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Study On The Utilization Of Waters sedimentary Soil And Water Hyacinth Biomass As A Medium For Sengon (*Paraserianthes falcataria*) Nurseries

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Abstract

Normalization of waters in urban areas produces waste in the form of sedimentary soil mud and water hyacinth plants. Normalization waste is usually piled up at the edge of the water which causes the environment to become slum and unhealthy. This study aims to examine the use of water sedimentary soil to replace garden soil as a planting medium for urban forest plants, and to determine the effect of the giving of water hyacinth biomass compost on urban forest growth. Factorial research with the treatment of the first factor is water/aquatic sedimentary soil, namely T1: garden soil as a comparison, T2: residential sewer sediment soil, T3: highway sewer sediment soil, T4: river sediment soil, and T5:reservoir sediment soil, while the second factor treatment is the amount of water hyacinth biomass compost, namely B0: 0% compost as control, B1: 5% compost, B2: 10% compost, B3: 15% compost, B4: 20% compost and B5: 25% compost. The experiment used a randomized block design repeated three times. The experimental unit was four polybags, each containing one sengon seedling, so that the total experiment was 360 polybags.

The results of the study showed that there was no interaction between the treatment factors of the water/aquatic sedimentary soil and the dose of water hyacinth biomass compost. In the treatment of water/aquatic sedimentary soils, there was a significant difference between the treatments, and sedimentary soils originating from the large sewer (highway sewer) were not significantly different from the comparison (garden soil) for all observation variables. The average value of plant height is 8,10 cm with a standard deviation of 2,34, the average value of the number of leaves amounted to 4,33 with a standard deviation of 0,84 and the average value of leaf canopy area equal to 748,14 with a standard deviation of 154,87. In the treatment of the dose of water hyacinth biomass compost, there was no significant difference between treatments for the variable of number of leaves, while for the variable of plant height and leaf canopy area there was a significant difference. The final conclusion from the research is that highway sewer sediment can replace garden soil by the giving of water hyacinth biomass compost equal to 5% as a medium for sengon seedling.

Keywords: waters sedimentary soil, water hyacinth biomass, sengon seedling

Introduction

Rapid population growth, urbanization and an increase in community activities have the potential to increase the amount of waste that enter the waters. Waste forms mud which will drive the sedimentation (Haryanta & Rejeki, 2021). In tropical countries, water hyacinth is considered a threat to aquatic biodiversity because weeds are highly reproductive and highly invasive to aquatic ecosystems. Likewise, the treatment and disposal of urban sewage sludge is risky to the environment and increasingly expensive (Rahman, Sultana, Mahmud, & Islam, 2017). Forest damage in the upstream area causes erosion, so that river water becomes cloudy carrying very soft soil particles. In addition, the problem that often occurs in urban areas is the amount of garbage and aquatic plants such as water hyacinth which causes the flow of water to almost stop. This causes the deposition of material carried by water, resulting in silting of rivers, ditches and reservoirs (Rahman et al., 2017).

Periodic removal of sediment from the bed of lakes, rivers, reservoirs and other waterways aims to facilitate flow and to slow down the silting process(Kazberuk, Szulc, & Rutkowska, 2021; Kiani, Raave, Simojoki, Tammeorg, & Tammeorg, 2021). The sewage sludge is rich in organic matter and nutrients which are indispensable for plant growth (Chu & Choi, 2000; Delibacak, Voronina, & Morachevskaya, 2020). Utilization of municipal sewage sludge mixed with ash can increase productivity (Antonkiewicz et al., 2020). The character of the water sedimentary mud soil in Surabaya is almost the same, namely for river sediment mud it contain N-total 0,11%, organic matter 6,30%, K_2O 1,05%, P_2O_5 2,15%, sand fraction 1,10%, dust fraction 5,68% and clay fraction 93,62%; reservoir sediment contains N-total 0,13%, organic matter 5,96%, K_2O 1,12%, P_2O_5 2,44%, sand fraction 1,22%, dust fraction 8,65% and clay fraction 90,13%; highway sewer deposits contain N-total 0,10%, organic matter 7,05%, K_2O 0,88%, P_2O_5 2,19%, sand fraction 1,38%, dust fraction 7,64% and clay fraction 90,98%; and residential sewer deposits containing N-total 0,12%, organic matter 6,10%, K_2O 1,09%, P_2O_5 2,08%, sand fraction 1,62%, dust fraction 6,82% and clay fraction 91,56% (Haryanta, Thohiron, &Gunawan, 2017). Sedimentation sludge waste in municipal wastewater is known to contain various heavy metals that need to be considered in its use as a medium for agricultural crops. Studies have shown that sewage sludge may contain heavy metals that are harmful to human and environmental health (Nzeve & Ikubano, 2021).

