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Effect of Arenga Palm [*Arenga pinnata* (WRMB)MERR.] Liquid on the Growth and Yield of Rice

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Arenga palm is a liquid obtained from palm plant stem [*Arenga pinnata* (Wurmb). Merr)] this liquid is used as an ingredient for brown sugar or alcoholic beverages, this liquid is then mixed with some organic ingredients through fermentation method. The result of laboratory analysis shows that the fermentation contained N, P, K, and IAA and GA3 hormones that were used as experimental fertilizer (Liquid Organic fertilizer arenga palm). This research aims to determine the effectiveness of the dosage of liquid organic fertilizer to the growth and yield of rice field plants. This research used a randomized block design consisting of 3 (three) replications and 10 doses so that there were 30 experimental treatments. The study was carried out at the Agricultural Research Institute of Sidondo Palu in Central Sulawesi in March to June 2017. The analysis used was the analysis of single factor variance with the Honest Significant Difference test (BNJ). The results of the analysis shows that the

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dose of arenga palm 25.75 L.ha^{-1} for plant growth aged 15 days after planting (HST), 28 HST and 43 HST affects significantly (P <0.001) to an average plant height of 49.3 cm, 6.51 cm and 86 cm, and the number of productive tillers is 15.23 stems. Cluster^{-1}. Likewise, the results of crop production shows that the use of a dose of 25.75 L. ha^{-1} is significantly different (P <0.001 harvested dry rice yield (GKP) 7.99 tons. ha^{-1}.

Keywords: Oryza sativa; LOF Arenga palm; dosage; NPK.

1. INTRODUCTION

Liquid organic fertilizer of arenga palm is a fertilizer produced from several organic materials, which have been through a fermentation process and decomposed by microorganisms, the function of liquid organic fertilizer is to improve physical properties, chemical and biological soil, help increase crop production, and improve product quality. Liquid organic fertilizer is one alternative to increase the availability, adequacy, and efficiency of nutrient uptake for plants. Liquid fertilizer is sprayed through the leaves to be spread evenly so that it can more quickly overcome the nutrient deficiency in plants. Crop production is often limited by the availability of low essential mineral elements [1], then organic fertilizers have been reported to be able to increase nutrient uptake efficiency, improve growth and yield and increase the efficiency of subsequent phosphorus (P) [2] inputs in the future agricultural systems must be more productive and more efficient in terms of inputs such as fertilizer needs, furthermore it is a must to look for alternatives for organic-based plant nutrition sources [3].

Arenga palm is an organic material that is easily available in the community and the price is cheap, arenga palm can be used as liquid organic fertilizer, because this material contains sucrose 11.28%, carbohydrate 0.66%, ash 0.04% protein 0.2% fat and another 0.02%, then on the arenga palm can grow various kinds of microbes such as: (1) *Bacillus subtillis*, (2) *Aceti baterium*, (3) *Micrococcus namely Escherichia,* (4) *Sachromo bacterium*, (5) *Flavobacterium*, (6) *Leuconostoc mesenteroides*, (7) *L. dextranicum*, is a bacteria that causes mucus formation, (8) *Lactobacillus plantarum*, (9) Sarcina from the genus *Pediococcus*, (10) *Acetobacter* (11) *Saccharomyces cereviciae* and *Saccharomyces carlbergensis var alcoholophila* [4].

In this regard, the research was conducted on the level of effectiveness of the use of liquid organic fertilizer of arenga palm on the growth and yield of rice fields.

2. MATERIALS AND METHODS

The fertilizer used is made of palm juice (1400 ml), fish meal (400 g), shrimp skin flour (75 g), coconut water (500 ml), rice washing water (400 ml), brown sugar (400 g) and distilled water (700 ml), each sample containing 3 liters in liquid form and then put into a closed container for fermentation for 42 days. Then the fermentation results are analyzed in the Laboratory, with the analysis containing Nitrogen (1.37%) Phosphorus (0.25%), Potassium (3.98%), IAA Hormones (0.493 ppm) and GA3 (6.458 ppm) [5]. the dosage of fertilizer use is:

