RJOAS: Russian Journal of Agricultural and Socio-Economic Sciences
ISSN 2226-1184 (Online) | Issue 2(134), February 2023

UDC 633; DOI 10.18551/rjoas.2023-02.13

COMBINATION OF LIQUID ORGANIC FERTILIZER OF ARENGA PALM [ARENGA PINNATA (WURMB) MERR] AND WATER HYACINTH (EICHHORNIA CRASSIPES) IN SUSTAINABLE AGRICULTURE SYSTEM ON GROWTH AND YIELD OF RICE PLANTS

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ABSTRACT
The higher the public awareness of the need for healthy food, which is free from chemicals, the more efforts are made to overcome it, including using organic fertilizers. This study aims to get the best results from the combination of palm sap [Arenga pinnata (WURMB) MERR] and water hyacinth on the growth and yield of paddy fields. This study used a single-factor randomized block design (RBD) consisting of 6 treatment levels, namely A0 = control (without giving SAP), A1 = 20 ml palm sap + 80 ml water hyacinth + 900 ml water, A2 = 30 ml palm sap + 70 ml water hyacinth + 900 ml water, A3 = 50 ml palm sap + 50 ml water hyacinth + 900 ml water, A4 = 60 ml palm sap + 40 ml water hyacinth +900 ml water, A 5 = 70 ml palm sap + 30 ml water hyacinth +900 ml of water. Based on the results of the study, the combination of palm sap and water hyacinth had an effect on plant height (92.98 cm), the number of tillers (15.78 tillers), panicle length (28 – 29 cm), and seed weight per panicle (4.4 g – 5 g. Panicle-1), and the weight of 1000 grains 29.17 g. The combination of palm sap [Arenga pinnata (WURMB) MERR] and water hyacinth can increase the growth and yield of paddy rice plants.

KEY WORDS
Combination, organic fertilizer, paddy, palm sap, water hyacinth.

The high price of artificial fertilizers today, causes farmers to think and look for alternatives to make organic fertilizers as a substitute for chemical fertilizers. This is done to reduce production costs in conducting farming, besides that it is driven by the importance of the need for healthy food, which is free from toxic ingredients, the use of organic fertilizers is the solution. Organic fertilizers commonly used for plants are from cow, sheep, and chicken manure, but their availability is increasingly difficult to obtain, so it is necessary to utilize available materials around us, including palm sap and water hyacinth. The need to use organic fertilizers is to reduce the use of chemical fertilizers because they can have negative impacts on the soil and the environment, such as damaging the soil structure and the soil becoming hard in the dry season, and sticky in the rainy season due to decreased soil porosity. Inorganic fertilizers do not have properties that can directly improve soil physical properties and functions as well as soil biological functions. In addition, the use of agricultural chemicals in high doses and for a long time causes a lethal effect on soil microorganisms and disrupts soil fertility. therefore it is necessary to increase the use of organic fertilizers as an alternative to maintain soil fertility, low production is caused by low soil fertility (Nasira et al., 2021) and (Effendy & Gumelar, 2020). The addition of organic fertilizers to the soil will accelerate the process of decomposition or mineralization and release minerals in the form of basic cations (Ca, Mg, Na, K) which cause an increase in OH- ions (Yuniarti et al., 2019).

(Chemura, 2014) states that the use of organic fertilizers is the main choice for soil fertility in sustainable farming systems. Organic fertilizers function to improve the physical, chemical, and biological properties of the soil and are beneficial for plant growth, organic

matter decomposes into nutrients used by plants, and becomes a necessity for rice plants. Organic fertilizers can increase yields and improve quality and prevent increased costs (Chen et al., 2018; Abduh et al., 2020) Lukman (2019) and (Marjenah et al., 2018) state that liquid organic fertilizers have more economic value high compared to solid fertilizers because the use is relatively small and directly focused on the plant tissue, such as leaves, stems and fruit. Palm sap and water hyacinth can be used as liquid organic fertilizers because they contain macro and micronutrients. The nutrient content in organic fertilizer for palm sap is N (Nitrogen) 1.37%, P (Phosphorus) 0.25%, and K (Potassium) 8.07% (Lukman 2019). Muhtar (2008), stated that water hyacinth has good properties, including absorbing heavy metals, and sulfide compounds, containing more than 11.5% protein, and containing cellulose which is higher than non-cellulose such as lignin, ash, fat, and other substances.

