Jurnal Presipitasi
Media Komunikasi dan Pengembangan Teknik Lingkungan
e-ISSN: 2550-0023

Vol 19, No 3, 2022, 487-497
Article available at homepage presipitasi

Research Article

Utilization of Rubber Factory WWTP Muds as Fertilizer for Rubber Plant Clone PB 260 *(Hevea Brasiliensis Muell. Arg)*

Anis Tatik Maryani[1*], Suri Seftyaningsih Dewi[1], Nyimas Myrna Elsa Fathia[1], Yudha Gusti Wibowo[2]
[1] Agricultural Science, Faculty of Agriculture, Universitas Jambi, Jambi, Indonesia
[2] Department of Mining Engineering, Institut Teknologi Sumatera, Lampung, Indonesia
*Corresponding Author, email: anis.tatik@yahoo.com

Abstract

The rubber plant *(Hevea brasiliensis Muell. Arg)* is an important plantation crop in Indonesia because it is one of the non-oil and gas products that are a source of large amounts of foreign exchange income for the country. Experiment was arranged in a Randomized Block Design with one factor, namely Compost for Wastewater Treatment Plant (WWTP) sludge from a rubber factory which consisted of 5 treatment levels. Statistical analysis was carried out using variance (ANOVA). Variables observed in rubber plants were an increase in bud grafting length, plant diameter, the number of leaves, shoot dry weight, and root dry weight. The results showed that the WWTP waste compost from the rubber factory affected the growth of rubber seedlings, as shown in the variable length of grafting shoots, the number of leaf stalks (strands), and the dry weight of the plant crown. Meanwhile, the increase in stem diameter and dry weight of plant roots showed no significant effect on the observed variables.

Keywords: Fertilizer; sludge waste; rubber clone PB 260

1. Introduction

The rubber plant *(Hevea brasiliensis Muell. Arg)* is an important plantation crop in Indonesia because it is a non-oil and gas product source of large amounts of foreign exchange income for the country (Kamaludin, 2018). The main product of rubber plants is sap (latex). Latex plays a significant role as raw material for transportation, medical, and household equipment (Sitepu et al., 2019). Furthermore, the development of technology and industry that is increasingly advanced causes the use of natural rubber to be increasingly widespread in everyday life. This phenomenon directly encourages increased world rubber consumption and demand for natural rubber (Warren-Thomas et al., 2015). The total area of rubber plantations in Indonesia in 2018 reached 3.6 million ha, of which 88.1% were smallholder rubber plantations and only 6.7% large private plantations and 5.2% large state-owned plantations, with total production reaching 3.6 million tons, or equivalent to an export value of US$ 3,949,287. The area and productivity of rubber plantations in Jambi province in 2018, namely 389,753 ha, with a total production of 319,470 tons (Direktorat Jenderal Perkebunan, 2021)

Rubber plants can also play a role in reforestation and land rehabilitation because they are easily adaptable to the environment and do not need soil with a high fertility level (Umami et al., 2019). Rubber's adaptability and high genetic diversity allow this plant to be developed in marginal and critical lands. In contrast to other plantation crops, rubber plantations are very profitable because the adaptation of plants to the environment and climate is excellent, and the cultivation is simple (Tisarum et al., 2018). However, rubber in Jambi Province has various problems. One of them is the low productivity of rubber.

The cause of rubber's low productivity is that many farmers still use extracted rubber seedlings, wild tillers, or seed seedlings from previously cultivated natural rubber trees, sub-optimal land management, and sub-optimal plant maintenance caused by the high price of inorganic fertilizers. Based on the recommendation of the Agricultural Research and Development Agency (2010), one of the recommended commercial latex-producing clones for Jambi Province is PB 260 clone. The potential for latex production of PB 260 clones is relatively high, ranging from 1.5-2 tons/ha/year. In addition, clone PB 260 was classified as resistant to leaf diseases, namely *Corynespora, Colletotrichum, Oidium*, and fast growth. Therefore, the rubber plant clone PB 260 is a latex producer superior to the various clones tested. In addition, this clone is more responsive to environmental conditions, such as being relatively more resistant to severe water stress.

The rubber nursery industry's development is still insufficient to meet the availability of rubber seeds, especially for smallholder plantations. This condition can be seen in smallholder rubber plantations that still use swept rubber seeds. To get quality ready-to-plant rubber seeds, efforts need to be made to increase the growth of these rubber seedlings, one of which is using superior cloned rubber seeds. Superior seeds are needed and meet the requirements to increase the productivity of rubber plants because superior seeds will guarantee good plant growth and increase production (Suyanto & Munte, 2018). In addition, superior seeds or planting material will prevent pests and diseases, eventually decreasing production. One of the recommended rubber clones based on the 2009 National Rubber Plant Breeding Workshop was the PB260 rubber clone. Environmental factors growing in rubber nurseries that are quite important include the growth media and nutrient requirements. Growth and a good and sturdy root system are closely related to the composition and volume of the growing media used. A good growing medium is a medium that can provide the needs for the growth and development of rubber seedlings to produce uniform and fast seedlings that can be grafted at the age of 4-6 months. In addition, the polybag's size is thought to affect rootstock growth because it is closely related to the volume of the growing medium and the proportion of materials that make up soil and manure.