A0 = Control = without fertilizer treatment
A1 = 5.25 L.ha-1 arenga palm fertilizer
A2 = 5.50 L. Ha-1 arenga palm fertilizer
A3 = 5.75 L. Ha-1 arenga palm fertilizer
A4 = 12.75 L. Ha-1 arenga palm fertilizer
A5 = 13.00 L.ha-1 arenga palm fertilizer
A6 = 13.25 L. Ha-1 arenga palm fertilizer
A7 = 25.25 L. Ha-1 arenga palm fertilizer
A8 = 25.50 L. Ha-1 arenga palm fertilizer
A9 = 25.75 L. Ha-1 arenga palm fertilizer

The rice plants used in this study were Mekongga varieties Plant age: 116–125 days, Plant shape: Upright, Plant height: 91–106 cm, Productive tillers: 13–16 stems, Weight 1000 items: 28 g [6].

Tools used: Hand tractors, hoes, machetes, rope, sprayers, scales, meters, sample bags, sickles, research signs and writing instruments. Before the research was carried out the soil chemical analysis was conducted out in the soil laboratory of Tadulako University which included pH, total N, total P, total K, organic C, Na, Ca, CEC, alkaline saturation, Mg and Al, bulk density, then tillage the beginning by using a tractor and hoe, after thT processing the land to 2, which is a week before planting, where the land has been cleaned and leveled, planting is done after 18 days old rice, on the plot area 2.40 mx 3.60 m and spacing of 20 cm x 10 cm x 40, jajar legowo system (2: 1). each planting hole is

inserted into one rice seedling. The administration of experimental fertilizer was carried out 3 times, 15 days after planting (DAP), 28 days after planting and 43 days after planting. Before the fertilizer is given the two ingredients are mixed first, then given the plant by spraying.

This research used Randomized Block Design (RBD) method of 10 treatments with 3 replications so that 30 test plots were obtained, if in the treatment affect significantly, then Tukey's Honest Significance Difference Test (HSD Test) will be continued. at the level of 5%.

Maintenaning plants through intermittent water supply, at the age of 7 days after planting, the soil is left saturated, then inundated for 1 day, afterwards the water is reduced again (saturated) for 7 days, this research used basic fertilizer namely Tanotec organic fertilizer as much as 100 kg h-1 or equivalent to 30 g plot^{-1}, for weed control is done by removing it.

3. RESULTS AND DISCUSSION

3.1 The Height of Plants

The results of analysis of variance on plant height on experimental land that was treated with LOF had a very significant effect, namely at plant age 15 DAP, 28 DAP, 43 DAP. Plant life is 15 DAP, the highest plant is found in the treatment 25.25 L. ha^{-1} which is 49.3 cm but not significantly different from the treatment of 13.00 L. ha^{-1} is 48.7 cm high and is significantly different from the other treatments.

Plant age 28 DAP, highest plant in treatment 25.25 L. Ha-1 64.51 cm and very different to other treatments (<0.001), as well as 43 highest plant DAP found in treatment 25.25 ml ha^{-1} 86 cm differs significantly from the other treatments.

It can be said that the best treatment of plant height in the field is the administration of LOF 25.25 L ha^{-1} Data analysis of the effect of the dose combination of LOF Arenga palm on plant height reveals that plant height of 15 DAP grow significantly because nutrient requirements are available through leaves after the application of LOF. Significant effects are seen after plants are 28 DAP, due to the needs of plants that have increased, the difference of plant height from each treatment gives a significant difference. The increase in growth due to the Nitrogen element found in the given LOF than can be directly absorbed through rice leaf stomata.

Plant growth is shown through the increase of plant height due to the availability of Nitrogen content [7,8], then it is said that Nitrogen is a very important element in building the protein needed by plants and if N is not available, plant growth will decrease. The differences in plant height are caused by the provision of suitable fertilizers [9] and if it gave inappropriate doses it will inhibit the growth. Besides, it was explained that plant height was influenced by genetic factors. The height of the rice plant is about 91 - 106 cm [10]. In addition to the influence of nitrogen, it is also influenced by the content of IAA and GA3 hormones found in the LOF of arenga palm. Fitohormones can change the growth and the development of plant, hormones play a role in various processes such as extension, flowering, root formation and vascular differentiation [11]

3.2 Number of Tillers

Data on the number of tillers in the plant age of 15 DAP, 28 DAP and 43 DAP, are presented in Table 2. The results of the variance analysis show that the use of arenga palm LOF skin flour significantly affects the number of tillers at 15 DAP, 28 DAP and 43 DAP. Furthermore, the HSD test results were 5% that the highest number of tillers at the age of 15 DAP is found in the use of Arenga palm LOF.

