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Utilization of Cocoa Pod Husk Waste Composting by *Tremella Sp* and *Pleurotus Sp* as A Medium to Growth of Cocoa Seedling

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Abstract. Cocoa pod husk waste is a problem in the cocoa field, but it potentially as a source of organic matter to improve soil fertility. The paper discuss about the ability of *Tremella sp* and *Pleurotus sp* on producing phytohormone and on degrading cocoa pod husks waste. The research start with isolation, screening, and propagation of rot fungi were collected from decayed cocoa plants. The measurement of IAA is according to the method of Glickman and Dessaux (1995), by addition of L-Tryptophan 0.1 g l⁻¹, whereas the Gibberellic Acid content was measured by using the method of Borrow *et al.*, (1955). Composting process of cocoa pod husks waste was revealed during 40 days. This research showed that the IAA and GA₃ content in compost fermented with *Tremella sp* was higher than treatment with *Pleurotus sp*. Similarly, the result was also observed in the ability of hemicellulose degradation. However, *Pleurotus sp* was capable to produce compost with higher nutrient levels. Compost fermented by rot fungi gave significant effect to the growth of cocoa seedlings. Nevertheless the difference in varieties of cocoa had no effect on growth of cocoa seedlings. Cocoa pod husk waste composted by *Tremella sp* and *Pleurotus sp* gave the significant effect on Leaf Area Index (LAI), Net Assimilation Rate (NAR), Crop Growth Rate (CGR), Root-shoot ratio, and root dry weight of Cocoa seedling.

Keywords: Cocoa, *Tremella sp*, *Pleurotus sp*

1. Introduction

Cocoa is one of the leading commodities in Indonesia. The development of wide and cocoa production has increased during the last 5 years. In 2007 the land area of cocoa 1,379,280 had increased to 1,677,254 hectares by 2011. However the production tends to decrease 2013 [1], in 2010, 2011, 2012, and 2013 it was successively in tons of 837,900, 712,200, 777,540, and 740,510 [2]. The decline in production is closely related to the level of soil fertility due to low soil organic matter. Organic materials in land area of Indonesia are very low that less 2%. Research by Munandar *et al* [3] in cocoa showed that the higher organic matter, the more efficient plant to use of water. Soil organic matter increased to 6.09% causing growth and cocoa production continued to increase in linear. Cocoa plants require minimum levels of organic matter of 3.5% (approx. 2% Carbon) on 0-15 cm depth [3]. Source of organic matter are easily found around us. The cocoa pod husk waste has a composition and

nutrient compounds that very potential as a medium growing plants, however it has not been processed optimally.

Water content of cocoa is about 86%, and organic material levels of around 14% [4]. According to Didiek and Yufnal (2004), cocoa pod compost has a pH of 5.4, N total of 1.30%, C-organic 33.71%, P_2O_5 0.186%, K_2O 5.5%, 0.23% CaO, and 0.59% MgO. However, the experiment results indicated that cacao pod compost had not significant effect yet to crop growth rate, the high of plants, stem diameter, dry weight, root dry weight, stem + leaf dry weight, and total dry weight of cocoa seed cultivars Upper Amazone Hybrid [5]. It is can be caused by nutrient on the cocoa pod husk has not absorbed by plants. Source of the nutrient in the cocoa pod husk waste can be utilized through the decomposition process. The cocoa pod husk waste, that has decomposed when it was returned to cocoa fields, will be a source of nutrients which play a role in the growth process and the production of cocoa as well as the sustainability of the land. The relationship between organic matter and plant growth can be directly or indirectly. Organic material of natural substrates for saprophytic microorganisms and indirectly provide nutrients for the plants through the activity of the microorganisms [6]. During the decomposition process of organic material, it results organic acids such as fulvic and humic, also phytohormones like Indole Acetic Acid (IAA), Gibberellin (GA), and cytokine. Hormones and organic acids are useful for cocoa plant growth. Saprophytic microorganisms which play a major role in the decomposition process of organic materials are rot fungi. The purpose of this research was to examine the capabilities of producing phytohormone, degradation ability of cocoa pod husk waste by *Tremella sp* and *Pleurotus sp*, and the growth of cocoa seedlings on the cocoa pod composting by *Tremella sp* and *Pleurotus sp*.