Water hyacinth poses serious problems for humanity and the environment, its growth and spread is so rapid that it is difficult to control. The forms of losses that result are blockage of waterways, disruption of

Water traffic, disruption of fishing activities, breeding grounds for pests and diseases, deterioration of water quality, and biodiversity loss (Ayanda, Ajayi, &Asuwaju, 2020). River hyacinth (Eichhorniacrassipes) in the water hastens silting and produces flooding (Sa'adah&Haryanta, 2016). The removal of aquatic sludge and water hyacinth biomass is a costly public burden. Water hyacinth can be transformed into an environmentally friendly organic fertilizer that can be blended with sedimentary soil sludge from municipal waste waters (John & Kakamega, 2016; Towett, Maingi, Ombori, & Mbuvi, 2020). (Rahman et al., 2017). Water hyacinth composting as an organic fertilizer has become one of the options to restoring soil fertility and a remedy to water hyacinth control in bodies of water (Beesigamukama et al., 2018; Kuke&Hunde, 2019; Sonter, Pattar, & Ramalingappa, 2018). Potassium 1,35 percent, calcium 1,85 percent, nitrogen 2,56 percent, phosphate 1,9 percent, C-organic 33,0 percent, magnesium 1,7 percent, and iron 0,70 percent are all found in water hyacinth biomass (Sanni & Adesina, 2012).

Sengon (*Paraserianthes falcataria*) plant, which belongs to the Fabaceae family, is one of the significant species in quickening land cover succession since it is a rapid growing plant. The quality of the wood can also be employed in the panel business and carpentry; additionally, the sengon plant can be used as a protective plant. The growth of sengon seeds on kuantan river sand media, estuary (muara) river sand media, and kuantan river sand + estuary (muara) river sand media had no effect on seed germination of sengon (*Paraserianthes falcataria*) (Julianda, Mardhiansyah, & Oktorini, 2017). Sengon nursery utilizing polybags offers greater outcomes than beds, however the government does not advocate it because the remaining polybags contaminate the environment (Zhang, Robinson, Lee, & Guan, 2021; Jabbar et al., 2010).

This study aims to determine the potential of aquatic/waters sedimentary soil and water hyacinth biomass as a planting medium in urban forest development using sengon seed indicators. The results of the study will be a reference for recommendations to reduce the use of garden soil and compost imported from outside the city and are encouraged to use aquatic sedimentary soil and water hyacinth biomass, which so far are harmful waste.

Research Method

Preparation of Experimental Materials

Sengon seeds are selected by selecting seeds that have clean skin, dark brown color, maximum seed size, immersed in water when the seeds are soaked and the shape of the seeds is still intact. The seeds needed in this study were 1080 seeds with 20% reserve seeds so that the number of seeds prepared amounted to 1300 seeds. Selected seeds are soaked in hot water (100^0C) for 30 minutes, then soaked in room temperature water for 12 hours. The seeds are drained and then ripened for 24 hours until the seeds appear radicels into sprouts that are ready to be planted in polybags that have been prepared 3 seeds (3 sprouts) per polybag.

