KnE Social Sciences
ASABEC 2023
Annual Symposium on Applied Business Economics and Communication 2023
Volume 2024

Research Article

Effect of Rice Straw Compost and NPKMg Fertiliser Treatment on Growth of Sugar Palm [*Arenga pinnata merr*] Age 12 Months

Dede Suhendra[1]*, Zahlul Ikhsan[1], Reflinaldon[2], and Yulmira Yanti[2]

[1]Department Plantation Cultivation, Faculty of Agriculture, Universitas Andalas, Padang, Indonesia
[2]Department of Plant Protection, Faculty of Agriculture, Universitas Andalas, Padang, Indonesia

ORCID
Dede Suhendra: https://orcid.org/0000-0003-0429-3106

Abstract.
Sugar palm has the potential to be cultivated because it has multiple benefits from plant to production. One of the efforts to increase the production of Sugar Palm palm is by using cultivation techniques and effective nursery methods. Sugar Palm nursery research has been carried out by giving rice straw compost and NPKMg in the experimental field of the Faculty of Agriculture Campus III, University of Andalas, Dharmasraya, West Sumatra with the research time from July to October 2023. This study aims to obtain the interaction of rice straw compost and soil with the best dose of NPKMg on the growth of palm seedlings. This research is in the form of experiments arranged in a randomized group design (RGD) 4 x 3 factorial pattern with 3 groups, so there are 36 experimental units. The first factor was the comparison of planting media with rice straw compost (M1: Rice straw compost 2.5 kg + Soil 2.5 kg, M2: Rice straw compost 3 kg + Soil 2 kg, and M3: Rice straw compost 3.5 kg + Soil 1.5 kg). The second factor is the dose of NPKMg fertilizer (P1: 130 g/polybag, P2: 140 g/polybag, P3: 150 g/polybag, and P4: 160 g/polybag). Observation data were analyzed with the F test at a 5% level and if F was continued with the DMRT test. The results of the experiment showed that there was no interaction between the comparison of soil media with rice straw compost and NPKMg fertilizer on growth.

Keywords: sugar palm seedlings, rice straw compost, NPKMg fertilizer

Corresponding Author: Dede Suhendra; email: dedesuhendra@agr.unand.ac.id

Published: 29 August 2024

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ASABEC 2023 Conference Committee.

1. Introduction

Sugar Palm (Arenga pinnata Merr.) is one of the plantation crops that need to be developed in Indonesia because it has the potential to be cultivated. When viewed from its benefits, Sugar Palmen has multiple benefits, almost in all parts of the plant. The morphological benefits include the leaves, fibers, roots, and stems as well as the production of fruit, sap, and starch. Therefore, the demand for Sugar Palm palm production has increased so that a very large amount is needed, but because logging activities are not balanced with planting, there is a decline [1].

Based on the Central Bureau of Statistics in 2018-2022, in West Sumatra Province shows that the cultivation of sugar palm plants has fluctuated, both in the area of sugar palm plants and their production. The area of sugar palm trees in 2018 (1449.2 ha), in 2019 (1427.4 ha), in 2020 (1125.00 ha) and in 2021 (1066.34 ha). Data from the Food, Horticulture, and Plantation Service Office states that the production of sugar palm decreased, in 2018 (1813.65 tons), 2019 (1814.00 tons), 2020 (1811.00 tons), and 2021 (1775.02 tons). The planting area and production of Sugar Palm palm have decreased, which shows that there is still no good processing in the cultivation of Sugar Palm palm. In general, palm trees still grow naturally or are rare so efforts are needed to cultivate Sugar Palm palm plants. The lack of attention and development of cultivation on this palm plant makes the palm plant less desirable in its cultivation less seriously by the community. One of the efforts that can be made to increase the production of Sugar Palm palm is by knowing how to cultivate a good Sugar Palm palm starting from an effective seedling method, determining the composition of a good planting media treatment, and accelerating the growth of the Sugar Palm palm seedlings. The first step of plant cultivation is nursery. In the nursery, seedlings that have superior quality are seedlings with the ability to grow, optimal strength, and in the implementation of transplanting can face environmental stress. An example of environmental stress is the dry season which affects the growth of palm production. This requires intensive maintenance efforts, especially on the amount and frequency of watering, and growing media as a provider of organic matter, shading, and fertilization [1].

