TIK-253 The Effect of Organic Materials on the Acidity and Organic Carbon for Floating Media in Lebak Swampland

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The Effect of Organic Materials on the Acidity and Organic Carbon for Floating Media in *Lebak* Swampland

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Abstract. The potential of floating cultivation in *lebak* swampland, particularly during flood periods, is underscored by this study. Composted aquatic weeds, a rich source of organic matter, are a key component of this potential. The study measures the nutrient content in the compost and chicken manure and analyzes the effect of both on the nutrient content in floating systems. The compost and chicken manure, with their slightly acidic pH and very high organic-C content, hold significant promise. The best-growing medium, a blend of compost (375 g) and chicken manure (375 g), demonstrates optimal pH and organic-C content. Soil treatment (500 g) and compost (250 g) show the most significant effect on eggplant plant height, while the best yield is obtained from the treatment of compost (375 g) and chicken manure (375 g).

Keywords. floating plants, organic materials, pH, organic-C, swampland

1. Introduction

With its vast expanse of 208,893 hectares of lowland, including an additional 110,452 ha recently opened as agricultural land (Mahbub & Mariana, 2019), South Kalimantan is a region of immense agricultural potential. The Lebak swamp, also known as wetland, lowland, peatland, inland, and deepwater land, is a unique ecosystem that remains wet throughout the year, with an average rainfall of 2,000 mm per year and a period of up to six wet months (Haryono et al., 2013). This study delves into the potential of this ecosystem for floating cultivation, offering valuable insights for researchers and practitioners.

In Indonesia, *lebak* has an area of 13.28 million ha, but only around 580 thousand ha, or around 5%, is used for agriculture and other activities (Wulandari, 2023). Most *lebak* swamp land is still not utilized optimally because it is often flooded during the rainy season, which can last up to six months. Due to the flood, there was almost no agricultural activity during that period. The risk of losing crops due to flooding severely threatens small farmers working on lowland swamp land (Siaga et al., 2016).

Lebak swampland is divided into three based on the length of inundation and water level, including shallow lowland areas with inundation time of less than three months with inundation

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height <50 cm, middle lowland areas with inundation time <6 months with inundation height of 50-100 cm, while deep swampland has a water level >100 cm with a period more than six months (Pujiharti, 2017). *Lebak* soil has the following nutrient content: moderate total-N content, around 0.33%, low P_2O_5 content, around 11.3 mL 100 g^{-1}, moderate K content, around 0.20 mL 100 g^{-1} and organic-C 10.8% (Syahbuddin, 2011). Mineral-type wetlands originating from river sediments have good potential for cultivating food crops. However, soil derived from marine deposits often contains high levels of pyrite (FeS_2), potentially detrimental to plants. Pyrite is also found in the mining area that generates acid mine drainage as wastewater (Noor et al., 2023; Saidy et al., 2024). Therefore, it is necessary to ameliorate the land and apply fertilizer appropriately so plants can grow well and provide optimal results (Djafar, 2012).

Lebak swamps have varying durations of standing water depending on the typology. The deep one usually floods throughout the year, from October to July; the middle usually floods from November to June, and the shallow one usually floods from November to April. These typological conditions force local farmers to adapt their methods of cultivating adaptive commodities in that environment. Local farmers still use conventional methods in rice cultivation (Herlinda, 2019). Farmers face difficulties determining an accurate time to start rice cultivation, especially at the seedling stage. In contrast, available seeds and the age of the seedlings are crucial factors in the process. In the face of difficulties in cultivating rice plants in lowland swampland still submerged in water, farmers overcome this problem by starting cultivation early using the floating seedbed method (Siaga et al., 2016).

Floating farming is planting media on the water's surface using floating materials such as bamboo as a base. The main advantage is that it does not require land modifications such as drainage and manual watering because water is available directly to plants through the planting medium. This keeps plants consistently hydrated and prevents stress from lack of water (Bernas et al., 2019). This system is also an adaptation strategy to annual flooding and the use of stagnant swampland, turning unproductive land into valuable resources and providing new knowledge to farmers. Another main advantage is saving water, reducing the need for manual watering, and optimizing farmers' energy and time (Hasbi et al., 2018).

Floating rice cultivation is a local practice conducted by farmers in the *Lebak* swamp before rice cultivation began after the flood period. In contrast, vegetable cultivation, in addition, is only conducted in rice fields with an area that is manageable and may even be waterlogged if rainfall is high (Irmawati et al., 2021). Farmers in Nazirpur, Pirojpurdi, Bangladesh, use a floating farming system with rafts lined with water hyacinth plants. This raft measures 54 m long, 1.2 m wide, and 0.6 m thick. Common vegetables include beans, eggplant, beets, pumpkin, peppers, and tomatoes. This method is considered very profitable because it does not require watering the plants and can reduce the intensity of fertilization (Hasbi et al., 2018).