MATERIALS AND METHODS OF RESEARCH

The main ingredients used are:

1. Mekongga variety rice seeds:

Before planting, the seeds of the Mekongga variety are sorted first by placing them in a container filled with water. Then the floating seeds are separated from those that sink to be used as seeds.

2. Chicken coop compost:

Chicken coop compost is used as basic fertilizer, giving each plant as much as 10 g/bucket at the beginning of planting. This manure compost is a mixture of several ingredients, namely banana weevils, chicken manure, and biochar derived from rice husks. Before being used, the material was first analyzed in the soil laboratory of the Faculty of Agriculture, University of Tadulako. The results of the analysis show that the fertilizer contains N (2.01%), P (0.2%), K (0.6%), C-organic (43.23%), and pH (7.7).

3. Palm juice liquid fertilizer:

Made from palm sap added with coconut water, banana cob water, and rice washing water, then fermented for 42 days, laboratory analysis results contain Nitrogen (1.37%) Phosphorus (0.25%), Potassium (3.98%), IAA Hormones (0.493 ppm) and GA3 (6,458 ppm) (Lukman, 2017).

4. Water hyacinth liquid fertilizer:

2 kg of water hyacinth which is mashed with 1 liter of water, then fermented for 1 month. The water hyacinth used had an organic matter content of 78.47%, C - organic 21.23, 0.28% total N, 0.0011% total P, and 0.016% total K (Moi, 2015).

Research Implementation. Prepare all the equipment and materials that will be used with the following procedure: The location of the research area measures 7 x 5 meters, using a distance between buckets of 20 x 20 cm, while between replicates using a distance of 40 cm, a trench is made around the experimental site to avoid standing water, and to avoid pest disturbance, it is surrounded by a net fence. The bucket media is filled with topsoil that has been loosened and cleaned and air-dried for 2 days. All buckets are first labeled, then filled with soil and organic fertilizer (chicken manure) as basic fertilizer with a ratio of 1: 5 (1 part basic fertilizer: 5 parts soil). The bucket containing soil is filled with water until it is saturated or reaches field capacity**.** Then, 2 seeds were added to each planting medium, and in the 2nd week one was removed and 1 plant was retained as a sample.

The SAP that will be used consists of 2 ingredients, namely 1 liter of palm juice and 1 liter of water hyacinth liquid, then the two ingredients are mixed and added with 100 grams of gambier powder with the aim of inhibiting microbial growth. Furthermore, SAP was applied to the plants according to the research dose, namely when the plants were 2 weeks after planting (WAP), according to the experimental dose, then the 2nd (4 WAP), 3rd (6 WAP), 4th (8 WAP) application. This experiment consisted of 6 levels of treatment, namely: A0' = control (without adding SAP) A1 = 20 ml of palm sap + 80 ml of water hyacinth + 900 ml of water, A2 = 30 ml of palm sap + 70 ml of water hyacinth + 900 ml of water, A3 = 50 ml palm sap + 50 ml Water hyacinth + 900 ml water, A4 = 60 ml palm sap + 40 ml Water hyacinth + 900 ml water, A 5 = 70 ml palm sap + 30 ml Water hyacinth + 900 ml water. Each treatment

was repeated 3 times so that there were 18 experimental units, each experiment consisted of 3 planting media, so there were 54 experimental units and all of them were used as sample plants.

