Effect of the application of chicken manure compost tea on the growth of certified cocoa (*Theobroma cacao* L.) seedlings

N Kasim, K Mustari, I Iswari, Nasaruddin, R Padjung and N Widiayani

Department of Agronomy, Faculty of Agriculture, Hasanuddin University, Jl. Perintis Kemerdekaan KM 10 Makassar 90245, Indonesia.

E-mail: nina_nurlina@yahoo.com

Abstract. This study aims to determine the best concentration of compost tea on various cocoa seedlings. The research was conducted in Sudiang Village, Makassar City, South Sulawesi, from August to December 2019. The experiment was set using a 2-factor factorial design in a randomized block design (RBD) as the environmental design. The first factor was the type of cocoa varieties which consists of three levels, namely Sulawesi 1, Sulawesi 2, and MCC 02. The second factor was the compost tea which consists of four levels, namely control (0 mL/L water), 50 mL/L water, 100 mL/L water, and 150 mL/L water. The results show that MCC 02 cocoa seedlings applied with compost tea fertilization of 100 mL/L of water showed the best response on the parameters of the number of leaves, stem diameter, fresh root weight, root dry weight and leaf chlorophyll index, chlorophyll A, chlorophyll B and total chlorophyll.

1. Introduction

Cocoa (*Theobroma cacao* L.) is an agricultural commodity that has an important and reliable role in realizing agricultural development programs. Cocoa is an important foreign exchange earner during the last decade. Cocoa is one of the top priority commodities. From an economic perspective, cocoa plantations are very supportive of exports and domestic industries based on products made from cocoa. The quality of Indonesian cocoa is not inferior to world cocoa. If fermented properly, Indonesian cocoa can achieve a taste equivalent to cocoa originating from Ghana. Cocoa as a source of foreign exchange from exports with export volume in 2018 reaching 380.75 thousand tons or worth USD1.24 billion [1]. Currently, Indonesia is the fifth largest cocoa producer in the world after Ivory Coast and Ghana, with a production in 2018 of 593.83 thousand tons. About 60% of the production is cocoa produced by smallholder plantations on an area of 1.68 million hectares, with 60% of Indonesia's cocoa area located in the Sulawesi region.

The development of cocoa in Indonesia is supported by a system of procuring seeds through generative propagation using seeds and vegetative propagation by seedlings. South Sulawesi is the center for cocoa development in Indonesia. This area also has the potential for shoot grafting seedlings of up to millions of stems [2]. One of the efforts that can be managed to improve the quality and quantity of cocoa production is to pay attention to the aspects of cocoa cultivation itself. Among them are soil processing, fertilization, pruning, pest and disease control, and provision of growth regulators which are equally important in the cultivation of cocoa plants, namely the provision of planting material in nurseries, because from these nurseries, suitable planting materials will be obtained for planting in a suitable field. Hence, it will produce cacao plant seeds that are able to produce optimally.
The clones used for rootstock are those with strong roots. Whereas for the scion, farmers usually choose Sulawesi 1, Sulawesi 2 or local clones such as 45 which have high production and are relatively resistant to VSD. The results in the field show that top grafted seedlings from South Sulawesi have productivity above an average of 1 ton/ha/year [3].

One of the problems faced in efforts to increase cocoa production in South Sulawesi is the low quality of seeds used by farmers. This is because some of the cocoa seeds are obtained from smallholder plantations. Most of the cocoa seeds available at the farm level are from uncertified clones. The first step in cocoa cultivation in supporting the development of cocoa plants to make it successful is to prepare planting material in the nursery [4].

Seed production tends to be produced under limited input, especially fertilizers, which are very limited or not at all. To overcome this, steps are needed that can change the habits of the farmers, which technically results in low quality cacao seeds produced from seed production carried out by farmers. Some of these actions include improving the quality of seeds by using certified cocoa seeds, using organic fertilizers that can be produced by farmers [5] and applying seed production methods that are in accordance with the Standard Operating Procedure (SOP) that has been determined so that seed quality does not become a constraint on cocoa production and productivity.