Fertilization requires the provision of organic materials and inorganic materials. Organic materials contain organic compounds produced from the remaining plant materials that are decomposed by microorganisms [2]. One of the inputs providing organic matter is rice straw compost. Rice straw compost was chosen as an organic provider because of its ample availability compared to other agricultural waste but its use is still minimal. Rice straw as an organic material is very good to use because it can improve the physical, chemical, and biological properties of the soil. In addition, rice straw can increase the efficiency of nitrogen fertilizer use, increase soil fertility, and improve soil physical properties as a source of nutrients, especially K. According to research by Gunarto [3], rice straw compost contains P (0.27%), K (0.47%), Na (0.27%), Ca (0.05%) and Mg (0.034%).

The nutrient content of organic matter is relatively low, so nutrient suppliers from inorganic fertilizers are needed. One of the inorganic fertilizers is compound fertilizer (NPK). NPK fertilizers contain N (nitrogen), P (phosphorus), and K (potassium) which

can increase single macronutrients such as urea, SP- 36, and KCl. The NPK compound fertilizer to be used is NPK Phonska Fertilizer (15:15:15) containing N (15%), P2O5 (15%), K2O (15%), S (10%) with a maximum moisture content of 2%. Compound fertilizers are usually given at the time of immature plants (TBM), the growth system is not perfect during the TBM period, for this reason, a combination of rice straw organic matter with inorganic NPK fertilizer is needed to maintain soil fertility balance, and accelerate the seedling process.

This study aims to obtain the interaction of rice straw compost and soil with the best dose of NPKMg on the growth of palm seedlings, obtain the best composition of rice straw compost and soil on the growth of palm seedlings, and obtain the best dose of NPKMg fertilizer on the growth of palm seedlings.

2. Materials and Methods

2.1. Place and time

This research was conducted at the Experimental Land of Andalas University Campus III Dharmasraya, Nagari Sungai Kambut, Punjung Island District, Dharmasraya Regency, West Sumatra Province, Geographically located between 0^{o}50’40”- 1^{o}10’04 “LS 101^{o}23’36”-101^{o}36’40” East with an altitude of 115-125 meters below sea level (masl). This research took place from July to November 2023.

2.2. Materials and tools

Materials and tools used in this study were 12 month old palm seedlings taken from Lima puluh Regency, label paper, plastic sacks, 5 kg polybags, rice straw compost, bran, kendang fertilizer, brown sugar, NPKMg fertilizer, soil, water, tarpaulin and EM4. The tools used in this research are 70% intensity paranet, hoe, machete, scales, ruler/meter, camera, razor/cutter, vernier, ruler, rope, scissors, paddle, hand sprayer, gloves and stationery.

2.3. Research methods

The research used a 4 x 3 two-factorial pattern Randomized Group Design (RGD) with 3 replications, so there were 36 experimental units. Each experimental unit consisted

of 2 plants so that there were 72 plants and all were observed. The first factor was the comparison of planting media with rice straw compost (M1: Rice Straw Compost 2.5 kg + Soil 2.5 kg, M2: Rice Straw Compost 3 kg + Soil 2 kg, and M3: Rice Straw Compost 3.5 kg + Soil 1.5 kg). The second factor is the dose of NPKMg fertilizer (P1: 130 g/polybag, P2: 140 an several stages.