Floating farms in Central Kalimantan use *ambul* media of bamboo constructions measuring 10 x 6 m tied to float on the water's surface. The middle of the *ambul* is equipped with a wooden box as a container to hold planting media such as water hyacinth, *kiambang*, and *purun* grass so that they do not fall to the bottom of the swamp. *Ambul* is filled with aquatic plants and stacked in a box until they are complete and solid. Plants are placed about 20 cm high on floating bamboo to prevent plant roots from rotting when submerged in water (Chotimah et al., 2014).

Farmers are strongly encouraged to use swamp weeds as raw material for organic fertilizer because they can reduce chemical fertilizers and production costs. Several types of swamp weeds such as water hyacinth, *kiambang*, *kayuapu*, and *purun* grass contain high levels of nutrients, making them suitable for making organic fertilizer (Mulyawan & Apriani, 2023; Noor et al., 2024). Water mimosa (*supan-supan*) is a local vegetation abundant in the research location and used as a planting medium or a medium for placing treatments in this research.

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Compost is a completely decomposed aquatic plant that can be used as a source of organic material for cultivation. Manure is a source of organic material that can provide nutrients plants use for growth and development. One of the treatments used in the research was the use of chicken manure that may contain N is 25 kg ton^{-1}, K is 10 kg ton^{-1}, P is 11 kg ton^{-1}, Ca is 36 kg ton^{-1} and Mg 6 kg ton^{-1} (Suwahyono, 2014). This nutrient content provides optimal support for plant growth and development. Based on the description above, research is needed regarding the effect of applying compost and chicken manure to determine the best type of organic material input on pH and organic-C concentrations that can be used in floating farming systems.

2. Materials and Methods

The research was conducted in the *lebak* swampland in South Daha District, Hulu Sungai Selatan Regency in South Kalimantan Province. The acidity (pH) and organic-C were observed at the Soil Department, Faculty of Agriculture, Lambung Mangkurat University in Banjarbaru, South Kalimantan. The research used a one-factor in Completely Randomized Design (CRD) with the following four treatments and three replications:

A1 = Control (Soil 750 g)
A2 = Soil (500 g) + Compost (250 g)
A3 = Soil (500 g) + Chicken manure (250 g)
A4 = Compost (375 g) + Chicken manure (375 g)

The media preparation was as follows:

a. Rafting Construction

Prepare six bamboo sticks with a length of 8 m and cut them in half to get 12 pieces of bamboo with a length of 4 m. Arrange the bamboo in a row with the top and bottom alternating and tie the bamboo using rubber tires to form a floating raft.

b. Planting Media Construction

Cut the water mimosa stem as needed, then roll it inwards so that the root part is on top until it reaches a thickness of 15 cm as the first layer. Prepare a polybag with the bottom cut out to place the planting medium and a place for growing eggplant plants. Fill it with soil and organic material according to the type and weight that has been determined. Leave the polybag filled with soil for a week.

c. The Eggplant Planting

Prepare the purple eggplant seedlings of the Antaboga variety 21 days after sowing with four leaves, ± 7.5 cm high, and free from pests and diseases. The eggplant seeds in polybags contain planting media that has been incubated for a week. The distance between polybags was 40 x 50 cm. After planting, compact the planting medium, measure the initial height of the plant, and take height measurements every week until harvest. Harvesting occurred when 50% of each experimental plot was ready, namely after 45-50 days. Eggplant fruit was harvested using clean and sharp scissors. Soil samples were taken at the beginning before treatment, after the treatment incubation period, and after the first harvest to measure soil pH and organic-C.

d. Data Analysis

Analysis of observational data on plant height and yield using the Bartlett variety for homogeneity, followed by analysis of variance. If there is a fundamental difference between treatments, continue with the DMRT (Duncan's Multiple Range Test) method with a confidence level of 95%.

3. Results and Discussion

Results from laboratory analysis of the organic material (compost) show that the pH content of H2O in compost was 3.63, with slight acid criteria; the organic-C content was 9.29%, with extremely high criteria, as mentioned in Table 1.

Table 1. Results of compost laboratory analysis

No	Nutrient Content	Result	Criteria
1	pH H_2O	5.63	slight acid
2	Organic-C(%)	9.29	very high

Results from laboratory analysis of the chicken manure showed that the pH of H2O was 5.8, with slightly acidic criteria, and the organic-C content was 5.77%, with very high criteria, as mentioned in Table 2.

Table 2. Results of laboratory analysis of chicken manure

No	Nutrient Content	Result	Criteria
1	pH H_2O	5.8	slight acid
2	Organic-C (%)	5.77	very high

The results of statistical tests on the degree of acidity of the planting medium (pH) for each treatment given, as mentioned in Figure 1, show that the control treatment has a pH value of 4.64, significantly different from the other three treatments. The soil treatment (500 g) and invitation compost (250 g) showed a pH value of 5.25, a higher pH value than the control. The highest pH value in the treatment of invitation compost (375 g) and manure (375 g) was 6.49. The different superscript values for each treatment indicate that the treatments given have significantly different effects on increasing the soil pH value.