Nurseries are one of the factors in determining the success of cocoa cultivation. The growth of cocoa plants in the field is largely determined by the growth of the plants during the nursery [6]. The planting medium is one of the factors that influence the growth of cocoa plants in nurseries. Planting media that are commonly used in nurseries are soil media or soil media that are given organic matter. Organic fertilizers according to the Regulation of the Ministry of Agriculture Republic of Indonesia [7], are fertilizers derived from dead plants, animal manure, animal parts or other organic waste that have been engineered, in solid or liquid form, which can be enriched with mineral or microbial materials, which are useful for increasing nutrient content and soil organic matter and improve soil physical, chemical and biological properties. The content of nutrients, compounds and microorganisms in various organic fertilizers is different due to the different materials used [8, 9]. Amilia [10], reported that the use of liquid organic fertilizer (LOF) has the potential to reduce the use of NPK fertilizer by 25%.

One of the efforts to increase the productivity of cocoa plants is by using solid or liquid organic fertilizers, namely compost tea. The use of fertilizers is needed to supply nutrients for plant growth. The use of organic fertilizers or other materials that are organic in nature is intended to reduce problems arising from the use of chemicals that can damage the soil and the environment. Prolonged use of chemical fertilizers will damage the soil. According to Zulkarnain [11] the ability of the soil to provide nutrients is determined by the content of soil organic matter (SOM) and soil moisture.

Compost tea is compost or compost extract liquid that has been ripe processed into compost tea by providing water and nutrients for microbial growth and aerated for a certain time. Compost tea contains high biodiversity. Compost tea has several benefits, including being able to provide soil fertility, help plant growth and increase plant resistance to disease. In addition, compost tea can also increase plant height [12, 13]. The microorganisms in compost tea are useful as antagonistic microbes and inhibit pathogen growth, compete for nutrients needed by pathogens, secrete metabolites (antimicrobials) to become parasites of pathogens directly and stimulate natural resistance of plants [12].

Three superior clones used in the recent study were Sulawesi 1, Sulawesi 2 and MCC 01 clones. According to Indonesian Research Center for Coffee and Cocoa[14], Sulawesi 1 clone, the clone has a potential yield of 1,800-2,500 tons/ha/year with dry seed weight of 1.10 grams, skin content 11.3%, fat content 45.0-50.0%, moderate pod rot resistance and resistance to VSD. On the other hand, Sulawesi 2 clone has a potential yield of 1,800-2,750 tons/ha/year with a dry seed weight of 1.27 grams, a skin content of 11.04, a fat content of 55.07, resistance to fruit rot and moderate resistance against the VSD. Based on the characteristics of the MCC 02 clone, the clone had a yield of 3.13 tons/ha (population of 1,100 trees/ha) with a dry seed weight of 1.61 grams, 12% seed coat content, 49.2% seed fat content and resistant to pod rot disease, VSD disease, and CPB pests [14].

Compost tea is an organic agricultural technology innovation that is being developed to overcome obstacles such as nutrient deficiency due to low absorption and low resistance of plants to pathogen.
attack. Compost tea is considered superior to compost, especially in terms of the speed of nutrient deficiency correction because of its application through leaves and also the speed of absorption through the roots because it is given in the form of dissolved nutrients, in addition to the supply of humic acid and growth hormones [15].

Compost tea is a mixture of liquid compost, rice washing water and fermented molasses. Rice washing water contains growth regulating substances which play a role in stimulating the formation of roots and stems and the formation of root and stem branches by inhibiting apical dominance and the formation of young leaves [16]. In general, organic fertilizers contain low macro nutrients N, P and K but contain micro nutrients in sufficient quantities which are needed by plants. To speed up the manufacturing process, it is necessary to add a starter of microorganisms and additives to molasses (molasses). Molasses plays a role in microbial growth, because it contains a source of carbon and nitrogen in the fermentation process. The principle of fermentation is the breakdown of organic compounds into simple compounds that involve organisms. These microorganisms are used to maintain the balance of carbon (C) and nitrogen (N) which are the determining factors in the fermentation process [17].

Compost contains nutrients needed by plants and microbes (bacteria, fungi, actinomycetes) which are beneficial to plants and soil ecosystems so that their application to the soil can improve soil fertility and increase plant resistance to pathogens through microbial activity contained therein. Some of the microbes contained in compost have a high nutrient competition capacity, produce antibiotic compounds, and are predatory or parasitic [18].

2. Methodology
The research was conducted in the farmers' land of Sudiang sub-district, Makassar City, South Sulawesi from August to December 2019. The study used a 2-factor factorial design in a randomized block design (RBD) as an environmental design. The first factor was the type of clone (V) which consisted of three levels, namely Sulawesi 1 (V1), Sulawesi 2 (V2), and MCC 02 (V3). The second factor was the application of compost tea consisted of four levels, namely: Control or 0 mL/L (P0), 50 mL/L (P1), 100 mL/L (P2), and 150 mL/L (P3). Each treatment combination was repeated 3 times resulted in 36 experimental units and each unit used 3 plants so the total number of cocoa seeds was 108 units of plants.