Measurement of plant height, measurements are made from the base of the stem to the growing point of the plant using a ruler. Observation of the number of tillers was carried out by counting all the tillers that grew in the 8th week after planting. Each parameter was carried out 4 times starting from the age of the plant 2 WAP, 4 WAP, 6 WAP, and 8 WAP Observations of panicle length were carried out at the age of 112 days after planting, namely by measuring from the base of the first grain emergence to the tip of the last panicle. Observation of weight was carried out at the age of 112 days after planting (DAP), by weighing every 1000 grains.

Data Analysis. This study used a single-factor Randomized Block Design (RBD), and the data obtained were analyzed using ANOVA. If there is a real or very significant effect on the treatment, then a further test is carried out using the Honest Significant Difference (HSD) analysis at the 5% or 1% level.

RESULTS AND DISCUSSION

The results of variance showed that the combination treatment of palm sap and water hyacinth had a significant effect on the growth of rice plant height at 2 WAP, and 6 WAP and had no significant effect at 4 WAP and 8 WAP (appendix 5, 10). Furthermore, plant height according to the age of observation can be seen in Figure 1.

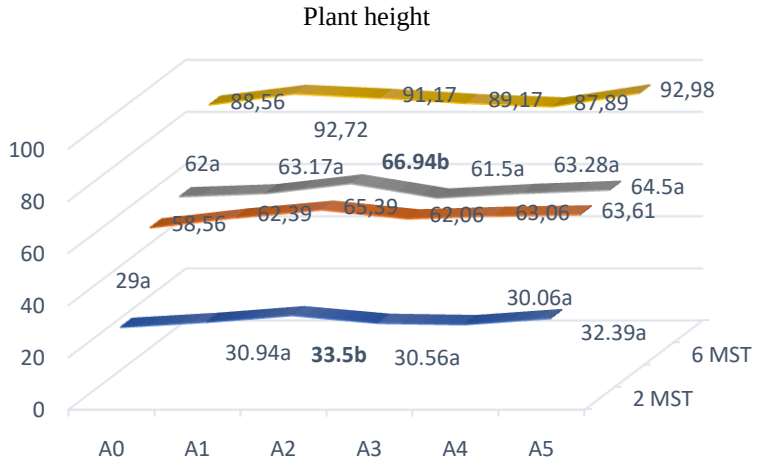

Figure 1 – Rice plant height at 2 WAP, 4, 6, and 8 WAP: A0 = control (without giving SAP) A1 = 20 ml Palm sap e + 80 ml Water hyacinth + 900 ml water, A2 = 30 ml Palm sap + 70 ml Water hyacinth + 900 ml water, A3 = 50 ml Palm sap + 50 ml Water hyacinth + 900 ml of water, A4 = 60 ml of palm sap + 40 ml of water hyacinth + 900 ml of water, A 5 = 70 ml of palm sap + 30 ml ofwater hyacinth + 900 ml of water.

The results of the analysis of variance showed that the combination of palm sap and water hyacinth had a significant effect on the number of tillers. The average number of offspring can be seen in Figure 2. The results of the analysis of variance showed that the combination of palm sap and water hyacinth had a very significant effect on panicle length. The average panicle length can be seen in Figure 3. The results of the analysis of variance showed that the combination of palm sap and water hyacinth had a very significant effect on the grain weight of panicle^{-1}. The average grain weight per panicle can be seen in Figure 4. The results of the analysis of variance showed that the combination of palm sap and water hyacinth had a very significant effect on the weight of 1000 grains. The average weight of 1000 grains can be seen in Figure 5.