The aquatic/waters sedimentary soil is obtained from the normalization of waste sludge (dredging) of rivers, reservoirs, highway ditches, and residential sewers in Surabaya. The water sediment mud is dried and then loosened. Garden soil was purchased from a plant shop in Surabaya. Garden soil is the topsoil of agricultural land imported from the Mojokerto area. The aquatic sedimentary soil and loosened garden soil are ready for experiment.

Water hyacinth biomass is obtained from the normalization waste of rivers, reservoirs, or sewers in Surabaya. Biomass withered for one week then composted with a microbial starter. After an incubation period of 42 days, the biomass has become compost and ready to be used for experiments.

Experimental Design

The research was conducted from November 2019 to March 2020 at the Experimental Garden of the University of Wijaya Kusuma Surabaya. Factorial experiment with two treatment factors arranged in a Randomized Block Design. The treatment factor I is the origin of the aquatic/water sedimentary soil which consists of five levels, namely T1: Garden Soil (soil traded for garden media) as a comparison; T2 : Residential sewer sediment soil (in a residential area); T3 : Large sewer sediment soil (on the edge of the highway); T4 : River sediment soil; and T5 : Reservoir sedimentary soil. Treatment factor II is the amount of addition of water hyacinth biomass compost (B) which consists of six levels, namely B0: Control (without the addition of compost); B1 : the addition of compost equal to 5% of the weight of the media; B2 : addition of compost as much as 10% of the weight of the media; B3 : the addition of compost amounted to 15% of the weight of the media; B4 : addition of compost equal to 20% of the weight of the media; and B5 : the addition of compost as much as 25% of the weight of the media. The combination of the two treatment factors obtained 30 treatment combinations which were repeated three times. The experimental unit was four polybags with a diameter of 20 cm and a height of 20 each planted with one sengon plant seed so that a total of 360 polybags were prepared.

Experimental Variables

Variables of sengon seed growth include seedling height, number of leaves, and leaf canopy area. Variable observations were conducted at 7-day intervals from 21 to 63 days after planting (DAP). The data were analyzed by analysis of variance and if the F test showed a significant difference then continued with the 5% Least Significant Difference (LSD) test.

Results and Discussion

Plant Height

Seedling height of sengon plants was observed every 7 days from 21 days old to 63 days old. Based on the results of the analysis of data variance, the height of the sengon plant seeds showed no interaction between the treatment factors of the origin of aquatic/water sedimentary soil and the amount of addition of water hyacinth biomass compost for all observation times. The average value of sengon seedling height (plant length) is presented in Table 2.

There was a significant difference in the treatment of a single factor of the origin of aquatic/waters sedimentary soil, the highest value was in garden soil (comparison) but not significantly different from small sewer sediment soil (residential sewer). The results of the study Sukarman et al. (2012), ofsengon plant nurseries with the media treatment of topsoil, a mixture of topsoil with sand, a mixture of topsoil with burnt husks and a mixture of topsoil with coco peat had no significant effect on stem height and diameter. Santoso (2016), showed that the best sengon seedling growth was obtained in a mixture of 50% Sidoarjo mud soil, 40% rice husk and 10% compost with a height of 31cm and was not significantly different from 20% Sidoarjo mud soil, 40% rice husk and 20% compost with a height of 3,6 cm. A good medium is one that proportionally provides space for plant root growth. Research Mulugeta (2014), stated that shoot length (seedling height), seedling dry weight and the highest percentage of live seedlings were obtained with mixed media of 50% forest topsoil, 40% compost and 10% sand. The use of topsoil is not recommended because it can encourage erosion. Research Usman et al. (2017), stated that the highest seedling was obtained in topsoil media (control) and followed by a mixture of topsoil with sawdust media.

There was a significant difference in the single factor treatment of the amount of addition of water hyacinth biomass compost, the highest value was in the treatment of the addition of water hyacinth biomass compost amounted to 15%. (B_3). Research Lata N, Dubey (2013), stated that shoot height and root length of Coriandrum sativum on water hyacinth biomass media, and a mixture of water hyacinth biomass with garden soil had higher values than manure and garden soil media alone. The results of this study are different from Research Daldoum et al. (2015), which showed that the treatment of various doses of dry leaf biomass on sandy soil media had no significant effect on the height of sengon seedlings.