Preparation of organic materials, the organic material used in this study is rice straw which will be cut with a size of 5-10 cm on a tarpaulin. This cutting aims to accelerate decomposition. 20 kg of rice straw that has been cut is then added with bran and manure as much as 2 kg and stirred until evenly distributed. Mix 200 ml EM4 solution, 50 g brown sugar, and 12 L water Flush the solution that has been made in the previous stage into the material that has been mixed (aims to help the weathering process) and stirred so that the temperature does not increase. Next, incubate for 30 days until mature compost is obtained with physical characteristics of color change to black with loose texture, no smell and no heat, indicating that the compost is ready for use.

Land preparation was carried out as the experimental site was cleaned of weeds and materials that could interfere with the growth of sugar palm seedlings, then the land was leveled. Shade making was adjusted to the land conditions and for the entire plot area with a height of 2 m. Shade was made from paranet with 70% illumination according to the treatment. The shade serves to avoid the palm seedlings from direct sunlight exposure.The preparation of palm planting media was using 5 kg polybags filled with soil and treated with rice straw compost. Then the polybags were arranged neatly, and labeled on each polybag.

Planting of palm seedlings was done by transferring the palm seedlings to the planting media that had been treated with rice straw compost. Rice straw compost treatment with a predetermined treatment. Planting the seedlings was done by making a hole in the center of the polybag that had been filled with a mixture of soil and rice straw compost, the seedlings that would be transferred to the polybag were sliced with a razor blade, then put into the polybag that had been filled with a mixture of rice straw compost and soil. One palm seedling was planted in each polybag. NPKMg fertilizer was applied after the Sugar Palm palm seedlings were 12 months old after planting the seedlings. NPKMg fertilizer was applied 5 times, once every 2 weeks by making a hole around the roots and around the trunk of the palm seedlings.

Plant maintenance is done by watering the soil once a day and if the weather conditions are rainy then no watering is done. Weeding is done when the weed population

grows very fast in the polybag or around the polybag by directly weeding by hand. The parameters observed were the increase in height of the sugar palm plants, the diameter of the stump, the number of leaflets, the length of the leaflets and the width of the leaflets. Observations were made on the first day after planting, and then every 2 weeks all seedlings were observed.

3. Result and Discussion

3.1. Height gain of sugar palm seedlings

The results of statistical analysis using the F test at the 5% level on the height increase of sugar palm seedlings showed that the treatment of soil media comparison with rice straw compost and the dose of NPKMg fertilizer did not significantly affect the height increase of sugar palm seedlings. The average height of palm seedlings can be seen in Table 1.

TABLE 1: Height increase of Sugar Palm seedlings (cm) with the treatment of soil media comparison with rice straw compost and doses of NPKMg fertilizer in Sugar Palm seedlings 60 MST.

NPKMg (g) Fertilizer Dose	Rice Straw Compost: Soil (kg: kg)			Average
	2.5: 2.5	3: 2	3.5: 1.5	
130	91.67	92.17	92.33	92.06
140	89.17	82.23	89.80	87.07
150	85.83	89.17	85.33	86.78
160	80.50	82.83	82.00	81.78
Average	86.79	86.60	87.37	

The treatment of rice straw compost media with soil which is 3.5: 1.5 contained in Table 1 showed high growth of palm seedlings with an average value of 87.37 cm. The treatment of the effect of NPKMg fertilizer dose with a dose of 130 g produced high growth in palm seedlings with an average value of 92.06 cm. The difference in plant height increase is due to the event of cell division and extension at the tip of the plant. Provision of organic materials and inorganic materials that cause protein synthesis in the height increase of palm plants [4].

In the organic material provider of rice straw compost, although it can improve soil structure and increase pores that take up more nutrients, rice straw compost has a low nutrient requirement that is not optimal for the nutritional needs of palm seedlings.