2.1. Preparation of the compost tea
In this study, the compost tea organic fertilizer were prepared in two stages. First stage was the preparation of chicken manure compost and the second stage was the making of liquid organic fertilizer of compost tea. Composting was carried out by fermenting the manure using bio-decomposer, Promi. Promi is a superior microbial formula containing plant growth-promoting microbes, soil-bound nutrient solvent, and plant disease control. Promi can decompose agricultural / plantation organic waste with active ingredients of superior microbes native to Indonesia that have been selected and tested at the Plantation Biotechnology Research Institute, Bogor, namely Trichoderma harzianum DT 38, T. pseudokoningi DT 39, and Aspergillus sp. [19].

The chicken manure was made by weighing 100 grams of Promi bio-activator that previously dissolved into 10 liters of water and then poured over the manure. Subsequently, the chicken manure was covered using a tarpaulin and fermented for 3 weeks. After 3 weeks, ready compost was characterised with a unique odour, which indicated that the compost is finished. The cover of compost was opened and dried for 2 days then the compost is ready to use. Following the preparation of the chicken manure compost, compost tea was made. The process of making compost tea was by mixing 25 kg of the solid compost, 100 liters of water, 1 liter of molasses and 5 liters of rice washing water. The compost and water were mixed and then stirred until homogeneous, before covered and left for 3 days. After 3 days, the liquid compost was filtered to separate the solid and liquid materials. Then the liquid compost solution is mixed with rice water and molasses and left to stand for 7 days. After 7 days the compost tea was aerated using an aerator for 2 hours to remove the ammonia gas and the compost tea is ready to use.
2.2. Land preparation
Land preparation is carried out by cleaning the research location from various kinds of disturbing grass and weeds. The polybag of cocoa seedlings were placed according to the research layout by prioritizing the direction of the East-West sunlight. Between treatments are given a distance of 50 cm which allows when watering according to the predetermined treatment.

2.3. Preparation of shades
Shading was in form of a seed house made of wooden and bamboo frames with a length of 10 m, a width of 5 m and a height of 2 m. The shade material used was UV plastic. UV plastic is plastic coated with certain chemicals, so that it can withstand excessive ultraviolet rays without damaging plants. The UV plastic used is the one with a UV protective level of 14%. UV plastic is installed on the roof of the seed house. Apart from UV plastic, this nursery house is surrounded on the sides with paranet (plastic mesh). The function of paranets is to provide shade for plants which reduces the excessive light intensity that will be received by plants and reduces the air temperature around the plants.

2.4. Cocoa seedlings nursery
The cacao plant seeds used in this study were shoot grafted seedlings, obtained from Soppeng Regency from the Coffee and Cocoa Research Center (Puslitkoka). There are 3 types of clones used, namely Sulawesi 1, Sulawesi 2, and MCC 02 clones. The age of the seedlings used is uniform, that is, about 3 months (for rootstock), while those on the upper stem (grafting shoot) are approximately one month old.

2.5. Treatment application
The treatment was given in the form of compost tea (liquid organic fertilizer) according to a predetermined concentration of 50 mL, 100 mL, and 150 mL per liter water. Application of compost tea was carried out on plants every 14 days using a 1 liter plastic sprayer and applied to the leaves and roots of plants.

2.6. Parameter observation
The parameters observed and measured in this study were plant height, leaf area, number of leaves, stem diameter, fresh and dry weight of the roots, leaf chlorophyll index, chlorophyll A, chlorophyll B, and total chlorophyll, and stomata density.

2.7. Data analysis
The data obtained from the results were analyzed using analysis of variance for a two-factor factorial design in a randomized block design. A further test was carried out if there is a significant effect of the treatment using the Tukey’s test (α = 0.05).

3. Results and discussion

3.1. Effect of compost tea on growth of cocoa seedlings
The variance survey showed that the use of compost tea and three types of cocoa clones with various concentrations had a very significant effect on plant height, number of leaves and stem diameter of cocoa seeds (table 1).