Table 2. The Average Height of Sengon Plant Seeds (Cm) with Mixed Media Treatment between Water Sedimentary Soil and Water Hyacinth Biomass Compost.

Treatment	The average value of plant height (cm) at the age of (DAP)						
	21	28	35	42	49	56	63
T_1	4,26 b	4,26 a	4,43 a	5,63 a	6,58 a	7,14 a	10,08 a
T_2	3,48 c	3,60 b	3,86 b	4,72 b	5,63 b	5,86 b	8,27 bc
T_3	3,33 b	3,47 b	3,81 b	4,88 b	6,08 ab	6,55 ab	8,71 ab
T_4	2,72 c	2,71 c	2,90 c	3,51 c	4,00 c	4,28 c	6,42 d
T_5	2,61 c	2,79 c	3,01 c	3,72 c	4,76 c	4,97 c	6,97 cd
LSD	0,27	0,30	0,33	0,45	0,82	0,85	1,56
B_0	3,69 a	3,83 a	4,03 a	4,89 a	5,64 a	6,05 a	8,28 abc
B_1	3,28 b	3,43 b	3,70 ab	4,63 ab	5,49 a	5,87 a	8,61 ab
B_2	3,13 b	3,21 bc	3,51 bc	4,39 abc	5,84 a	6,01 a	8,00 abc
B_3	3,32 b	3,47 b	3,67 ab	4,68 ab	5,89 a	6,37 a	9,52 a
B_4	3,18 b	3,26 bc	3,53 bc	4,38 bc	5,12 a	5,48 ab	7,51 bc
B_5	3,06 b	2,98 c	3,20 c	3,98 c	4,47 b	4,78 a	6,63 c
LSD	0,30	0,32	0,36	0,50	0,90	0,93	1,71
SD	0,40	0,45	0,49	0,68	1,23	1,27	2,34

Information: The average value followed by the same letter is not significantly different based on the 5% LSD test SD: standard deviation. DAP= days after planting

Number of Leaves

The number of leaves of sengon plant seeds was observed every 7 days starting from 28 days old to 70 days old. Based on the results of the analysis of data variance, the number of leaves of sengon plant seeds showed no interaction between the treatment factors of the origin of the aquatic/water sedimentary soil with the treatment of the addition amount of water hyacinth biomass compost for all observation times. The average value of the number of leaves of sengon seedlings is presented in Table 3.

There was a significant difference in the treatment of a single factor of the origin of the aquatic/water sedimentary soil, the highest number of leaves was in garden soil (comparison) but not significantly different from small sewer sediments (residential sewer) and highway sewer sediments. Research Usman et al. (2017), stated that the number of leaves was not significantly different between the media of topsoil, a mixture of topsoil with sawdust, and sawdust media. Plant cultivation using water/aquatic sedimentary mud soil media showed an increase in plant biomass, average leaf surface area, a + b chlorophyll content because mud can increase soil fertility by reducing soil pH, increasing the content of C-organic, nitrogen and phosphorus. Shan et al. (2021), the aquatic/water sedimentary mud is proven to contain a lot of humus and total organic carbon (Urbaniak et al., 2017).

In the single factor treatment of the addition amount of water hyacinth biomass compost, the result was inconsistent. Observational data on seedlings aged 28, 35, 63, and 70 days showed no significant differences between treatments, while observations on seedlings aged 42, 49, and 56 days showed significant differences.

Table 3. Average Number of Leaf Seedlings of Sengon Plants with Mixed Media Treatment between Water Sedimentary Soil and Water Hyacinth Biomass Compost.