One of the efforts that can be made to meet the nutrient requirements for the growth of single-wing rubber seedlings to support the growth and productivity of rubber is by providing fertilizer. Fertilizer is a material given to plants to promote plant growth, increasing production and improving its quality as a result of improved nutrition. Fertilizers are classified into two, namely organic fertilizers and inorganic fertilizers. Organic fertilizers are fertilizers with the primary raw material being the remains of living things, such as plant residues, sewage or household waste, and factory waste that has undergone a decomposer process. Meanwhile, inorganic fertilizers are fertilizers made by fertilizer factories with high levels of chemicals. Besides supplying macronutrients, organic fertilizers can also provide micronutrients to prevent the loss of microelements in marginal soils or soils cultivated intensively with unbalanced fertilization. The higher the application of inorganic fertilizers without returning organic matter to the soil resulted in the balance and availability of soil nutrients being disturbed. Organic fertilizer is an alternative to increase the availability, adequacy, and efficiency of nutrient uptake for plants, one of which is compost (Khan et al., 2021).

Compost is the result of the decomposition of a mixture of organic materials that can be accelerated by a population of various microbes in warm, humid, and aerobic or anaerobic environmental conditions. The intended use of compost as organic fertilizer is due to its very optimal role in soil media, such as increasing the availability of nutrients, increasing soil absorption of water, improving soil structure, and improving the life activities of beneficial microorganisms in the soil by providing food for these microorganisms (Siedt et al., 2021). Giving compost to the soil, especially in the nursery medium, has a good impact on plant development. WWTP Mud Waste Rubber Factory is one source of natural compost that contains many nutrients. WWTP Rubber Factory Sludge Compost can reduce the application of inorganic fertilizers at the beginning of planting. However, special treatment is needed before being applied to composting the Rubber Factory WWTP Mud Waste (Prasmawari, 2011). Rubber Factory WWTP Mud Waste, adding cow dung and sawdust, proved effective in producing compost with physical-chemical characteristics. It stated that a mixture of 10:2:1 waste mud-cow dung-sawdust was the most optimum. Based on the description above, the authors are interested in researching "Growth of Rubber Clones 260 *(Hevea brasiliensis Muell. Arg)* with the Provision of Waste Mud WWTP Rubber Factory in Polybags."

2. Methods

2.1. Materials

This research was conducted at the Teaching and Research Farm, Faculty of Agriculture, Jambi University, Mendalo Indah Village, Jambi Outer City District, Muaro Jambi Regency. The materials used in this study were three months old clone PB 260 rubber seeds. Waste sludge from the rubber factory WWTP, cow manure, sawdust, NPKMg fertilizer (12-12-17-2), Ultisol soil, 30 x 35 cm polybag, and water. The tools used in this study were machetes, hoes, buckets, scales, analytical balances, soil sieves, tarpaulins, wood ranges, parents, meters, labels, rulers, caliper, stationery, cameras, and tools that support the research. Ultisol soil is characterized by C-organic, nitrogen (N), phosphor (P) and potassium (K) as variables of fertilizer.

2.2. Research Design

The sludge from WWTP and ultisol soil was combined using a polybag. The research design used in this experiment was a randomized block design with one factor, namely Compost of WWTP sludge from a rubber factory (K) which consisted of 5 levels as follows:

k0 : 15 gr Dosage (NPKMg Fertilizer 12-12-17-2).
k1 : 150 gr WWTP Sludge Compost + 15 gr NPKMg . Dosage
k2: 300 gr WWTP Sludge Compost + 15 gr NPKMg. Dosage
k3: 450 gr WWTP Sludge Waste Compost + 15 gr NPKMg. Dosage
k4: 600 gr WWTP Sludge Waste Compost + 15 gr NPKMg. Dosage

Each treatment was repeated five times in order to obtain 25 experimental units. Each experimental unit consisted of 4 plants, so the total number of plants was 100 plants. Each plot was taken with 2 plants as samples.

2.3. Plant Preparations

The research location was first cleaned of weeds or existing bushes using a machete. Then the ground was flat and cleaned of plant roots and garbage to make it easier to place polybags. To protect the seedlings from direct sunlight and rain, the shade was made using paranet with 50% sunlight intensity with a shaded area of 9 x 8 m and a shade height of 170 cm. Nets are installed around the shade to protect the seedlings from environmental disturbances. Meanwhile, nets are installed around the shelter to protect the seedlings from environmental disturbances such as chickens, monkeys and cats.