Table 1 shows that MCC 02 cocoa seeds with a fertilization dose of 150 mL/L compost tea (V3P3) had the highest average plant height, namely 12.78, not significantly different from other treatments with cocoa seeds (V2P0, V2P1 and V2P2). The fertilizer concentration of 0 mL/L compost tea and MCC 02 (V3P0) cocoa seedlings had the shortest average plant height, namely 5.78, which was not significantly different from the V1P3 treatment but significantly different from the V2P3 and V1P1 treatments. MCC 02 cocoa seeds with a fertilization dose of 100 mL/L of compost tea (V3P2) had the highest average number of leaves, namely 19.44, not significantly different from other treatments with cocoa seeds (V3P3, V3P0 and V2P1). Fertilization concentration of 0 mL/L compost tea and Sulawesi
1 (V1P0) cacao seedlings had the least average number of leaves, namely 10.89, which was not significantly different from the V1P1 treatment but significantly different from the V2P3 and V3P1 treatments. MCC 02 cocoa seeds with a fertilization dose of 100 mL/L of compost tea (V3P2) had the highest average stem diameter value of 2.28, not significantly different from other treatments with cocoa seeds (V3P1, V1P3 and V2P3). The fertilization concentration of 50 mL/L compost tea and Sulawesi 2 (V2P1) cocoa seedlings had the smallest average stem diameter, namely 1.48, which was not significantly different from the V2P1 treatment but significantly different from the V2P2 and V1P2 treatments.

**Table 1.** Effect of liquid organic fertilizer of compost tea on the growth of various cocoa seedlings.

| Cocoa clones | Concentration of liquid organic fertilizer (Compost tea) | Ave | Tukey’s $0.05$ |
|--------------|------------------------------------------------|-----|---------------|
|              | 0 mL/L | 50 mL/L | 100 mL/L | 150 mL/L |               |
| **Plant height (cm)** |               |         |           |           |               |
| Sulawesi 1   | 7.11$^b$ | 9.44$^b$ | 9.22$^b$ | 8.67$^c$ | 8.61 |
| Sulawesi 2   | 11.78$^a$ | 10.56$^a$ | 9.11$^b$ | 9.44$^b$ | 10.22 |
| MCC 02       | 5.78$^c$ | 8.78$^c$ | 10.11$^a$ | 12.78$^a$ | 9.36 |
| **Ave**      | 8.22   | 9.59    | 9.48     | 10.30    |         |
| **Number of Leaves (leaves)** |               |           |           |           |               |
| Sulawesi 1   | 10.89$^c$ | 11.56$^c$ | 14.67$^b$ | 13.33$^c$ | 12.61 |
| Sulawesi 2   | 12.78$^b$ | 17.89$^a$ | 12.11$^c$ | 15.78$^b$ | 14.64 |
| MCC 02       | 18.33$^a$ | 14.89$^b$ | 19.44$^a$ | 18.44$^a$ | 17.78 |
| **Ave**      | 14.00   | 14.78   | 15.41    | 15.85    |         |
| **Stem Diameter (cm)** |               |           |           |           |               |
| Sulawesi 1   | 1.41$^b$ | 1.65$^b$ | 1.75$^b$ | 1.83$^a$ | 1.66 |
| Sulawesi 2   | 1.41$^b$ | 1.48$^c$ | 1.77$^b$ | 1.73$^a$ | 1.60 |
| MCC 02       | 1.60$^a$ | 2.14$^a$ | 2.28$^a$ | 1.42$^b$ | 1.86 |
| **Ave**      | 1.48    | 1.76    | 1.93     | 1.66     |         |

Numbers followed by the same letters in the same row (a, b, c) and column (p, q, r, s) means that it is not significantly different in the level test Tukey’s $\alpha =0.05$.

### 3.2. Effect of compost tea on leaves parameter of cocoa seedlings

The variance analysis shows that the use of compost tea and three types of cocoa clones with various concentrations had a very significant effect on leaf area and leaf stomata density of cocoa seedlings.
Table 2. Average leaf area and stomata density of cocoa seedlings.

| Cocoa clones | Concentration of liquid organic fertilizer (Compost tea) | Ave | Tukey’s 0.05 |
|--------------|----------------------------------------------------------|-----|--------------|
|               | 0 mL/L  | 50 mL/L  | 100 mL/L | 150 mL/L | [Clones] |
| Leaf area (cm²) |        |          |          |          |          |
| Sulawesi 1    | 89.08ₚ | 85.97ₚ | 90.02ₚ | 110.05ₚ | 93.78   |
| Sulawesi 2    | 104.72ₚ | 106.94ₚ | 92.53ₚ | 99.10ₚ | 100.82   |
| MCC 02        | 65.22ₚ | 84.91ₚ | 78.32ₚ | 77.70ₚ | 76.54   |
| Ave           | 86.34   | 92.61   | 86.96   | 95.62   |          |