Treatment	**The average value of the number of plant leaves (cm) at the age of (DAP)**						
	28	**35**	**42**	**49**	**56**	**63**	**70**
T_1	1,88 a	2,08 a	1,94 a	2,86 a	4,14 a	4,32 abc	4,15 a
T_2	1,19 b	1,29 b	1,42 b	2,57 a	3,14 b	4,46 ab	3,97 a
T_3	1,56 a	1,58 ab	1,97 a	2,92 a	3,93 a	4,86 a	4,21 a
T_4	1,03 b	1,74 ab	1,08 c	1,89 b	3,93 a	3,86 c	3,04 b
T_5	1,04 b	1,18 b	1,24 bc	2,15 b	3,74 a	4,13 bc	3,32 b
LSD	0,34	0,58	0,32	0,40	0,50	0,56	0,58
B_0	1,52	2,05	1,55 abc	2,40 ab	4,07 a	4,42	3,90
B_1	1,20	1,50	1,58 ab	2,67 a	3,93 ab	4,27	3,73
B_2	1,43	1,63	1,72 a	2,82 a	4,10 a	4,60	3,90
B_3	1,50	1,62	1,78 a	2,77 a	3,67 abc	4,67	3,97
B_4	1,17	1,42	1,33 bc	2,10 b	3,50 bc	4,03	3,57
B_5	1,22	1,23	1,22 c	2,12 b	3,38 c	3,97	3,32
LSD	NS	NS	0,35	0,44	0,54	NS	NS
SD	0,5	0,87	0,48	0,60	0,74	0,84	0,87

Information: The average value followed by the same letter is not significantly different based on the 5% LSD test SD: standard deviation. DAP= days after planting

Leaf Canopy Circumference Area

The canopy circumference area of sengon plant seeds is obtained by the formula for the area of the circle with the radius of the leaf length. Leaf length was observed twice, namely when the plants were 56 and 63 days old. Based on the results of the analysis of data variance, the leaf canopy area of the sengon plant seeds showed no interaction between the treatment factors of the origin of the aquatic/water sedimentary soil and the addition amount of water hyacinth biomass compost for all observation times. The average value of the leaf canopy circumference area of sengon seedlings is presented in Table 4.

There was a significant difference in the single factor treatment of the origin of the aquatic/water sedimentary soil, the widest canopy was in garden soil (comparison) but not significantly different from small sewer sediment soil (residential sewer) and highway sewer sediment soil. This is because the highway sewer sediment soil and residential sewer sediment soil were physically more crumbly than river or reservoir sediment soil. In accordance with the results of the best seed performance was obtained on topsoil media (control) and followed by a mixture of topsoil with sawdust media, but the percentage of seed germination and live seedlings was obtained on sawdust media. The results are also in accordance with the results of research Daldoum et al. (2015), which showed that the treatment of various doses of dry leaf biomass on sandy soil media had a significant effect on the vigor of sengon seedlings, and the higher the dose of seedling vigor, the better. According to R.Vaca et al. (2011), there was a significant difference in the content of organic matter, phosphorus and zinc between the water-sediment mud (water sludge), soil plus compost, and soil plus inorganic fertilizers. Soil media plus compost and water sludge plus soil have higher productivity than soil media plus inorganic fertilizers. Utilization of urban sewer mud compost as a medium for mango plants, there is no risk of metal pollutants being absorbed by plants (Shuangshuang et al., 2017). Sewer mud compost contains a lot of organic matter and nutrients that plants need. Utilization of sewage sludge compost as a medium for growing seedlings is considered an ecological method in the utilization of sewage sludge (Chu et al., 2017).