Rubber seeds must be selected first to get healthy and free from pests and diseases. Landing media is prepared by hoeing the Ultisol soil's top layer. Then the soil is cleaned of roots and other impurities and sifted. Furthermore, the compost from the WWTP sludge from the rubber factory was mixed with sifted soil before being put into polybags and incubated for a week. Rubber seeds were planted in polybags that had been treated. Planting is done by filling polybags and then making holes in the soil where the rubber seeds are placed.

Furthermore, the rubber seeds are separated from the polybag by cutting the polybag so that the roots are not broken. Planting time is done in the afternoon, so the seeds do not wilt. After the seeds are transferred to polybags, then the seeds are watered. Inorganic fertilizer was applied one week after transferring the seeds to the polybag, using 15 g of NPKMg (12-12-17-2) fertilizer (recommended dose). NPKMg fertilizer was given as much as 5 grams every month for three months. Plant maintenance includes watering and weeding. Watering is done daily, morning and evening or according to field conditions using a watering can. When it rains, there is no watering. Weeding is done manually by pulling weeds in the polybag by hand or with a hoe, either inside or outside the polybag. This is done to avoid competition between the main crop and weeds for nutrients from the soil. Again, weeding is carried out according to field conditions.

3. Result and Discussion

3.1. Result

3.1.1. Characteristics of Compost

Compost was analysed in laboratory of Universitas Jambi and Laboratory of Balai Pengkajian Teknologi Pertanian Jambi. The result of ultisol soil before and after being added as compost can be seen in the Table below.

Table 1. Soil characteristics

No	Sample	pH	Total N (%)	P HCl 25% (mg P_2O_5 100 g^{-1})	K HCl 25% (mg P_2O_5 100 g^{-1})	C-Organic	C/N
1	Soil (before treatment)	4.8	0.19	5.61	9.86	-	-
2	WWTP Sludge	-	1.58	0.20	0.20	29	18.40
3	Soil (after treatment) (K0)	3.97	0.17	-	-	1.04	6
4	Soil (after treatment) (K1)	4.32	0.17	-	-	1.72	10
5	Soil (after treatment) (K2)	3.68	0.21	-	-	1.94	9
6	Soil (after treatment) (K3)	4.37	0.18	-	-	1.63	9
7	Soil (after treatment) (K4)	4.33	0.21	-	-	1.68	8

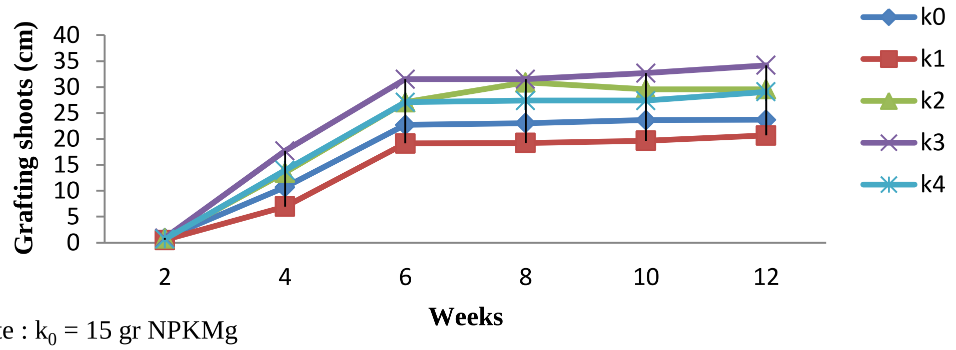
3.1.2. Increase in Length of Grafting Shoots (cm)

The analysis of variance (ANOVA) showed that the addition of WWTP sludge compost from the rubber factory significantly affected the length of grafting shoots at 12 weeks after planting (MST). The average increase in shoot length of rubber seedling grafting 12 weeks after planting can be seen in Table 2.

Table 2. The average increase in grafting shoot length (cm) of rubber seedlings of one umbrella clone of PB 260 on the provision of compost from WWTP sludge from rubber factories in polybags at 12 WAP.

Treatment	Average Increase in Length of Grafting Shoots (cm)
k_0: 15 gr NPKMg	23.68 c
k_1:150 gr kompos + 15 gr NPKMg	20.65 c
k_2 : 300 gr kompos + 15 gr NPKMg	29.57 b
k_3: 450g kompos + 15 gr NPKMg	34.18 a
k_4 : 600g kompos + 15 gr NPKMg	29.09 b

Table 2 showed that adding WWTP mud compost for rubber factories plus 15 g of NPKMg increased the length of grafting shoots in rubber plants. Each treatment of rubber mill WWTP compost showed differences when from the treatment of 15 g of NPKMg (ko). The treatment of 450 g compost + 15 g NPKMg(k3) showed the highest increase in the bud length of grafting rubber seedlings. Increase in the length of grafting shoots of one umbrella rubber seedling clone of PB 260 on the provision of compost waste from WWTP rubber factory 2 weeks after planting until 12 weeks.