25.25 L. ha^{-1} is an average of 9.26 tillers per clump and not significantly different from the 13.00 L. ha^{-1} LOF Arenga palm with number of tillers of 8.9 and very significantly different from other treatments.

Plant age of 28 DAP, the most tillers were found in the use of Arenga palm LOF 25.25 L. ha^{-1} is 17.46 tillers and very significantly different (<0.001) with other treatments as well as at plant age 43 DAP, the best treatment was on the use of arenga palm LOF 25.25 L. ha^{-1} with a number of tillers 17.7, not significantly different from the treatment of LOF Arenga palm Juice 13.00 L. ha^{-1} (17.03 tillers) and LOF Arenga palm 25.50 L ha^{-1} (17.0 tillers).

The yield of seedlings of rice hollow varieties which were planted by the Jajar Legowo system of 2: 1 amounted to 13 tillers [12]. The number of tillers of rice plants in the age of 43 days reached 16.7 -18.7 stems [13]. Lack of nutrient sources is a major factor in the low productivity of newly emerging tillers [14]

Productive tillers are plants that are able to form panicles and grains found in each clump of rice because not all stems in a clump of rice can produce panicles or grains, thus productive tillers are one indicator in determining the productivity of rice plants. The analysis results showed that the use of LOF arenga palm significantly affected the number of productive tillers of rice fields.

The results of further tests showed that the control treatment was significantly different from the other treatments but was not different from the treatment of 25.50 L. ha^{-1} with a number of productive tillers of 10.4 to 11.9 stems per clump.

The highest yield obtained from this treatment was 25.75 L ha^{-1} and provides a significant difference to all treatments with the number of productive tillers reaching 15.23 stems per clump. Productive tillers of rice plants ranging from 13-16 stems per clump as well as the genetic potential of Mekongga varieties (hollow), namely 13-16 16 stems per clump [15].

The number of tillers of rice plants is influenced by fertilization, sun irradiation and the use of spacing. [16] The treatment of 25.75 ml ha^{-1} was the highest dose of LOF treatment where the nutrient content of N was 1.37%, and the hormone auxin (IAA) content was 0.49 ppm. The content can spur the development and the growth of the number of productive tillers of rice plants. So that it can be stated that the number of doses given, the more available N nutrients that can be used by plants, the better the growth and productive tillers of rice plants. Auxin hormones play a very important role in the growth and development of shoots and tillers of rice plants [17].

Potassium serves to affect the balance of N and P. [18] Furthermore, the formation of the number of productive tillers is closely related to the number of maximum tillers, the maximum number of tillers tends to produce a higher number of productive tillers for rice plants with productive tillers of Makongga varieties ranging from 13-16 stems [19].

3.4 The Yield of Harvested Dry Grain

The results of the variance analysis showed that the combination treatment of LOF arenga palm had a very significant effect on the yield of harvested dry grain (HDG). The average weight of grain per plot and per hectare can be seen in Table 4.

The results of further tests showed that the highest yield of harvested dry grain (HDG) was found in the treatment of 25.75 L ha^{-1}, namely 5.11 kg $plot^{-1}$ or equivalent to 7.99 tons ha^{-1}. and very different (<0.001) with other treatments. The control treatment (without treatment) only reached 2.75 kg $plot^{-1}$ or 4.29 tons ha^{-1}. The second highest treatment is in the treatment of 25.50 L. ha^{-1} with a yield of 4.25 kg $plot^{-1}$ or equivalent to 6.65 tons ha^{-1}. From this description, it can be said that the higher the use of liquid organic fertilizer, the higher the results obtained, this is because the nutrients contained in the LOF are sufficiently available and can be absorbed properly by plants. Besides this increase in the number of rice grains contained