Thus, it requires an inorganic provider, namely NPKMg fertilizer. Providing N nutrients will affect total N and help activate cells in plants so that it can facilitate the photosynthesis process which ultimately affects the growth of plant height. Table 1 shows that there is no significant effect on the height increase of palm seedlings, it is suspected that the lack of N limits the production of proteins and other materials used in the formation of new cells, lack of P elements that affect cell division and lack of K and Mg elements will reduce the growth stimulation point of the plant. The increase in plant height is influenced by the provision of N, P, K, and Mg elements simultaneously in the provision of nutrients needed by palm seedlings [4]. This is evidenced by the implementation of the NPKMg fertilizer dosage range that is too long and the nursery period that is too fast so as not to see the difference given the treatment. The sugar palm plant is a plantation crop. Plantation crops require experiments with a short time to see the differences given by the treatment [5]. This could also be due to the provision of organic material, namely rice straw compost, which has not been decomposed properly. According to Manahan [6], the optimal application of organic fertilizer will be seen after several years so it is suspected that it cannot have an immediate effect to support the growth of height and plant production.

3.2. Diameter of sugar palm seedlings

The results of statistical analysis using the F test at the 5% level on the increase in diameter of the Sugar Palm palm trunk showed that the comparison of soil media with rice straw compost and the dose of NPKMg fertilizer did not significantly affect the increase in diameter of the Sugar Palm palm seedlings. Observations of the increase in diameter of the Sugar Palm palm trunk showed that the average increase in diameter of the Sugar Palm palm trunk with the treatment of soil media with rice straw compost and doses of NPKMg fertilizer was between 21.40 - 26.67 cm. The average stem diameter increment can be seen in Table 2.

The treatment of rice straw compost with soil media 3.5: 1.5 in Table 2 shows that the increase in diameter of the palm trunk is not significantly different in palm seedlings with the highest average value of 24.54 cm. The treatment of the effect of NPKMg fertilizer with a dose of 160 g produced an increase in stem diameter in palm seedlings with the highest average value of 24.04 cm. This is inseparable from the provision of organic materials and inorganic materials where according to Leiwakabessy [7], the increase in

Table 2: Increase in diameter of Sugar Palm seedlings (cm) with the treatment of soil media comparison with rice straw compost and dosage of NPKMg fertilizer on Sugar Palm seedlings 60 week after planting.

NPKMg (g) Fertilizer Dose	Rice Straw Compost: Soil (kg: kg)			Average
	2.5: 2.5	3: 2	3.5: 1.5	
130	24.03	21.40	24.13	23.19
140	22.40	23.30	21.53	22.41
150	21.77	23.30	26.67	23.91
160	24.37	21.93	25.83	24.04
Average	23.14	22.48	24.54	

stem diameter is inseparable from inorganic elements namely N, P, K, and Mg. These elements play a role in increasing the diameter of the palm plant.

3.3. Increase In number of sugar palm leaflets

The results of statistical analysis using the F test at the 5% level on the number of leaflets showed that the treatment of soil media comparison with rice straw compost and the dose of NPKMg fertilizer had no significant effect on the increase in the number of leaflets and as a tissue connecting the roots with the leaves. According to Tambuanan [5], plants will thrive if there are enough nutrients so that they can be absorbed for the photosynthesis process and utilized for the increase in the number of plant leaves. In the experiments that have been carried out, the short period has caused the treatment differences not to be seen. This agrees with what Fitriyani [8] said that annual plants need a long time to increase the growth of the stem of the palm plant. The average increase in the number of leaves can be seen in Table 3.

Table 3: Increase in the number of Sugar Palm leaf blades (sheet) with the treatment of soil media comparison with rice straw compost and doses of NPKMg fertilizer in Sugar Palm seedlings 60 week after planting.