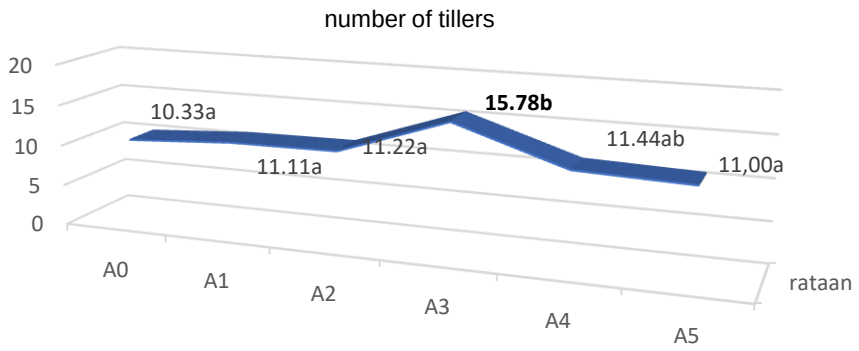

Figure 2 – Number of tillers of rice plants aged 8 WAP: A0 = control (without giving SAP) A1 = 20 ml Palm sap e + 80 ml Water hyacinth + 900 ml water, A2 = 30 ml Palm sap + 70 ml Water hyacinth + 900 ml water, A3 = 50 ml Palm sap + 50 ml Water hyacinth + 900 ml of water, A4 = 60 ml of palm sap + 40 ml of water hyacinth + 900 ml of water, A 5 = 70 ml of palm sap + 30 ml ofwater hyacinth + 900 ml of water.

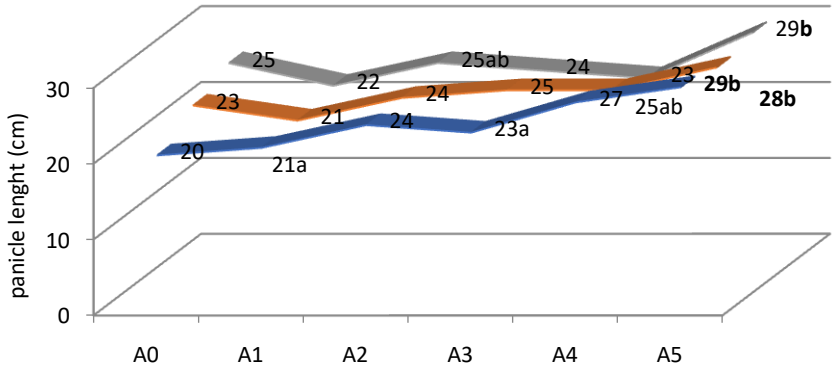

Figure 3 – Panicle length of 112 DAP rice plants: A0 = control (without giving SAP) A1 = 20 ml Palm sap e + 80 ml Water hyacinth + 900 ml water, A2 = 30 ml Palm sap + 70 ml Water hyacinth + 900 ml water, A3 = 50 ml Palm sap + 50 ml Water hyacinth + 900 ml of water, A4 = 60 ml of palm sap + 40 ml of water hyacinth + 900 ml of water, A5 = 70 ml of palm sap + 30 ml ofwater hyacinth + 900 ml of water.

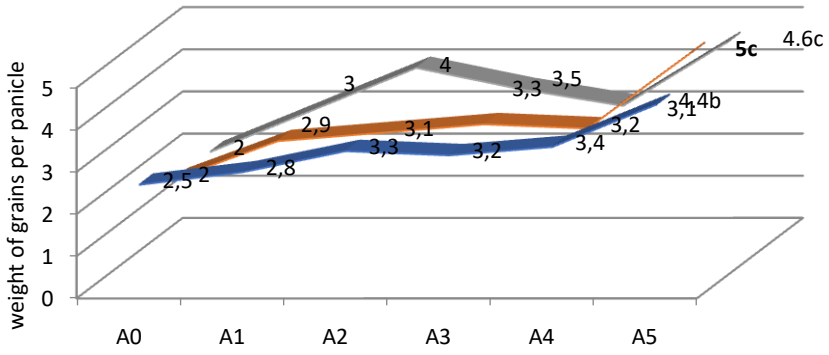

Figure 4 – Weight of grains per panicle of rice plants aged 112 DAP: A0 = control (without giving SAP) A1 = 20 ml Palm sap e + 80 ml Water hyacinth + 900 ml water, A2 = 30 ml Palm sap + 70 ml Water hyacinth + 900 ml water, A3 = 50 ml Palm sap + 50 ml Water hyacinth + 900 ml of water, A4 = 60 ml of palm sap + 40 ml of water hyacinth + 900 ml of water, A5 = 70 ml of palm sap + 30 ml of water hyacinth + 900 ml of water.