2. Method

2.1. Isolation, Screening, and Propagation of Fungi

Isolates of *Tremella sp* and *Pleurotus sp* were obtained from decayed stems of cacao in cocoa plantation in the Bila Village of Pitu Riase, Sidrap district, South Sulawesi, Indonesia. The fruiting body of fungi were stored in the paper bag until it isolated in the laboratory. Pieces of fungal fruit bodies (1 cm x 1 cm in size) were surface sterilized with 70% alcohol, rinsed 2 times with sterile water and placed on to sterile filter paper. Each piece (\approx 2 mm) cultivated aseptically on PDA medium and incubated at room temperature. After sub culturing and purification, isolates are then coded according to the kind of fungi [7].

2.2. Measurement of IAA and GA_3 Content

A \varnothing 5 mm disc of seven days old of rot fungi isolates were incubated on Potato Dextrose Broth (PDB) added L-Tryptophan $0,1 \text{ g l}^{-1}$ shaken out with speed 150 rpm/min during 7 days at temperature room. Suspension of rot fungi centrifuged with speed of 5000 rpm for 25 minutes. Five ml supernatant was added 1ml Salkowski reagent ($12 \text{ g l}^{-1} \text{ FeCl}_3$ in $429 \text{ ml l}^{-1} \text{ H}_2\text{SO}_4$), following this, it was stored for 24 hours at temperature room in the dark conditions. The quantity test was done by measured absorbance supernatant with spectrophotometer wavelength of 535 nm [8]. Supernatant colour change into pink indicates the presence of IAA. IAA concentration measured using a standard curve with the regression equation $Y = x + 0.064$ 0.09, where $R^2 = 0.995$. Equations obtained at one of the dilution of stock solution of IAA range 0 – 5.0 mg l^{-1} . Concentration in the culture filtrate was compared to the standard curve.

The production of GA_3 used isolates from PDA's media taken 5 pieces with cork borer, grown on a medium of PDB, and incubated at room temperature for 7 days. Then, the culture was centrifuged at 8000 rpm for 10 minutes, and it was transferred 15 ml into test tubes and added 2 ml of aqueous solution of zinc acetate. After 2 minutes, added 2 ml of a solution of Potassium Ferro cyanide and centrifuged at 8000 rpm for 10 minutes. Five ml supernatant added 5 ml of hydrochloric acid 30% and incubated at room temperature for 75 minutes. Blanco prepared with hydrochloric acid 5%. Absorbance is measured at a wavelength of λ 254 nm using the spectrophotometer. GA concentration compared to the standard curve of GA_3 (Sigma-Aldrich) in the range of 0.25-2.25 ppm.

2.3. Composting Cocoa Pod Husk Waste by Fungi

Isolates of *Tremella sp* and *Pleurotus sp* were sub cultured on the dried corn soaked media and sterilized by autoclave temperature 250°C for 1 hour. Isolates on reproduction media incubated at room temperature for 7 days. Cocoa pod husk waste were chopped then mixed with sawdust, and chaff. Compost medium were moisten with water until 30% of RH, spread on plastic sheets up to a thickness of 60 cm pile and covered with plastic tarpaulin. The temperature was measured daily, when it reached 50°C the mix was reversed. Compost were fermented for 40 days.

2.4. Measurement of Nutrient and Lignocellulose Content

Mature cocoa pod husks waste compost were mixed and sieved (\varnothing 2 mm), separated and weighed then analyzed for its total N, pH, organic C, the ratio C/N, P, Mg, and S according to Soil Research Hall (2009). Measurement of lignin, cellulose, and hemicellulose content was also revealed 40 days after fermentation using the method [11].

2.5. Experiment Design

The study used Split-Split Plot design, consist of the cocoa varieties as main plot: Sulawesi 1 (v1) and Sulawesi 2 (v2). Kind of fungi treatment compost as sub plot: without rot fungi (j0), *Tremella sp* (j1), and *Pleurotus sp* (j2). The use of P fertilizer as sub sub-plot: without P fertilizers (p0), and with P fertiliser (p1). There were 12 treatment combinations repeated in 3 groups, so there were 36 units of treatment. Each unit consists of 4 poly-bags. The data were analyzed by using the analysis of kovarian (ANOVA), if the treatment was significant, the advanced test using Tukey Honest Significant Difference (HSD) test for means comparison.