NPKMg (g) Fertilizer Dose	Rice Straw Compost: Soil (kg: kg)			Average
	2.5: 2.5	3: 2	3.5: 1.5	
130	17.67	14.00	17.33	16.33
140	15.33	17.00	16.33	16.22
150	14.33	13.00	17.33	14.89
160	14.00	18.33	15.00	15.78
Average	15.33	15.58	16.50	

Treatment of rice straw compost with soil media in Table 3 shows the best increase in the number of palm leaves on palm seedlings with an average value of 16.50 strands in the treatment of rice straw compost with 3.5 soil media: 1.5. The treatment of the effect of NPKMg fertilizer at a dose of 130 g produced the highest increase in the number of leaf blades on palm seedlings with an average value of 16.33 blades. Research in a short time is difficult to know the effect, the leaf midrib of this palm plant emerges from the stem, and the higher the palm seedlings, the number of leaf midribs will continue to grow. The number of leaves affects the results of photosynthesis because the phloem network is circulated through plant cells that experience growth. The number of leaves will affect the growth of palm seedlings [9].

The length of decomposition time that produces available nutrients. However, in this study, the decomposition time of straw compost is still classified as a short time, namely for 1 month. According to Mulyani [10], natural decomposition that occurs in rice straw compost should be able to occur for up to 12 months or 1 year. The components of rice straw consisting of cellulose, hemicellulose, lignin, and protein in small amounts make the C/N value high. If C/N is high, it causes the decomposition process of rice straw for a long period [11]. Therefore, inorganic fertilizers are needed to meet the nutrients needed in palm seedlings. The appearance of leaves is due to the availability of sufficient nutrients for plants. Because the role in providing inorganic materials is the content of N and P. According to Dachlan et al. [12] stated that the content of this N element is the main material provider in amino acids, cell division, elongation, and cell enlargement in meristem tissues to help leaf growth. According to Manahan [6], optimal fertilizer application will be seen after several years so it is thought that it cannot have an effect in a short time.

3.4. Sugar palm leaf length increase

The results of statistical analysis using the F test at the 5% level on the increase in the length of palm leaves showed that the treatment of soil media comparison with rice straw compost and the dose of NPKMg fertilizer did not significantly affect the increase in the length of palm leaves. Observations of the increase in the length of palm leaves showed that the average with the treatment of rice straw compost with soil media and the dose of NPKMg fertilizer was between 19.93 and 22.60 cm. The average leaf length increase of sugar palm seedlings can be seen in Table 4.

Table 4: Sugar Palm Leaf Length Increase (cm) with the treatment of soil media comparison with rice straw compost and doses of NPKMg Fertilizer on Sugar Palm Seedlings 60 weeks after planting.

NPKMg (g) Fertilizer Dose	Rice Straw Compost: Soil (kg: kg)			Average
	2.5: 2.5	3: 2	3.5: 1.5	
130	21.60	22.50	21.27	21.79
140	19.93	21.53	22.60	21.35
150	21.83	21.47	21.07	21.46
160	22.03	21.87	20.93	21.61
Average	21.35	21.84	21.47	

The treatment of rice straw compost with soil media in Table 4 showed the best increase in the length of palm leaves on palm seedlings with the highest average value of 21.84 cm in the treatment of rice straw compost with soil media 3 : 2. The treatment of the effect of NPKMg fertilizer with a dose of 130 g produced the best increase in the length of palm leaves on palm seedlings with an average value of 21.79 cm. The height of palm seedlings is also one of the links with leaf length. The height of the palm seedlings produced no significant effect, which also caused the increase in the length of the palm leaves to have no significant effect. According to Dwidjoseputro [13], the length of the leaves of sugar palm seedlings is closely related to the height of the seedlings.

The higher the palm seedlings, the longer the length of the leaves. The length of the leaves is also closely related to the surface area of the leaves, where the more extensive the photosynthesis process will be. The process of photosynthesis greatly affects the development and growth of leaves. Leaf age greatly affects the level of chlorophyll contained in a leaf. Leaf meristem activity that causes leaf elongation.

3.5. Sugar palm leaf width increase

The results of statistical analysis using the F test at the 5% level on the increase in width of palm leaves showed that the treatment of soil media comparison with rice straw compost and the dose of NPKMg fertilizer did not significantly affect the increase in width of palm leaves. Observations of the increase in leaf width of sugar palm showed that the average with the treatment of rice straw compost with soil media and doses of NPKMg fertilizer was between 23.97 - 30.33 cm. The average increase in the width of palm leaves can be seen in Table 5.