Note : k_0 = 15 gr NPKMg
k_1 = 150 gr compost from WWTP + 15 gr NPKMg
k_2 = 300 gr compost from WWTP + 15 gr NPKMg
k_3 = 450 gr compost from WWTP + 15 gr NPKMg
k_4 = 600 gr compost from WWTP + 15 gr NPKMg

Figure 1. Graph of bud length growth of grafting shoots of rubber PB 260 clones by giving compost from factory WWTP sludge in polybags

Figure 1 shows all treatments showing an increase in the length of grafting shoots of rubber plants every week. From 4 weeks after planting to 6 weeks after planting, all treatments experienced a rapid increase in the length of grafting shoots of rubber plants. However, at 8 WAP to 12 WAP after planting, the length of grafting shoots increased, which was not as rapid as the previous week.

3.1.3. Bar Diameter Increase (m)

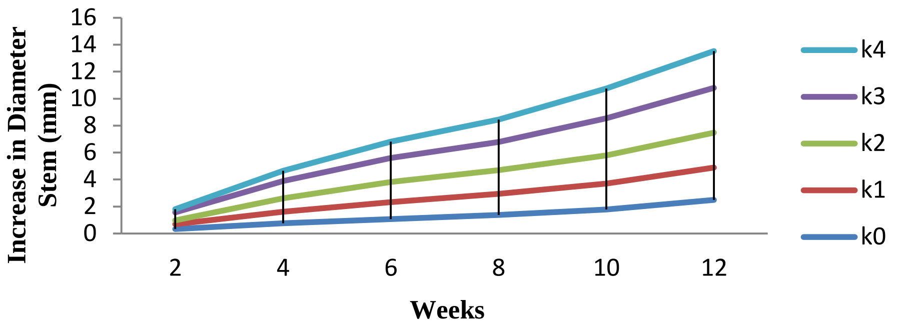
The analysis of variance (ANOVA) shows that the addition of WWTP sludge compost from the rubber factory did not significantly affect the increase in stem diameter. Therefore, the average increase in stem diameter is presented in table 3.

Table 3. The average increase in plant stem diameter (mm) of rubber seedlings of one umbrella clone of PB 260 on the provision of compost from WWTP sludge from rubber factories in polybags at 12 WAP.

Treatment	Average Plant Diameter
ko : 15 gr NPKMg	2.49 b
k1 : 150 gr compost + 15 gr NPKMg	2.40 b
k2 : 300 gr compost + 15 gr NPKMg	2.58 b
k3 : 450 gr compost + 15 gr NPKMg	3.34 a
k4 : 600 gr compost + 15 gr NPKMg	2.72 ab

Note: The numbers followed by the same lowercase letters are not significantly different based on the BNT test with a level of = 5%

Table 3 showed that the dose of WWTP compost for the rubber factory plus 15 g of NPKMg dose increased the diameter of the rubber stem. Compost treatment of 450 g plus 15 g of NPKMg(k3) showed the highest increase in stem diameter of rubber seedlings. Meanwhile, giving 150 g of compost plus 15 g of NPKMg(k1) showed the lowest average diameter value. The increase in stem diameter on a single PB 260 clone rubber plant composting of WWTP sludge waste from a rubber factory aged 2 WAP to 12 WAP is presented in Figure 2.



Note : k_0 = 15 gr NPKMg
k_1 = 150 gr compost from WWTP + 15 gr NPKMg
k_2 = 300 gr compost from WWTP + 15 gr NPKMg
k_3 = 450 gr compost from WWTP + 15 gr NPKMg
k_4 = 600 gr compost from WWTP + 15 gr NPKMg

Figure 2. Graph of the increase in the diameter of the rubber plant of PB 260 clones with the addition of factory WWTP sludge compost in polybags

In figure 2, all treatments showed an increase in plant stem diameter every week. Likewise, with increasing time (from the age of 2 weeks after planting to 12 weeks after planting), the diameter of the stem of the plant also increases. From 2 weeks to 12 weeks after planting, all treatments experienced an increase in plant stem diameter. In the treatment, the addition of 450 g of WWTP Sludge Compost plus 15 g of NPKMg(k3) showed a rapid increase.

3.1.4. Increase in Number of Leaves (Strand)

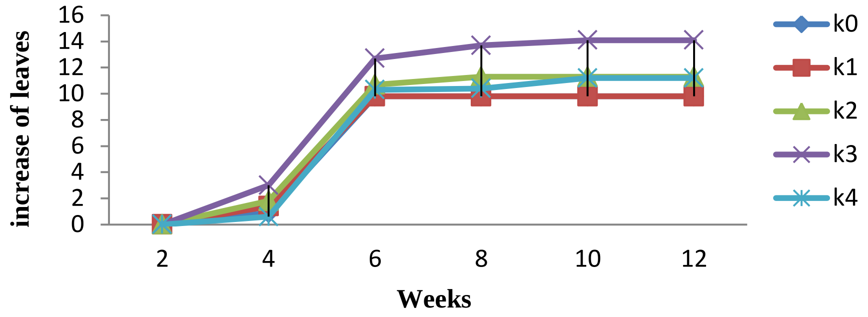
Based on the analysis of variance (ANOVA) at the age of 12 weeks after planting, it was found that the addition of compost from WWTP sludge from the rubber factory significantly affected the increase in the number of leaves of rubber seedlings. Therefore, the average increase in the number of leaves is presented in Table 4.