Stomata density (mm⁻²)

| Cocoa clones | Concentration of liquid organic fertilizer (Compost tea) | Ave | Tukey’s 0.05 |
|--------------|----------------------------------------------------------|-----|--------------|
|               | 0 mL/L  | 50 mL/L  | 100 mL/L | 150 mL/L | [Compost tea] |
| Sulawesi 1    | 72.44ₚ | 76.33ₚ | 77.00ₚ | 91.44ₚ | 79.31   |
| Sulawesi 2    | 70.56ₚ | 68.78ₚ | 80.67ₚ | 77.11ₚ | 74.28   |
| MCC 02        | 69.00ₚ | 75.67ₚ | 83.78ₚ | 84.56ₚ | 78.25   |
| Ave           | 70.67   | 73.59   | 80.48   | 84.37   |          |

Numbers followed by the same letters in the same row (a, b, c) and column (p, q, r, s) means that it is not significantly different in the level test Tukey’s α = 0.05.

Table 2 shows that the Sulawesi 1 cocoa seedlings with a fertilization dose of 150 mL/L of compost tea (V1P3) had the highest average stomatal density value of 91.44, not significantly different from other treatments with cocoa seeds (V3P2, V1P1 and V2P0). Fertilization concentration of 50 mL/L compost tea and Sulawesi 2 (V2P1) cocoa seedlings had the smallest average stomatal density, namely 68.78, which was not significantly different from the V3P0 treatment but significantly different from the V3P3 and V3P2 treatments. Sulawesi 1 cocoa seedlings with a fertilization dose of 150 mL/L of compost tea (V1P3) had the highest average leaf area value of 110.05, not significantly different from other treatments with cocoa seeds (V2P1, V2P0 and V2P2). The fertilization concentration of 0 mL/L compost tea and MCC 02 (V3P0) cocoa seedlings had the smallest average leaf area, namely 65.22, which was not significantly different from the V3P2 treatment but significantly different from the V2P3 and V1P2 treatments.

3.3. Effect of Compost Tea on Chlorophyll index, Chlorophyl a, b and total of cocoa seedlings leaves

The analysis of variance showed that giving compost tea to three types of cocoa clones with various concentrations and their interactions had a very significant effect on leaf chlorophyll index, chlorophyll a, b and total chlorophyll leaves of cocoa seedlings.

Table 3 shows that MCC 02 cocoa seeds with a fertilization dose of 100 mL/L compost tea (V1P3) had the highest leaf chlorophyll index average value of 126.40, not significantly different from other treatments with cocoa seeds (V3P3, V3P1 and V2P0). The fertilization concentration of 100 mL/L compost tea and Sulawesi 2 (V2P2) cocoa seeds had the smallest average leaf chlorophyll index, namely 115.11, not significantly different from the V2P3 treatment but significantly different from the V1P1 and V1P2 treatments. MCC 02 cocoa seeds with a fertilization dose of 100 mL/L of compost tea (V1P3) had the highest average chlorophyll A value of 489.75, not significantly different from other treatments...
with cocoa seeds (V3P3, V3P1 and V2P0). Fertilization concentration of 100 mL/L compost tea and Sulawesi 2 (V2P2) cocoa seeds had the smallest chlorophyll A, namely 486.35, which was not significantly different from V2P3 treatment but significantly different from V1P1 and V1P2 treatments.

Table 3 shows that MCC 02 cocoa seeds with a fertilization dose of 100 mL/L of compost tea (V3P2) had the highest average chlorophyll B value of 323.21, not significantly different from other treatments with cocoa seeds (V3P3, V3P1 and V2P0). Fertilization concentration of 100 mL/L of compost tea and Sulawesi 2 (V2P2) cocoa seedlings had the smallest chlorophyll B, namely 300.66, which was not significantly different from V2P3 treatment but significantly different from V1P1 and V1P2 treatments.