There was a significant difference in the single factor treatment of the amount of water hyacinth biomass addition, the widest canopy was in the treatment of the addition of water hyacinth biomass amounted to 5% (B_1) but not significantly different with the addition of 10% (B_2). The increase in growth and yield of plants treated with water hyacinth compost according to Sanniand Adesina (2012), was due to the release of N and Mg elements during the mineralization process, which are needed in the formation of chlorophyll for photosynthesis and plant growth. These results are in accordance with research that the application of water hyacinth compost had a significant effect on increasing the growth and yield of wheat plants. The utilization of water-sediment mud had no effect on growth variables and sunflower yield variables, the results are the same as garden soil (top soil) which is widely sold as the park soil

(Haryantaand Rejeki, 2021). According to Lata N, Dubey (20130, growth and productivity of Coriandrum sativum was better on the media of 100% water hyacinth compost. Vidya S & Girish (2014), reported that water hyacinth biogas compost as organic fertilizer can restore soil fertility and increase maize production. The results of the study Osoro et al. (2014), showed that the application level of water hyacinth compost had a significant effect on plant height, harvest age and yield but had no effect on the number of tomatoes per plant. The results of the study Mashavira et al. (2015), showed that the application of water hyacinth compost had a significant effect on the increase in plant height (cm), stem diameter (mm), leaf production, and leaf area of Afzelia Africa.

Table 4. Average Leaf Canopy Area of Sengon Plant Seeds (Cm2) with Mixed Planting Media Treatment between Aquatic/Water Sedimentary Soil and Water Hyacinth Biomass Compost

Treatment	**In plant at the age of (DAP)**	
	56	**63**
T_1(garden soil)	677,99 a	931,10 a
T_2 (residential sewer sediment)	685,44 a	845,46 a
T_3 (highway sewer sediment)	718,18 a	896,03 a
T_4(river sediment)	305,28 c	471,99 c
T_5(reservoir sediment)	521,60b	596,10 b
LSD	99,05	103,24
B_0(0% water hyacinth compost)	486,18b	533,58 c
B_1 (5% water hyacinth compost)	702,56a	1.024,32 a
B_2 (10% water hyacinth compost)	735,86a	965,14 ab
B_3 (15% water hyacinth compost)	700,30a	885,27 b
B_4 (20% water hyacinth compost)	496,20b	585,02 c
B_5 (25% water hyacinth compost)	369,10c	495,48 c
LSD	108,51	113,10
SD	148,59	154,87

Information: The average value followed by the same letter is not significantly different based on the 5% LSD test SD: standard deviation. DAP= days after planting

Conclusion

Treatment of the origin of sedimentary soil had a significant effect on the growth of sengon (*Paraserianthes falcataria*) plant seeds. Garden soil media (as a control) was not significantly different from residential sewer sediment and highway sewer soil gave a better effect on the growth of sengon seedlings at the age of 63 days (seedling height 8,27-10,08 cm; number of leaves 3,97 – 4,21, and leaf canopy area of 845,46 – 931,10 cm^2) compared to reservoir sediment soil and river sediment soil. The addition of water hyacinth compost can increase the growth of sengon seedlings and the best effect is on the addition with a concentration of 5-15%, namely seedling height 8,00-9,52 cm, number of leaves 3,73 - 3,97 and leaf canopy area ranging from 885,27 – 1024,32 cm^2. Based on research data for sengon plant nurseries, it is recommended to use sewer sediment soil with the addition of water hyacinth compost at a concentration of 5% by weight.

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Fig. 1 Sengon Plant Seeds 56 days old

Fig. 2 Sengon Plant Seeds 110 days old

References

Aderounmu, A. F. (2019). Effects of Organic and Inorganic Fertilzer on the Early Growth Response of Afzeliaafricana. Asian Journal of Biology, 1-8.

Antonkiewicz, J., Popławska, A., Kołodziej, B., Ciarkowska, K., Gambuś, F., Bryk, M., &Babula, J. (2020). Application of ash and municipal sewage sludge as macronutrient sources in sustainable plant biomass production. Journal of Environmental Management, 264, 110450.

Ayanda, O. I., Ajayi, T., &Asuwaju, F. P. (2020). Eichhorniacrassipes (Mart.) Solms: Uses, Challenges, Threats, and Prospects. The Scientific World Journal, 2020.