Table 4. The average increase in the number of leaves (strands) at various doses of compost for WWTP sludge from rubber factories in polybags 12 WAP

Treatment	Average Increase in Number of Leaves (Leaves)
ko : 15 gr NPKMg	9.8 b
k1 : 150 gr compost + 15 gr NPKMg	8.7 b
k2 : 300 gr compost + 15 gr NPKMg	11.1 b
k3 : 450 gr compost + 15 gr NPKMg	14.1 a
k4 : 600 gr compost + 15 gr NPKMg	11.2 b

Note: The numbers followed by the same lowercase letters are not significantly different based on the BNT test with a level of = 5%

Table 4 showed that the dose of WWTP compost for rubber mills plus 15 g of NPKMg increased the number of leaves. However, the treatment of 450 g compost + 15 g NPKMg was significantly different from all treatments for increasing the number of leaves. The development of the increase in the number of rubber seedling leaves in the provision of compost for WWTP sludge from a rubber factory aged 2 to 12 weeks after planting is presented in Figure 3.



Note : k_0 = 15 gr NPKMg
k_1 = 150 gr compost from WWTP + 15 gr NPKMg
k_2 = 300 gr compost from WWTP + 15 gr NPKMg
k_3 = 450 gr compost from WWTP + 15 gr NPKMg
k_4 = 600 gr compost from WWTP + 15 gr NPKMg

Figure 3. The graph of the increase in the number of leaves of the rubber seedling clones of PB 260 with the provision of compost by giving compost from the factory WWTP sludge in polybags

Figure 3 showed an increase in the number of leaves at observations 4 weeks after planting (MST) until observations 6 weeks after planting. After that, the treatment showed a rapid increase in the number of leaves. However, at observations 6 to 12 weeks after planting (MST), all treatments showed an increase in the number of leaves. Leaves that are not rapid as week 2 and week 4 after planting. The highest number of leaves at the observation 12 weeks after planting (MST) was found in the treatment of 450 g of WWTP Sludge Compost and 15 g of NPKMg.

3.1.5. Head Dry Weight (g)

The analysis of variance (ANOVA) showed that the composting of WWTP sludge from the rubber factory significantly affected the dry weight of rubber seedling shoots. The effect of giving compost from WWTP Rubber Factory on the dry weight of the rubber seedling crown is presented in Table 5.

Table 5. Average canopy dry weight (gr) of cloned PB 260 rubber seedlings to the provision of composted WWTP sludge from rubber factories in polybags at 12 WAP.

Treatment	Average Head Dry Weight
ko: 15 gr NPKMg	17.1 c
k1: 150 gr compost + 15 gr NPKMg	17.5 c
k2: 300 gr compost + 15 gr NPKMg	22.0 b
k3: 450 gr compost + 15 gr NPKMg	29.7 a
k4: 600 gr compost + 15 gr NPKMg	19.0 c

Note: The numbers followed by the same lowercase letters are not significantly different based on the BNT test with a level of = 5%

Table 4 showed that the results significantly differed for the canopy dry weight increase. For example, the treatment of 450 g of compost and 15 g of NPKMg resulted in an enormous canopy dry weight of 29.7 grams, significantly different from all other treatments.

3.1.6. Root Dry Weight (gr)

The analysis of variance (ANOVA) showed that the addition of WWTP sludge compost from the rubber factory had an insignificant effect on the root dry weight of rubber seedlings. The effect of giving compost WWTP sludge from rubber factories on root dry weight is presented in table 6.

Table 6. Average root dry weight (gr) of rubber seedlings of Clones PB 260 to apply rubber factory WWTP waste compost in polybags at 12 WAP.

Treatment	**Average Dry Weight of Root**
k0: 15 gr NPKMg	18.8 b
k1: 150 gr compost + 15 gr NPKMg	17.0b
k2: 300 gr compost + 15 gr NPKMg	17.5b
k3: 450 gr compost + 15 gr NPKMg	22.0 a
k4: 600 gr compost + 15 gr NPKMg	17.9b

Note: The numbers followed by the same lowercase letters are not significantly different based on the BNT test with a level of = 5%

Based on table 4, the treatment showed significantly different results on root dry weight. The treatment of 450 g of rubber factory WWTP waste compost + 15 g of NPKMg resulted in the largest root dry weight of 22 grams, significantly different from all other root dry weight treatments.