2.6. Data Collection

Observation on the growth of seedlings of cocoa on cocoa pod compost inoculated *Tremella sp* and *Pleurotus sp* measured in 90 days after planted, namely:

- Leaf Area Index (LAI)[12]:
LAI = Leaf area total/ plant area
- Net Assimilation Rate (NAR), by Gardner, 1985:
 $NAR = (W2 - W1) / (T2 - T1) \times (\ln ld2 - \ln ld1) / (ld2 - ld1)$.
- Crop Growth Rate (CGR) (Gardner, 1985) :

$$NLD = \frac{1}{T2 - T1} \int_{T1}^{T2} Id/w = \frac{ld2 - ld1}{W2 - W1} \times \frac{\ln W2 - \ln W1}{ld2 - ld1} \text{ cm}^2/\text{mg}$$

- Where: ld2 = leaf area in the end of experiment (63 days)
ld1 = leaf area in first measurement (42 days)
W2 = Total dry weight in the end of experiment
W1 = Total dry weight in the first measurement.
T1-T2 = Period of growth (21 days).

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3. Results and Discussion

3.1. Morphological characterization of *Tremella sp* and *Pleurotus sp*

The morphological characterization of two kinds of rot fungi isolated from decayed cacao stem showed on Figure 1.

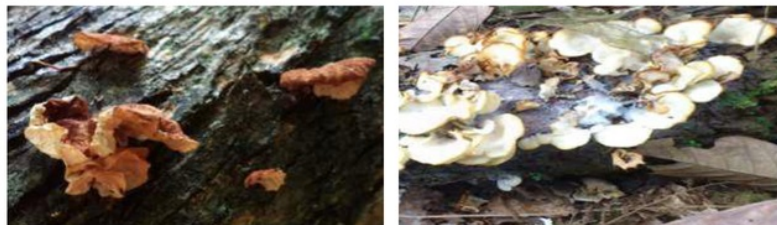


Figure 1. Fruiting bodies of fungi *Tremella sp* (left) and *Pleurotus sp* (right) collected from decayed cocoa stem.

Tremella sp have orange-coloured fruit body, thin, and dry. The edge of the cap rolled and attached on one side on a wooden rod. The upper surface of the hood is darker than the surface of the bottom. The rot fungi is included in the division of Basidiomycota, sub divisions of Agaricomycotina, 26 mellomycetes class, order Tramellales [13]. The fruiting body is yellow, orange, and brown. Variations in the intensity of the colour of fruit body could be caused by variations in light intensity by carotenoid [14]. *Pleurotus sp* is also known as oyster mushrooms. Have the stalk and a thick covering of flesh and soft. The surface is smooth and feels feathery soft. The spores are white to creamy. The diameter of basidiospores were in $8.7 - 11.2 \times 2.3 \mu\text{m}$, cylindrical, thin walls, and soft [15]. This fungi has the ability to kill the nematode known toxin called trans-2-decenedioic acid [16] and linoleic acid [14].

3.2. Phytohormone Production

Tremella sp and *Pleurotus sp* has the ability to produce secondary metabolites in the form of the hormone grows IAA and GA_3 . Measurement results showed concentrations of the phytohormones generated *Tremella sp* was higher than *Pleurotus sp*. The Figure 2 clearly showed that concentrations of IAA and GA_3 produced by *Tremella sp* was $2,444 \mu\text{gL}^{-1}$ and $4,111 \mu\text{gL}^{-1}$, while the IAA and GA_3 produced by *Pleurotus sp* respectively are $1,794 \mu\text{gL}^{-1}$ and $2,551 \mu\text{gL}^{-1}$. Hormone GA, such as IAA, is very useful for the process of growth and physiology of plants. This process includes the seed germination, seedling emergence, growth of stems and leaves, the flower induction and growth of flowers and fruit [17],[18],[19]. Challenged and was also involved in root growth, abundance of hair roots, the inhibition of differentiation of flower buds on the island, setting up the generative and vegetative bud dormant, and delaying senescence in many organs in various plant species [19].