MCC 02 cocoa seeds with a fertilization dose of 150 mL/L of compost tea (V3P3) had the highest average total chlorophyll value of 742.20, not significantly different from other treatments with cocoa seeds (V3P3, V3P1 and V2P0). The fertilization concentration of 100 mL/L compost tea and Sulawesi 2 (V2P2) cocoa seeds had the smallest chlorophyll B, namely 721.64, which was not significantly different from V2P3 treatment but significantly different from V1P1 and V1P2 treatments.

**Table 3.** Average leaf chlorophyll index, chlorophyll a, b and total of cocoa seedlings.

| Cocoa clones | Concentration of liquid organic fertilizer (Compost tea) | Ave | Tukey’s 0.05 [Clones] |
|--------------|------------------------------------------------------|-----|----------------------|
|              | 0 mL/L | 50 mL/L | 100 mL/L | 150 mL/L |               |
| Sulawesi 1   | 119.74<sup>b</sup> | 122.43<sup>b</sup> | 121.60<sup>b</sup> | 117.39<sup>b</sup> | 120.29 |
| Sulawesi 2   | 123.24<sup>a</sup> | 121.88<sup>a</sup> | 115.11<sup>c</sup> | 116.25<sup>c</sup> | 119.12 |
| MCC 02       | 119.86<sup>b</sup> | 123.16<sup>a</sup> | 126.40<sup>a</sup> | 123.74<sup>a</sup> | 123.29 |
| Ave          | 120.94 | 122.49 | 121.04 | 119.12 |               |

**Tukey’s 0.05 [Compost tea]** |

| Chlorophyll a | |
|---------------|---|
| Sulawesi 1    | 493.19<sup>b</sup> |
| Sulawesi 2    | 498.09<sup>a</sup> |
| MCC 02        | 493.13<sup>b</sup> |
| Ave           | 494.80 | 496.97 | 494.87 | 492.24 |

**Tukey’s 0.05 [Compost tea]** |

| Chlorophyll b | |
|---------------|---|
| Sulawesi 1    | 309.96<sup>b</sup> |
| Sulawesi 2    | 316.93<sup>a</sup> |
| MCC 02        | 310.14<sup>b</sup> |
| Ave           | 312.34 | 315.42 | 312.51 | 308.72 |

**Tukey’s 0.05 [Compost tea]** |

| Chlorophyll total | |
|-------------------|---|
| Sulawesi 1        | 732.90<sup>b</sup> |
| Sulawesi 2        | 741.01<sup>a</sup> |
Numbers followed by the same letters in the same row (a, b, c) and column (p, q, r, s) means that it is not significantly different in the level test Tukey’s $\alpha = 0.05$.

4. Discussion

The results showed that the Sulawesi 1 clone and the MCC 02 clone had a good response to the fertilization treatment using compost tea compared to the Sulawesi clone 2. The indication was seen in each plant growth parameter, especially in the number of leaves, leaf area and root weight. The optimum number of leaves on the cocoa plant will provide an even distribution of light reception and increase the photosynthetic capacity of the plant. According to Christiansen and Lewis [20] that the emergence of leaves is related to the capacity of photosynthesis. The K content in fertilizers plays a role in supporting the stomata to remain open so that the photosynthesis process continues. Hence the leaf area index increases with increasing fertilizer doses.

In addition, the root character (root fresh weight and root dry weight) of cocoa plants in Sulawesi 1 and MCC 02 clones showed the highest number where good root development would also support good plant growth. According to the opinion of Prihastanti et al. [21] that the importance of root morphology of cocoa plants, because roots have an important role in the formation of plant biomass, absorption of nutrients, and absorption of water.

Compost tea is compost tea brewing using water as an extracting material [22]. Chicken manure compost is the main source in making liquid organic fertilizer for compost tea. The use of organic fertilizers with inappropriate concentrations can cause its own problems, where the use of high concentrations inhibits the growth and development of seedlings, on the other hand, too low concentrations are not able to produce and develop optimal cocoa seedlings. Therefore, determining the right concentration in certain plants is needed [23].

The results showed that the best treatment was at a dose of 100 mL/L of water. Compost tea dosage of 100 mL/L water is an economical concentration and is able to provide a better effect on the growth of cocoa seedlings. The indications can be seen in the average height increase of cocoa seedlings (2.14 cm), the highest number of leaves (19.44), the largest stem diameter (10.55 mm) and the highest average number of stomata (91.44), highest root wet weight (18.67 g), highest root dry weight (4.64 g), highest leaf area (110.05 cm$^2$), highest leaf chlorophyll index (126.40), highest chlorophyll A (502.45), the highest chlorophyll B (323.21) and the highest total chlorophyll (748.24). This indicator provides an overview of the level of good plant fertility due to the compost tea treatment given.