3.2. Discussion

Nitrogen is one of the variables useful for plant growth, so plant growth will be disrupted if there is a lack of nitrogen. The test results inform that the nitrogen content increases with the addition of sludge from WWTP. This condition confirms that the fertilizer derived from a mixture of ultisol soil and sludge from WWTP will have a good effect on plant growth. N, P, K is one of the factors that can accelerate plant growth as one of the variables needed by plants, the N content in the soil that can be used for plant growth has a content of 0.02% to 2.5% for the bottom layer and 0.06% to 0.5% for the top layer (source). The testing of this research was carried out on ultisol soil, the top soil. The test results showed that the soil that had not been mixed with fertilizer had an N content of 0.19%. The results of testing the N content in the WWTP sludge is 1.58% which means that the WWTP sludge is a potential material to be used as a mixture to increase the N content in the soil. N in plants is absorbed in the form of $NH4+$ or $NO3$. N is also a macro element that can stimulate plant growth quickly. Nitrogen is also needed by plants to carry out the photosynthesis in chlorophyll. Not only N, but the mixed results also showed that all nutrients needed by plants increased in soil mixed with sludge from WWTP.

Based on the results of the variance, it was known that the composting of WWTP sludge from the rubber factory at the end of the study showed results that had a significant effect on the variables, namely the increase in grafting shoot length, increase in the number of leaf stalks and crown dry weight. Meanwhile, the stem diameter and root dry weight of the rubber plant showed no significant effect on the variables.

Based on the results of further tests shown in table 2, the observation of the increase in grafting shoot length showed that the treatment showed a significant difference in the average grafting shoot length of rubber plants. The provision of rubber factory WWTP compost plus 15 g of NPKMg can increase the length of grafting shoots on rubber plants. Treatment with 450 g of WWTP compost for rubber mills plus 15 g of NPKMg (k3) showed the highest increase in grafting shoot length for rubber plants, while treatment with 150 g of WWTP compost for rubber mills plus 15 g of NPKMg (k1) showed an increase in shoot length for rubber plants.

Treatment of WWTP sludge waste compost from rubber factories on the addition of The increase in grafting shoot length of rubber plants from 4 weeks after planting to 6 weeks after planting showed a rapid increase in grafting shoot length. This is because the nutrients contained in the composted wastewater from the WWTP rubber factory have been utilized by plants, especially for an optimal photosynthetic activity to support plant height growth. The increase in plant height is strongly influenced by the availability of nitrogen in the soil. Nitrogen for plants stimulates overall plant growth, especially stems, branches and leaves (Ahmed et al., 2018). The availability of nitrogen in this study was in the moderate category. However, the addition of the dose was different for each treatment, so the growth was different in the second week of observation.

In addition, the compost from the WWTP sludge from the rubber factory also serves to provide nutrients and improve soil structure. The factors that affect plant growth consist of internal factors and external factors. Internal factors are factors contained in the seed or plant itself. External factors are outside the seed or plant, one of which affects growth in terms of external factors. A *suitable planting medium* is a medium that can provide water and nutrients in sufficient quantities for plant growth. It can be found in soils with good air conditioning, stable aggregates, good water holding capacity and sufficient root space.

Based on the results of further tests shown in table 3, for the observation of the increase in the diameter of the rubber plant stem, it showed that the treatment showed a significant difference from the average increase in the diameter of the rubber plant stem. The treatment of rubber factory WWTP compost plus 15 g of NPKMg can increase the stem diameter in rubber plants. Treatment with 450 g of WWTP compost for rubber mills plus 15 g of NPKMg (k3) showed the highest increase in the diameter of rubber plant stems. In comparison, treatment with 150 g of WWTP compost for rubber factories plus 15 g of NPKMg (k1) showed the lowest stem diameter of rubber plants. The treatment of increasing the diameter of the rubber plant stem shown in Figure 2 showed that the provision of WWTP sludge from the rubber factory gave a good response because the nutrient content of N, P, and K needed by rubber seed plants was available in sufficient quantities for plant needs so that plants could use it for the growth and development of plant parts, such as forming an enlarged stem diameter. Which states that if the nutrients given to plants are in a small or excessive range, these nutrients will inhibit the rate of plant growth (Liu et al., 2019). The availability of NPK nutrients in sufficient quantities causes the plant's metabolic activity to increase and the accumulation of assimilation in the stem area, resulting in the enlargement of the stem.

Based on the results of further tests shown in table 4, for the observation of the increase in the number of leaves (strands) of rubber plants, it was shown that the treatment showed a significant difference from the average increase in the number of leaves (strands) of rubber plants. Treatment with WWTP sludge compost treatment for rubber factories plus 15 g of NPKMg can increase the number of leaves (strands) on rubber plants. The treatment of 450 g of rubber factory WWTP mud compost plus 15 g of NPKMg(k3) showed the highest increase in the number of leaves (strands) of rubber plants, which was 14.1. On the other hand, the treatment of 150 g of rubber factory WWTP compost plus 15 g of NPKMg(k1) showed the lowest increase in the number of leaves (strands) of rubber plants which were 8.7. The treatment of 450 g of WWTP mud compost, plus 15 g of NPKMg(k3), provided good nutrient content for rubber seedlings, especially nitrogen, which plays a role in the forming plant vegetative parts (leaves). All the elements of nitrogen, phosphorus and potassium are sufficiently available in the soil according to to plant needs, then plant growth can run smoothly and normally (Mndzebele et al., 2020).