Table 1. Effect of using POC on plant height in experimental fields

Treatment (L.ha^{-1})	Height of Plants (cm)		
	15 DAP	**28 DAP**	**43 DAP**
A0 = Control	39.8a	59.23a	73.48a
A1= 5,25	43.2b	59.77b	77.44b
A2= 5,50	44.5c	60.36c	78.67c
A3= 5,75	45.2c	60.66c	79.64d
A4= 12,75	46d	61.03d	81.45e
A5= 13,00	48.7g	62.99h	83.81h
A6= 13,25	46.8ef	61.95f	82.71fg
A7= 25,25	49.3g	64.54i	86.0i
A8= 25,50	46.5d	61.42e	82.05ef
A9= 25,75	47.2f	62.58g	83.51gh

Note: Numbers followed by different letters show a significant differences at the 5% level according to the HSD test

Table 2. Effect of the use of Arenga palm POC to maximum till amount in experimental field

Treatment (L.ha^{-1})	Number of Tillers		
	15 DAP	28 DAP	43 DAP
A0 = Control	5.9a	12.63a	12.33a
A1= 5,25	6.4b	14.1b	14.8b
A2= 5,50	6.8c	14.83c	15.4bc
A3= 5,75	7.1c	15.3d	15.56bc
A4= 12,75	7.6d	15.9e	15.86c
A5= 13,00	8.9fg	17.03h	17.03de
A6= 13,25	8.06e	16.56g	16.76d
A7= 25,25	9.26g	17.46i	17.7e
A8= 25,50	7.83de	16.7gh	17de
A9= 25,75	8.56f	16.13f	16.26cd

Note: Numbers followed by different letters show significant differences at the 5% level according to the HSD test

Table 3. Effect of use of Arenga palm LOF on the number of productive tillers on the experimental land

Treatment(L.ha^{-1})	ProductiveTillers100 DAP
A0 = Control	11.9a
A1= 5,25	12.8bcd
A2= 5,50	11.4ab
A3= 5,75	14.37de
A4= 12,75	12.37bc
A5= 13,00	12.6bcd
A6= 13,25	13.6cde
A7= 25,25	13.23bcd
A8= 25,50	10.4a
A9= 25,75	15.23e

Note: Numbers followed by different letters show significant differences at the 5% level according to the HSD test

Table 4. Effect of use of Arenga palm POC on 125 harvests of dry grain results in experimental fields

Treatment (L.ha-1)	Result of GKP	Result of GKP
	Kg/Plot	Ton/ha
A0 = Control	2.75a	4,296.88
A1= 5,25	3.08ab	4,817.7
A2= 5,50	2.95ab	4,609.38
A3= 5,75	3.25abc	5,078.13
A4= 12,75	3.98cd	6,224.0
A5= 13,00	3.75cd	5,859.38
A6= 13,25	3.45bc	5,390.63
A7= 25,25	3.72cd	5,807.29
A8= 25,50	4.25d	6,645.83
A9= 25,75	5.11e	7,989.58

Note: Numbers followed by different letters show significant differences at the 5% level according to the HSD test

due to the presence of Auxin hormones in arenga palm LOF. The application of IAA through the leaves will increase the rate of photosynthesis and cause maximum photosynthate partition to the grain is evidenced by the ability of higher grain filling and grain yield [20].

Potassium elements contained in LOF can increase the amount of grain per panicle, and help enzyme activity in the opening and closing the stomata, the mechanism of taking nutrients through leaves occurs due to diffusion and osmosis through the stomata hole, thus

absorption of nutrients can be easier. Potassium can increase grain yield to 6.86 tons ha^{-1} [21]. Rice mekongga varieties have yield potential ranging from 6 - 8.4 tons ha^{-1}. If K is absorbed in the primordial phase it will help increase grain weight and grain yield [22] and when compared with the use of arenga palm it can be said that optimal rice production has been achieved, which is 7.99 tons ha^{-1}. The effect of the application of IAA hormone on leaves can increase weight and density of rice grain [23].

4. CONCLUSION

a. The dose of using arenga palm is good for plant height, the maximum number of tillers at age 15 DAP, 28 DAP and 43 DAP is 25.25 L. ha^{-1}
c. The dose of using arenga palm is good for the number of productive tillers and the yield of harvested grain is 25.75 L. ha^{-1}.

COMPETING INTERESTS

I am expert in soil and fertilizer will always make improvements to get better quality fertilizers for plant growth and yield.

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