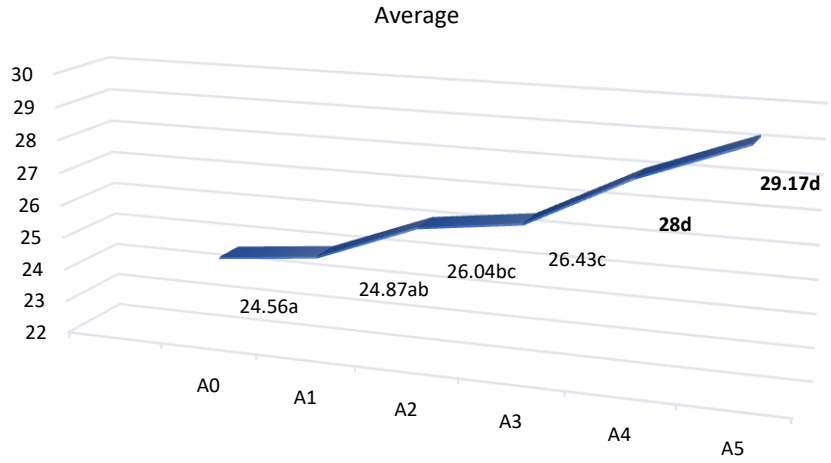

Figure 5 – Weight of 1000 grains of rice plants aged 112 days after planting: A0 = control (without giving SAP) A1 = 20 ml Palm sap e + 80 ml Water hyacinth + 900 ml water, A2 = 30 ml Palm sap + 70 ml Water hyacinth + 900 ml water, A3 = 50 ml Palm sap + 50 ml Water hyacinth + 900 ml of water, A4 = 60 ml of palm sap + 40 ml of water hyacinth + 900 ml of water, A 5 = 70 ml of palm sap + 30 ml ofwater hyacinth + 900 ml of water.

In the concept of growth, that plant height is more influenced by N elements that can be absorbed by plants. With a higher dose of palm, the sap can affect the height of rice plants, the N content in liquid organic fertilizer palm sap is 1.37%, this N element can be absorbed by rice plants properly so that it can stimulate rice plant growth (Lukman, 2019a). besides that N is also available in nature and in water hyacinths. Organic fertilizers in rice plants can increase growth because they contain growth hormones and contain nutrients needed by plants (Suriani, 2019). Plant growth is limited by the nutrients available in the lowest amount in the medium (plant) when viewed from the presentation of optimum needs.

Figure 1 shows that each difference in dose gives an increase in plant height. It can be said that the higher the concentration of the dose given, the plant will respond well to the age of 8 WAP when compared to the control. The highest plants were in treatment A 5 = 70 ml of palm sap + 30 ml of water hyacinth + 900 ml of water (92.98 cm). The concept of growth when connected with the combined dosage of palm sap and water hyacinth can be considered relevant starting from a dose of 20 ml of palm sap + 80 ml of water hyacinth + 900 ml of water up to a dose of 70 ml of palm sap + 30 ml of water hyacinth + 900 ml of water. Lukman (2019) states that the use of 5.25 liters/ha of liquid organic fertilizer for palm sap can increase the growth of lowland rice plants up to the age of 43 days after planting as high as 77.44 cm (Moi, 2015) states that the use of water hyacinth liquid organic fertilizer doses of 10 – 40 ml/liter of water has an effect on plant growth. Water hyacinth can increase the height of rice plants because it contains higher N (Bernas et.al 2012), Nitrogen (N) is one of the main mineral nutrients for plants and its availability has an impact on growth and development (Nacry et al., 2013) The highest yield on rice plant height after 8 weeks reached 58.03 cm (Solihin et al., 2019). Other studies show that the combination of palm sap and water hyacinth fertilizer has a better effect.