Beesigamukama, D., Tumuhairwe, J. B., Muoma, J., Maingi, J. M., Ombori, O., Mukaminega, D., … Amoding, A. (2018). Improving water hyacinth-based compost for crop production. Journal of Agricultural Science and Food Technology, 4(3), 52–63.

Chu, R. K., & Choi, T. (2000). An importance-performance analysis of hotel selection factors in the Hong Kong hotel industry: A comparison of business and leisure travellers. Tourism Management, 21(4), 363–377.

Chu, S., Wu, D., Liang, L. L., Zhong, F., Hu, Y., Hu, X., ... & Zeng, S. (2017). Municipal sewage sludge compost promotes Mangiferapersiciforma tree growth with no risk of heavy metal contamination of soil. Scientific reports, 7(1), 1-11.

Delibacak, S., Voronina, L., &Morachevskaya, E. (2020). Use of sewage sludge in agricultural soils: Useful or harmful. Eurasian Journal of Soil Science, 9(2), 126–139.

Daldoum, D. M. A., & Hammad, G. H. (2015). Performance of Acacia senegal (L.) wild seedlings growth under some tree manures and NPK fertilizers in nursery Site. Journal of Forest and Environmental Science, 31(4), 303-311.

Farhana, J., Nure, F., Hossain, M. K., & Hoque, A. T. M. R. (2010). Comparative growth performance of Albiziaprocera seedlings raised in nursery bed, polybag and root trainers. Australian Journal of Basic and Applied Sciences, 4(8), 3038-3042.

Haryanta, D., &Rejeki, F. S. (2021). The Utilization of Sediment Mud In Water Channel And Urban Organic Compost Waste For Sunflower (Helianthus Anuus L. Var. Early Russian) Cultivation. Agricultural Science, 4(2), 113–125.

Haryanta, D., Thohiron, M., &Gunawan, B. (2017). Kajian Tanah EndapanPerairanSebagai Media TanamPertanian Kota. Journal of Research and Technology, 3(2), 1–10.

John, M., & Kakamega, K. (2016). Production of Organic Compost from Water Hyacinth (Eichhorniacrassipes [Mart.] Solms) in the Lake Victoria Basin: A Lake Victoria Research Initiative (VicRes). Research & Reviews: Journal of Agriculture and Allied Sciences, 5(2), 50–57.

Julianda, R., Mardhiansyah, M., &Oktorini, Y. (2017). Perkecambahan Benih Sengon (*Paraserianthes falcataria*) Menggunakan Media Pasir Sungai Kuantan dengan Pasir Sungai Muara (Anak Sungai) di Kecamatan Kuantan Hilir Kabupaten Kuantan Singingi.

Kazberuk, W., Szulc, W., &Rutkowska, B. (2021). Use Bottom Sediment to Agriculture—Effect on Plant and Heavy Metal Content in Soil. Agronomy, 11(6), 1077.

Kiani, M., Raave, H., Simojoki, A., Tammeorg, O., &Tammeorg, P. (2021). Recycling lake sediment to agriculture: Effects on plant growth, nutrient availability, and leaching. Science of the Total Environment, 753, 141984.

Kuke, A. C., &Hunde, K. K. (2019). Evaluation of Water Hyacinth (EichhorniaCrassipes) Compost for Its Nutrient Content at Adami Tulu Agricultural Research Center". Innovative Techniques in Agriculture, 3(4), 690–696.

Lata, N., & Dubey, V. (2013). The impact of water hyacinth manure on growth attributes and yields in Coriandrum sativum. IOSR J Environ Sci Toxicol Food Technol, 5, 4-7.

Mashavira, M., Chitata, T., Mhindu, R. L., Muzemu, S., Kapenzi, A., &Manjeru, P. (2015). The effect of water hyacinth (Eichhorniacrassipes) compost on tomato (Lycopersiconesculentum) growth attributes, yield potential and heavy metal levels. American Journal of Plant Sciences, 6(04), 545.