Table 5: Sugar Palm Leaf Width Increase (cm) with the Treatment of Soil Media Comparison with Rice Straw Compost and Doses of NPKMg Fertilizer on Sugar Palm Seedlings 60 weeks after planting.

NPKMg (g) Fertilizer Dose	Rice Straw Compost: Soil (kg: kg)			Average
	2.5: 2.5	3: 2	3.5: 1.5	
130	28.50	24.80	26.07	26.46
140	23.97	26.50	30.33	26.93
150	28.13	27.20	27.20	27.51
160	29.70	26.73	26.23	27.55
Average	27.58	26.31	27.46	

The treatment of rice straw compost with soil media in Table 5 shows the best increase in the width of palm leaves in palm seedlings with an average value of 27.58 cm in the treatment of rice straw compost with soil media 2.5: 2.5. The treatment of the effect of NPKMg fertilizer with a dose of 160 g produced the best increase in the length of palm leaves on palm seedlings with an average value of 27.55 cm. Kaya [14] revealed that the increase in leaf size or width of leaves on palm seedlings is highly dependent on the element nitrogen. However, if the nutrients are less able to be absorbed by the plant then the metabolism in the plant will be disrupted. So that it has not been able to significantly affect the width of the leaves. The timing of NPKMg fertilizer dosing has a range that is not yet effective because the distance is close. So that the changes or reactions in the Sugar Palm palm seedlings are not yet known. In addition, the palm is a plantation crop. Plantation crops require experiments with a short time to see the differences given the treatment [5].

Condition of Sugar Palm seedlings figures 1 soursed from germination patterns of sugar palms were observed starting from the beginning of the seeds being planted until the age of 120 days after planting. This germination pattern was observed to determine the parts of the sprouts that appeared after the seeds did the imbibition process or the dormancy breaking treatment was carried out which is physical dormancy which is to break dormancy by using sandpaper and a sanding machine so that the process of removing the skin of the palm seeds can be faster, we know sugar palm seeds are difficult to germinate under optimum conditions so treatment is carried out to break the dormancy of the palm seeds Suhendra [15].

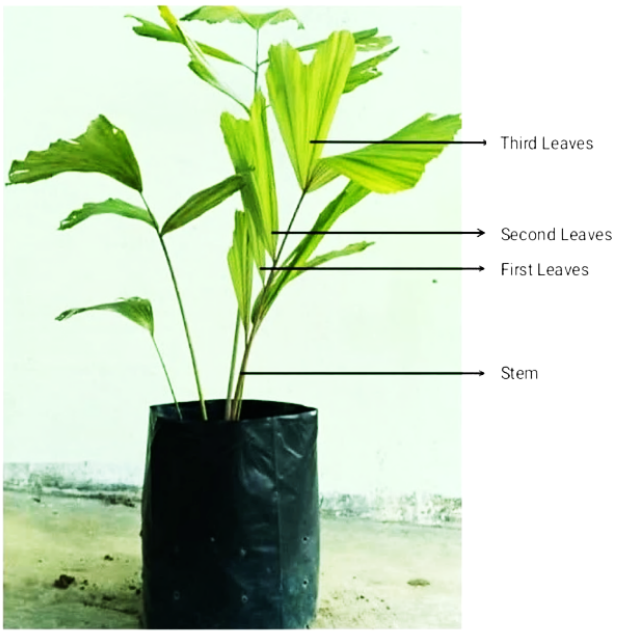

Figure 1: Sugar Palm Seedlings 60 weeks.

TABLE 6: Plant seedling criteria 60 weeks after planting.