The highest number of tillers used 50 ml of palm sap + 50 ml of water hyacinth + 900 ml of water with an average value of 15.78 more tillers than the other treatments (Bernas et.al 2012), the tillers of rice plants that were given water hyacinth compost only produced 17 of the highest number of tillers, the number of tillers planted using bucket media was less than the rice plants planted in paddy fields, while the rice planted in paddy fields using POC reached 23.53 tillers (Solihin et al., 2019). The increase in the number of tillers per clump was significantly affected by the treatment of the number of seedlings per planting hole (Rahayu et al., 2019; Sufardi, 2020; Rahardjo, 2012). In addition, to increase the number of

tillers of rice plants, sufficient nutrients are needed, namely the nutrients N (Nitrogen) P (phosphorus), and K (Potassium) (Nugroho & Prayogo, 2016). Fertilizers that contain complete nutrients will give a good response to the process of forming tillers of rice plants, palm sap, and water hyacinth contain complete nutrients so that they have a real effect on tiller formation.

In Figure 3 it can be seen that the average longest panicle of rice was found in treatment A5, namely 28-29 cm, and had a very significant effect on the control, namely the panicle length of 20-25 cm. The difference in the length of the panicles is caused by the increase in the volume of giving palm sap up to 70 ml of palm sap + 30 ml of water hyacinth with 900 ml of water, meaning that this combination can provide more balanced nutrition towards increasing panicle length up to 28-29 cm, which is different from what is done (Sohail et al., 2018) the panicle length of the Mekongga variety only ranged (24.59 cm) and 27.57 cm (Marbun, and Oswald 2016). Hatta (2012), in his research, said that panicle length was determined more by factors genetics rather than environmental factors and environmental factors, among others, is fertilizer. The combination of chemical fertilizers with organic fertilizers of 1.5 tons.ha-1 only reached (25.50 cm) (Siavoshi et al., 2011). The use of a combination of palm sap and water hyacinth is higher than in some previous studies.

In Figure 4 it can be seen that the highest average panicle weight of rice was found in treatment A5, namely 4.4 g – 5 g panicle^{-1}, and had a very significant effect on the control, namely panicle weight 2.0-2.5 g. panicle^{-1}. The difference in seed weight panicle^{-1} is caused by the increase in the volume of palm sap up to 70 ml of palm sap + 30 ml of water hyacinth with 900 ml of water, meaning that this combination can provide more balanced nutrition for increased grain weight. panicle-1 to 4.4 g – 5 g, compared to controls only reaching 2 – 2.5 g.malai^{-1}. The longer the panicle, the greater the opportunity to form filled grain (Delima Napitupulu 2015), the panicle length is largely determined by the NPK content (Ahmad, 2016; Ghimire et al., 2021). The higher the concentration of liquid organic fertilizer applied, the higher the percentage of filled grain that will be produced. This is also related to the N, P, and K nutrients contained in organic liquids (Ministry of Agriculture, 2018) (Ginting, 2019). The weight and number of panicles were significantly affected by the application of organic fertilizers (Polthanee, 2011).

Giving palm sap up to 70 ml of palm sap + 30 ml of water hyacinth with 900 ml of water, there was an increase in the weight of 1000 grains up to 29.17 g (Salawati & Suprianto, 2021) The weight of 1000 grains only reaches 28.05 g. The weight of 1000 grains is an indicator of the quality and quantity of rice plants (Masdar, 2007); (Ministry of Agriculture, 2018). the high or low weight of the seeds depends on how much or not dry matter is contained in the seeds. The dry matter in the seeds is obtained from the results of photosynthesis which can then be used for seed filling (Masdar, 2007).

CONCLUSION

The use of liquid organic fertilizer with a combination of palm sap and water hyacinth at a dose of 50-70 ml can increase the growth of rice plants, increase the number of tillers, panicle length and seed weight of panicle^{-1} and the weight of 1000 grains.

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