Mulugeta, G. E. T. A. C. H. E. W. (2014). Effect of different potting mixture on the seedling growth and survival of Albiziagummifera and Cordia Africana. Journal of Natural Sciences Research, 4(3), 25-33.

Nikonovas, T., Spessa, A., Doerr, S. H., Clay, G. D., &Mezbahuddin, S. (2020). Near-complete loss of fire-resistant primary tropical forest cover in Sumatra and Kalimantan. Communications Earth & Environment, 1(1), 1-8.

Nzeve, J. K., &Ikubano, S. L. (2021). Heavy Metals and Macronutrients Concentrations in Sewage Sludge Obtained from Decentralized Treatment Facility, Machakos Town, Kenya. Journal of Health and Environmental Research, 7(2), 105–110.

Osoro, N., Muoma, J. O., Amoding, A., Mukaminega, D., Muthini, M., Ombori, O., &Maingi, J. M. (2014). Effects of water hyacinth (Eichhorniacrassipes [mart.] solms) compost on growth and yield parameters of maize (Zea mays). British Journal of Applied Science & Technology, 4(4), 617.

Rahman, M. M., Sultana, S., Mahmud, M., & Islam, K. N. (2017). Green manure potentials of water hyacinth and sewage sludge: The seed germination and seedling growth trials of Albiziasaman. Res. Agric. Vet. Sci, 1, 18–31.

Sa'adah, T. T., &Haryanta, D. (2016). PENGEMBANGAN TEKNIK PRODUKSI MASSAL BIOMAS ECENG GONDOK. Journal of Research and Technology, 2(2), 14–22.

Sanni, K., & Adesina, J. (2012). Response of water hyacinth manure on growth attributes and yield of Celosia argentea L (Lagos Spinach). Journal of Agricultural Technology, 8(3), 1109–1118.

Santosa, S. (2016). Growth and physical quality of *Paraserianthes falcataria* (L) Nielsen seedling on ten types of transplanting media. International Journal of Plant Biology, 7(1).

Sonter, S., Pattar, R., &Ramalingappa, A. (2018). Effect of Eichorniacrasipes (Mart) Sloms compost on morphological parameters of black gram (Vinga mungo Hepper). International Journal of Health Science and Research, 3, 20–26.

Sukarman, S., Kainde, R., Rombang, J., & Thomas, A. (2012). Pertumbuhanbibitsengon (*Paraserianthes falcataria*) pada berbagai media tumbuh. Eugenia, 18(3).

Towett, G., Maingi, J., Ombori, O., & Mbuvi, H. (2020). Reduction of Mobile Heavy Metals During Composting of Water Hyacinth Weed. International Journal of Biological, Physical and Chemical Studies, 2(1), 1–7.

Urbaniak, M., Wyrwicka, A., Tołoczko, W., Serwecińska, L., &Zieliński, M. (2017). The effect of sewage sludge application on soil properties and willow (Salix sp.) cultivation. Science of the Total Environment, 586, 66-75.

Usman, A. I., Otalu, B. A., &Wakawa, L. D. (2013). PRELIMINARY ASSESSMENT OF GERMINATION AND EARLY GROWTH CHARACTERISTICS OF ALBIZIA ZYGIA (DC.) MACBR INFLUENCED BY DIFFERENT GROWTH MEDIA. Education, 2015.

Vaca, R., Lugo, J., Martinez, R., Esteller, M. V., &Zavaleta, H. (2011). Effects of sewage sludge and sewage sludge compost amendment on soil properties and Zea mays L. plants (heavy metals, quality and productivity). Revistainternacional de contaminaciónambiental, 27(4), 304-311.

Vidya, S., & Girish, L. (2014). Water hyacinth as a green manure for organic farming. International Journal of Research in Applied, Natural and Social Sciences, 2(6), 65-72.

Zhang, K., Robinson, N., Lee, S.-W., & Guan, C. (2021). Adaptive transfer learning for EEG motor imagery classification with deep Convolutional Neural Network. Neural Networks, 136, 1–10.