No	Plant Part	Plant Seedling Criteria 60 weeks after planting
1	Root	Root branching and more root hairs
2	Stem	diameter of the stem increases and there are 5 leaf midrib branches
3	First Leaf	Leaf is located close to the surface of the soil and elongated
4	Second Leaf	The leaf is elongated and there are 2 parts
5	Third Leaf	Fully open and located at the tip of the midrib

4. Conclusion

The results showed no significant effect on the single treatment and interaction of soil media composition with rice straw compost and NPKMg fertilizer on the growth of sugar palm seedlings. The highest results were found in the treatment of the composition of straw compost and soil in a ratio of 3.5: 1.5 and NPKMg fertilizer at a dose of 130 g on the observation of plant height increase and number of leaves.

Acknowledgment

Authors thank the research fund PTNBH Universitas Andalas which has funded this research activity with the 2022 Indexed Publication Research (RPT) scheme with Contract Number T/6/UN.16.19/PT.01.03/Pangan-RPT/2023.Very useful for researchers & for the development of Universitas Andalas institutions in general.

References

[1] Syakir EDS. Prospek pengembangan tanaman aren (Arenga pinnata Merr) untuk bioetanol, peluang dan tantangan. In: Workshop Peluang, Tantangan dan Prospek Pengembangan Aren untuk Bioetanol Skala Industri dan UMKM, Hotel Salak Bogor. 2010.

[2] Susetya D. Panduan Lengkap Pembuatan Pupuk Organik. Yogyakarta: Pustaka Baru Press; 2017.

[3] Gunarto L, Lestari P, Supadmo H, Marzuki AR. Dekomposisi jerami padi, inokulasi Azospirillum dan pengaruhnya terhadap efisiensi penggunaan pupuk N pada padi sawah. Penelitian Pertanian Tanaman Pangan. 2002;21(1):1–10.

[4] Haryadi D, Yetti H, Yoseva S. Effect of some types fertilizeron the growth and production of kailan (Brassica alboglabra L.). Jom Faperta. 2015;2(2):1–10.

[5] Tambuanan ER. Growth response of cocoa seedlings (Theobrema cacao L.) on subsoil growing media with application of agricultural waste compost and inorganic fertilizers. Thesis. USU; 2009.

[6] Manahan PL, Agustina, SH. Growth Response of Seedlings Sugar Palm (Arenga pinnata Merr,) to the application of liquid organic fertilizer. USU; 2014.

[7] Leiwakabessy FM. Fertilizer and Fertilization. Bogor: Department of Soil Science. Faculty of Agriculture, Bogor Agricultural University; 1998.

[8] Fitriyani. Effect of PSugar Palmt Tree Age and Bokashi on the Growth of Rubber (Havea brasilliensia) Rootstock Candidates. Thesis. University of Riau.; 2008.

[9] Nurmayulis, Susiyanti SI, Reza MM, Saiful, Septi Y. RPS. Morphological Identification of Sugar Palm Plants from Lebak Regency. UNTIRTA; 2021.

[10] Mulyani H. Kajian Teori dan Aplikasi Optimasi Perancangan Model Pengomposan. Jakarta: Trans Info Media.; 2014.

[11] Sitepu RB, Anas I, Djuniwati S. Utilization of straw as organic fertilizer to increase growth and production of rice (Oryza sativa). Buletin Tanah dan Lahan. 2017;1:100–8.

[12] Dachlan A, Syam'un E, Singkerru AU. Pertumbuhan dan produksi tiga varietas padi pada berbagai paket pemupukan N sintetik bakteri Azotobacter. Jurnal Agrivigor. 2008;7(3):230–40.

[13] Dwidjoseputro D. Dasar-dasar mikrobiologi. 2019;

[14] Kaya E. Pengaruh kompos jerami dan pupuk NPK terhadap N-tersedia tanah, serapan-N, pertumbuhan, dan hasil padi sawah (Oryza Sativa L). Agrologia. 2013;2(1):288785.

[15] Suhendra D, Ikhsan Z, Aisyah S. Seed structure and germination pattern of sugar palm [Arenga pinnata L.]. In: IOP Conference Series: Earth and Environmental Science. IOP Publishing; 2023. p. 12018.