019).

The fresh weight of the plant was measured just after harvest when the water and mineral content were at their highest. The plants that were given guano fertilizer showed the highest fresh weight. They have the highest number of leaves and branches, but not the greatest growth diameter. An increase in the number of plant organs results in a high fresh weight because plant organs are the result of cell addition and enlargement. The bat droppings that form guano have a high nutrient content and the potential to support plant growth. The nitrogen content of guano is much higher than that of manure, agricultural waste, or municipal waste (Suwarno et al., 2007). Guano is also rich in carbon, vital minerals and beneficial microbes. Soil fertility increases due to its chemical properties and microbial load. Soil texture and microbes can reduce toxins and control fungi and soil nematodes. The beneficial properties of guano depend on the bat species, location, and age of the guano (Bhat et al., 1990; Sharma et al., 2013).

Conclusion

The combination of planting media and organic fertilizer did not significantly affect growth parameters. The single variable of organic fertilizer made a difference in growth diameter and fresh weight. Rabbit urine resulted in the highest growth diameter and guano resulted in the highest fresh weight. The results suggest that purslane cultivation can benefit from a mix of soil and compost, fertilized with guano. Further research should investigate the optimal dosage of guano fertilizer to achieve optimal purslane growth.

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Author Contributions
Conceptualization: F. Deru Dewanti; Methodology: Ahmad Yunus; software: Puji Lestari Tarigan; validation: Sukendah and F. Deru Dewanti; formal analysis: Praise Lestari Tarigan; investigation: F. Deru Dewanti; resources: F. Deru Dewanti; data curation: F. Deru Dewanti; writing—original draft preparation: Praise Lestari Tarigan; writing—review and editing: Puji Lestari Tarigan; visualization: Sukendah; supervision: Ahmad Yunus; project administration: F. Deru Dewanti; funding acquisition: F. Deru Dewanti. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interests
There is no conflict of interest in conducting the research and publishing the manuscript. Copyright on behalf of the author.

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