Compost tea consists of a mixture of liquid compost, rice washing water and molasses. The results of laboratory analysis on the nutrient content of compost tea containing a total N of 0.27%; P$_2$O$_5$ 0.06%; K$_2$O 0.17%; C-Organic 0.36%; and pH 6.07. Rice washing water contains many nutrients dissolved in it, including 80% vitamin B1, 70% vitamin B3, 90% vitamin B6, 50% Manganese, 50% phosphorus, 60% iron [16]. Rice washing water also contains auxins. According to Widiastuti et al. [24], auxin is a growth regulator which functions to stimulate the formation of new shoots, thereby increasing the number of leaves. The K content in fertilizers plays a role in supporting the stomata to remain open so that the photosynthesis process continues. Hence the leaf area index increases with increasing fertilizer doses.

The nutrients mentioned above are dissolved nutrients that are quickly available for absorption by plants so that their application to the soil can improve soil fertility. Molasses contains 25-40% sucrose and 12-25% reducing sugar with a total sugar content of 50-60% and carbohydrates which are able to maintain the microbial environment so that microbes can develop properly [25]. Plants given compost tea can increase plant resistance to pathogens through microbial activity contained in them. Some of the microbes contained in compost, have a high nutrient competition capacity, produce antibiotic
compounds, and are predatory or parasitic, so that their application to plants can increase plant resistance to disease-causing disorders [18].

The recent study showed that there was an interaction effect between clones and the application of compost tea at various concentration. The concentration of compost tea affected the seed growth rate of each cocoa clone. There is a positive interaction between cacao clone seeds and compost tea fertilizer. The combination of treatment between MCC 02 clone cocoa with 100 mL/L of compost tea treatment was the best treatment on leaf number, stem diameter, wet weight and root dry weight, and leaf chlorophyll index. Then the combination of treatment between the Sulawesi Clone 1 cocoa with the treatment of 150 mL/L compost tea was the best treatment on the number of stomata and leaf area and the MCC 02 clone with 150 mL/L of compost tea was the best treatment combination for plant height.

According to the opinion of Pibars et al. [26], the process of giving compost tea from the leaves to the planting medium can have a good effect on plants where fertilization through plant leaves or spraying, namely: 1) plant nutrients or growth hormones can be more easily absorbed through the stomata of the leaves, the surface area of the leaves becomes the absorption surface, and the nutrients reach the place where they are needed (shorter distances); 2) beneficial microbes can occupy the leaf surface so as to suppress pathogen attack; 3) The frequency and volume of compost tea can be adjusted according to the conditions / needs of the plant. In addition, compost tea can also function as an antagonist that causes leaf rust disease and compost tea is thought to increase humus substances, growth hormones and enzymes and other organic compounds in the soil.

5. Conclusion
Based on the research results that have been obtained, it can be concluded that:
- There was a difference between the growth of the three cocoa clones and the best growth was Clone MCC 02.
- Application of compost tea fertilizer has an effect on the growth of three cocoa clones and the best is 100 mL/Liter of water.
- The interaction between clones and compost tea has an effect where the best treatment combination is the MCC 02 clone and the provision of 100 mL/Liter of compost tea.