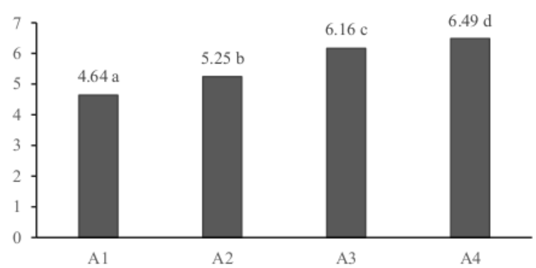

Figure 1. pH observation data in planting media. A1 = control, A2 = 500 g of soil + 250 g of compost, A3 = 500 g of soil + 250 g chicken manure, A4 = 375 g compost + 375 g chicken manure..

The results of the mean value test on the effect of giving each treatment on increasing the C-organic value in the soil media (Figure 2) show that the control treatment had an organic-C value of 7.50%, which was not significantly different from the soil treatment (500 g) and manure (250 g) which has a value of 7.79%, this is proven by the same superscript letter in these two treatments. These two treatments were significantly different from the other two treatments, namely the soil treatment (500 g) and invitation compost (250 g), which had an organic carbon value of 11.94%, and the invitation treatment (375 g) and manure (375 g) which had C-organic value was 17.13%.

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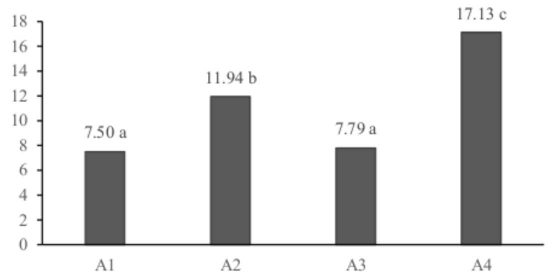

Figure 2. Organic-C observation data in planting media. A1 = control, A2 = 500 g of soil + 250 g of compost, A3 = 500 g of soil + 250 g chicken manure, A4 = 375 g compost + 375 g chicken manure.

The potential of lowland swampland that is not yet optimal is swamp grass such as *purun* grass (*Menyanthes trifoliata)*, daffodil grass (*Fimbristylis vahlii*), and *kumpai* grass (H*ymenachne amplexicaulis*) which are abundant throughout the year and can be used as organic fertilizer. Organic fertilizer from marsh grass supports organic farming and reduces costs. Organic fertilizers provide macro and micronutrients, especially nitrogen, which plants absorb after decomposition. It is also a source of soil microorganisms' energy, increasing nutrient availability (Marlina & Syafrullah, 2014).

Providing organic materials from weathered swamp weeds and chicken manure affects pH and organic-C, as well as the growth and yield of eggplant in bamboo rafts. The nutrient content in organic materials improves the quality of the planting medium and eggplant growth. The nutrient content of invitation compost and chicken manure has a slightly acidic pH (5.6 and 5.8) and high organic-C (9.29% and 5.77%). Analysis showed that organic matter increased soil pH from 4.23 to 5.25 (compost), 6.16 (manure), and 6.49 (combination). This is in line with research conducted by Erma (2021), which found that the provision of compost and chicken manure could increase the soil's pH in lowland swampland.

Organic-C was very high in planting media with compost (11.94%) and in combination with manure (17.13%). Providing organic fertilizer increases soil fertility both physically, chemically, and biologically, as well as provides nutrients (Susetya, 2015). This was following other research which states that the content of organic matter (organic-C) in the soil reflects the quality of the soil, which directly or indirectly plays a role in the quality of the soil and the sustainability of agronomy because it influences physical, chemical and biological indicators of soil quality (Habibie, 2019; Shahbuddin, 2011).

The growth of the eggplant on the floating raft was excellent, especially with the compost, which produced a plant height of 72.98 cm in the seventh week. This was due to the excellent buoyancy of the raft and the nutrient content in compost, which meets the needs of the plants. The harvest yield with compost was 3,613 kg, and the combination with manure was 4,285 kg, indicating that using organic materials increased harvest yields following the nutrient requirements of the eggplant plants. This is thought to occur because the nutrient requirements for the growth of eggplant plants are met by providing organic materials in the planting media used (Susilawati et al., 2017). The use of swamp weed compost had better growth compared to soil without organic material.

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4. Conclusion

Compost and chicken manure had a slightly acidic pH and an extremely high organic-C content. The best pH and organic-C were found with compost and chicken manure in the planting medium. Soil treatment and compost had the best effect on the eggplant plant height, while the best harvest results were obtained from compost and chicken manure treatment.

5. Acknowledgment

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