Based on the results of further tests shown in table 5, for the observation of dry canopy weight on rubber plants, it showed that the treatment showed a significant difference in the average canopy dry weight on rubber plants. With WWTP sludge compost treatment, the rubber factory added 15 g of NPKMg (k3), resulting in the highest dry weight of the canopy on rubber plants, 29.7. In comparison, the treatment with 15 g of NPKMg (k0) resulted in the lowest dry weight of the canopy on rubber plants, which was 17, 1

The best dose of composting of WWTP Waste Mud Rubber Factory, which can increase the growth of rubber seedlings *(Hevea brasiliensis Muell. Arg),* is clone PB 260 in polybags by giving 450 gr Compost of Waste Mud WWTP Rubber Factory + 15 gr NPKMg. The nutrient element nitrogen (N) stimulates plant growth, especially stems, branches and leaves (McKim, 2019). The formation of green leaves is also closely related to the element nitrogen. In addition, this element is influential in forming proteins, fats and other organic compounds. Phosphorus (P) for plants is more functioning to stimulate root growth, especially in the roots of young plants (Elhaissoufi et al., 2020). Certain types of protein require phosphorus as a raw material. Phosphorus also serves to help assimilation and respiration and accelerate the ripening of seeds and fruit (Mulyono et al., 2022). The primary use of potassium (K) is to help form protein and carbohydrates (Hasanuzzaman et al., 2018). Giving this element will strengthen the plant so that the leaves, flowers and fruit do not fall easily. In addition, potassium also makes plants resistant to drought and disease. The analysis of the WWTP mud compost for the rubber factory showed that the WWTP mud compost for the rubber factory contains 1.58% N nutrients, 0.20% P nutrients, 0.20% K nutrients, C- Organic is 29%, and C/N is 11.40. Compost is one of the organic fertilizers used in agriculture to reduce the use of inorganic fertilizers. Using compost can improve soil's physical properties and microbiology (Kertesz & Thai, 2018). Furthermore, applying compost and manure can increase the C-Organic content of the soil (Khaitov et al., 2019). The more organic fertilizer added to the soil, the more significant the increase in the C-Organic content in the soil.

The most crucial factor in plant growth is soil, which provides nutrients, soil moisture and sufficient and available nutrients for plants. A loose soil structure can create aeration (for root respiration) and drainage (to drain water) in the soil, as well as increase the activity of soil microorganisms (Usharani et al., 2019). The content of organic matter contains many nitrogen nutrients, and the rate of the process of nitrogen liberation through the mineral process from the remnants of organic matter needed by microorganisms. Fertilization aims to meet the needs of nutrients for plants and optimize growth. One type of fertilizer usually given is Phosphorus (P) fertilizer. The roles of P fertilizer for plants include: can accelerate and strengthening plant growth, accelerating flowering and ripening of fruit, seeds or grain, and increasing grain production. However, plant needs for phosphorus have various problems, such as small amounts in the soil, almost all P compounds found in soil being low in solubility, and the presence of phosphorus fixation (Bindraban et al., 2020).

4. Conclusions

Based on the results of the research on the Growth of Rubber Seedlings of Clones PB 260 *(Hevea brasiliensis Muell. Arg)* with the provision of compost from the WWTP Waste Mud for Rubber Factory in Polybags, it can be concluded that: Provision of compost treatment for WWTP Mud Waste Rubber factory proved to affect the growth of rubber seedlings Clones PB 260 *(Hevea brasiliensis Muell. Arg)* as shown in the variables of increase in plant grafting shoot length (cm), increase in the number of leaf stalks (strands), and dry weight plant crown (gr), while the variable of increase in stem diameter (mm) and dry weight of plant roots showed no significant effect on the observed variables. Therefore, treating WWTP Rubber Factory Sludge Compost on clone PB 260 *(Hevea brasiliensis Muell. Arg)* by giving 450 gr Rubber Factory WWTP Mud Waste Compost + 15 gr NPKMg can increase seedling growth the best compared to other treatments.

References

Ahmed, A. K. A., Shi, X., Hua, L., Manzueta, L., Qing, W., Marhaba, T., & Zhang, W. 2018. Influences of air, oxygen, nitrogen, and carbon dioxide nanobubbles on seed germination and plant growth. Journal of Agricultural and Food Chemistry 66, 5117–5124.