Reference
[1] BPS Direktorat Jenderal Perkebunan 2018 Gerakan Peninkatan Produksi dan Mutu Kakao Nasional Bahan presentasi Dirjenbun pada bulan November 2018 di hadapan Tim Itjen Deptan 26 p
[2] BPS 2014 Statistik Perkebunan Indonesia “Kakao” (Jakarta: Direktorat Jenderal Perkebunan)
[3] Pusat Penelitian dan Pengembangan Perkebunan 2013 Budidaya dan Pasca Panen Kakao (Jakarta: Pusat Penelitian dan Pengembangan Perkebunan)
[4] Pinem A 2011 Pengaruh media tanam dan pemberian kapur terhadap pertumbuhan kakao (Theobroma cacao L.) di pembibitan J. Agroland 17(2) 138-143
[5] Kaimuddin et al. 2020 IOP Conf. Ser.: Earth Environ. Sci. 575 012150
[6] Nasaruddin et al 2020 IOP Conf. Ser.: Earth Environ. Sci. 486 012118
[7] Kementerian Pertanian 2011 Permentan No.70/permentan/SR.140/10/2011 tentang Pupuk Organik, Pupuk Hayati, dan Pemberahan Tanah (Jakarta: Departemen Pertanian)
[8] Pranata A S 2010 Pupuk Organik Cair Aplikas dan Manfaatnya (Jakarta: Agromedia Pustaka)
[9] Nasaruddin and I Ridwan 2018 IOP Conf. Ser.: Earth Environ. Sci. 157 012014
[10] Amilia Y 2011 Penggunaan Pupuk Organik Cair Untuk Mengurangi Dosis Penggunaan Pupuk Anorganik Pada Padi Sawah (Oryza sativa L.) (Bogor: Institut Pertanian Bogor)
[11] Zulkarnain L 2012 Evaluasi Erosi Laboratorium pada Kandungan Bahan Organik Tanah (BOT) Melalui Pendekatan Satuan Lahan (Lampung: Program Pascasarjana Fakultas Pertanian Universitas Lampung)
[12] Sari S 2013 Pengaruh Penggunaan Teh Kompos Untuk Menekan Perkembangan Penyakit Hawar Daun (Pantoea sp.) pada Tanaman Jagung (Zea mays L.) (Malang: Universitas Brawijaya)
[13] Damanik Y, Hidayat N and Anggarini S 2014 Pengaruh Penambahan Molase dan Lama Waktu Fermentasi Pada Kualitas Teh Kompos Sebagai Biobakterisida Terhadap Pengendalian Bakteri Ralstonia Solanacearum (Malang: Fakultas Teknologi Industri Pertanian. Universitas Brawijaya)

[14] Pusat Penelitian Kopi dan Kakao Indonesia 2010 Sertifikasi dan Pembangunan Kebun Benih Kakao Pelatih Pengawas Mutu Benih di Medan

[15] Berek K 2017 Teh kompos dan pemanfaatannya sebagai sumber unsur hara dan agen ketahanan tanaman Savana Cendana 2 68-70

[16] Bahar A E 2016 Pengaruh Pemberian Limbah Air Cucian Beras Terhadap Pertumbuhan kangkung darat (Ipomoea reptans L.) (Riau: Program Studi Agroteknologi Fakultas Pertanian Universitas Pasir Pengairan).

[17] Wijaya K A 2008 Nutrisi Tanaman Sebagai Penentu Kualitas Hasil dan Resistensi Alami Tanaman (Jakarta: Prestasi Pustaka)

[18] St. Martin C C G 2015 Enhancing soil suppressiveness using compost and compost tea Organic Amendments and Soil Suppressiveness in Plant Disease Management ed Meghvansi M K and Varma A Soil Biology 46 (Switzerland: Springer International Publishing)

[19] Mulia S 2015 Laporan Hasil Pengkajian Komoditas Kakao di Sulawesi Selatan (Makassar: Balai Pengkajian Teknologi Pertanian)

[20] Christiansen M N and Lewis C F 1982 Breeding Plants for Less Favorable Environments (New York: John Wiley & Sons, Inc.)

[21] Prihastanti E, Tjitoosemito S, Sopandi D and Qoyim I 2015 Pertumbuhan fineroot kakao (Theobroma cacao) pada cekaman kekeringan selama 13 bulan di kawasan agroforestri dengan pohon pelindung (Gliricidia sepium) Pros. Seminar Nasional Masyarakat Biodiversitas Indonesia 1 1683 – 1688

[22] Ingham E R 2005 The Compost Tea Brewing Manual (USA: Soil Foodweb Inc.)

[23] Nasamsir 2014 Respons pertumbuhan bibit kakao (Theobroma cacao L.) terhadap aplikasi pupuk organik cair pada jenis aksesi buah kakao yang berbeda Jurnal Ilmiah Universitas Batanghari Jambi 14 (3)

[24] Widiastuti L, Tohari and Sulistyaningsih E 2004 Pengaruh intensitas cahaya dan kadar Daminosida terhadap iklim mikro dan pertumbuhan tanaman krisan dalam pot Ilmu Pertanian 11 (2) 35-42

[25] Cheeke P R 1999 Applied Animal Nutrition: Feeds and Feeding 2 ed (New Jersey: Prentice Hall)

[26] Pibars S Kh, Eldardiry E I, Khalil S E and El-Hady M A 2015 Effect of compost tea on growth character of sunflower (Helianthus annuus L.) under surface and subsurface drip irrigation Int. J. Chem Tech Res. 8 (6) 490-495