Bindraban, P. S., Dimkpa, C. O., & Pandey, R. 2020. Exploring phosphorus fertilizers and fertilization strategies for improved human and environmental healthBindraban, P. S., Dimkpa, C. O., & Pandey, R. (2020). Exploring phosphorus fertilizers and fertilization strategies for improved human and environment. Biology and Fertility of Soils 56, 299–317.

Direktorat Jenderal Perkebunan. 2021. Statistik perkebunan unggulan nasional. In Sekretariat Dirjend Perkebunan Kementerian Pertanian.

Elhaissoufi, W., Khourchi, S., Ibnyasser, A., Ghoulam, C., Rchiad, Z., Zeroual, Y., Lyamlouli, K., & Bargaz, A. 2020. Phosphate solubilizing rhizobacteria could have a stronger influence on wheat root traits and aboveground physiology than rhizosphere p solubilization. Frontiers in Plant Science 11, 1–15.

Hasanuzzaman, M., Bhuyan, M. H. M. B., Nahar, K., Hossain, M. S., Al Mahmud, J., Hossen, M. S., Masud, A. A. C., Moumita, & Fujita, M. 2018. Potassium: A vital regulator of plant responses and tolerance to abiotic stresses. Agronomy 8.

Kamaludin, R. 2018. Competitiveness and exports sustainability of the indonesian natural rubber. Sriwijaya International Journal of Dynamic Economics and Business 2, 85–98.

Kertesz, M. A., & Thai, M. 2018. Compost bacteria and fungi that influence growth and development of Agaricus bisporus and other commercial mushrooms. Applied Microbiology and Biotechnology 102, 1639–1650.

Khaitov, B., Yun, H. J., Lee, Y., Ruziev, F., Le, T. H., Umurzokov, M., Bo, A. B., Cho, K. M., & Park, K. W. 2019. Impact of organic manure on growth, nutrient content and yield of chilli pepper under various temperature environments. International Journal of Environmental Research and Public Health 16.

Khan, M. I., Afzal, M. J., Bashir, S., Naveed, M., Anum, S., Cheema, S. A., Wakeel, A., Sanaullah, M., Ali, M. H., & Chen, Z. 2021. Improving nutrient uptake, growth, yield and protein content in chickpea by the co-addition of phosphorus fertilizers, organic manures, and bacillus sp. Mn-54. Agronomy 11.

Liu, L., Wang, S., Guo, X., & Wang, H. 2019. Comparison of the effects of different maturity composts on soil nutrient, plant growth and heavy metal mobility in the contaminated soil. Journal of Environmental Management 250, 109525.

McKim, S. M. 2019. How plants grow up. Journal of Integrative Plant Biology 61, 257–277.

Mndzebele, B., Ncube, B., Fessehazion, M., Mabhaudhi, T., Amoo, S., du Plooy, C., Venter, S., & Modi, A. 2020. Effects of cowpea-amaranth intercropping and fertiliser application on soil phosphatase activities, available soil phosphorus, and crop growth response. Agronomy 10.

Mulyono, Putri, M. N., & Hidayat, T. 2022. Effectiveness of cattle bone ash nano particle as a source of p to replace sp 36 fertilizer in sweet corn cultivation in entisol soil. IOP Conference Series: Earth and Environmental Science 985, 6–10.

Siedt, M., Schäffer, A., Smith, K. E. C., Nabel, M., Roß-Nickoll, M., & van Dongen, J. T. 2021. Comparing straw, compost, and biochar regarding their suitability as agricultural soil amendments to affect soil structure, nutrient leaching, microbial communities, and the fate of pesticides. Science of the Total Environment 751, 141607.

Sitepu, M. H., Matondang, A. R., & Sembiring, M. T. 2019. Sustainability assessment of natural rubber primary processing: a review. IOP Conference Series: Materials Science and Engineering 648.

Suyanto, & Munte, J. 2018. Implementation of sobel method to detect the seed rubber plant leaves. Journal of Physics: Conference Series 983.

Tisarum, R., Samphumphung, T., Theerawitaya, C., Prommee, W., & Cha-um, S. 2018. In vitro photoautotrophic acclimatization, direct transplantation and ex vitro adaptation of rubber tree (Hevea brasiliensis). Plant Cell, Tissue and Organ Culture 133, 215–223.

Umami, I. M., Kamarudin, K. N., Hermansah, & Abe, S. S. 2019. Does soil fertility decline under smallholder rubber farming? The case of a West Sumatran lowland in Indonesia. Japan Agricultural Research Quarterly 53, 279–287.

Usharani, K., Roopashree, K., & Naik, D. 2019. Role of soil physical, chemical and biological properties for soil health improvement and sustainable agriculture. Journal of Pharmacognosy and Phytochemistry 8, 1256–1267.

Warren-Thomas, E., Dolman, P. M., & Edwards, D. P. 2015. Increasing demand for natural rubber necessitates a robust sustainability initiative to mitigate impacts on tropical biodiversity. Conservation Letters 8, 230–241.