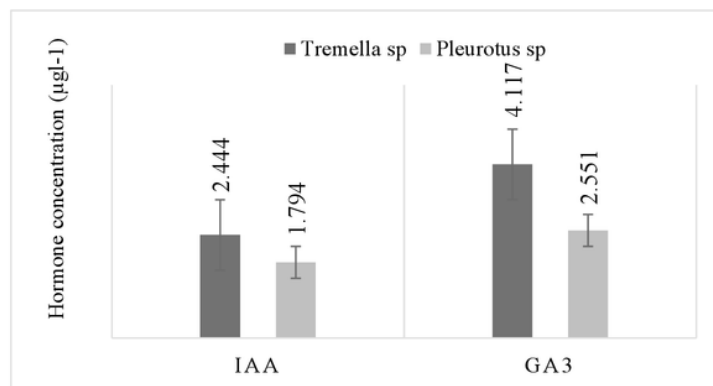
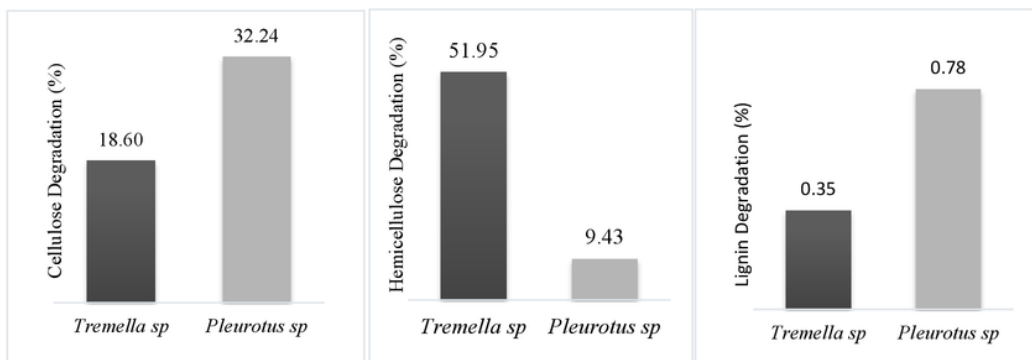


Figure 2. Production of IAA and GA_3 by fungal rot *Tremella sp* and *Pleurotus sp*.

3.3. Cocoa Pod Husk Waste degradation by *Tremella sp* and *Pleurotus sp*

Cocoa pod husk waste fermented for 40 days with isolates *Tremella sp* and *Pleurotus sp* changing colours and textures become more dark and smooth.

Figure 3. Degradation rate of Lignocellulotic of cocoa pod husk composted by *Tremella sp* and *Pleurotus sp*.



This is due to the activity of the microorganisms. The compost is organic matter that has decomposed [6], referred to as the dark topsoil and quite stable, and is defined as a complex of ligno-protein or a complex of amino acid-lignin. Polyphenols compounds is the result of the decomposition of compound lignocellulose and Quinones became the next reaction with amino acid-forming compounds, or humicfulvic dark (black) [20].

The cocoa pod decomposed by rot fungi became the major constituent components of plant cell component, namely cellulose, hemicellulose, and lignin. The components obtained from results of photosynthesis, i.e. glucose. Cellulose and hemicellulose were formed of glucose units. Whereas, lignin is composed of fenilpropan units. The percentage degradation of cellulose and lignin were the highest on the inoculated composting *Pleurotus sp.*, i.e. each 32.24% and 0.78%. However, the degradation of hemicellulose was the highest on compost *Tremella sp* i.e. 51.95% (Figure 2). According to Brady (1984) [21], dried biomass contains 60% carbohydrates, 1-5% sugar and starch, 10-30% of hemicellulose, 20-50% cellulose, 10-30% lignin, 10% protein, and 1-8% fat, wax, and tannins. Lignocelluloses is the main component of woody plants, consisting of 40% cellulose, hemicellulose 20-30%, and the 20-30% lignin [22].

This research showed that hemicellulose has the lowest levels compared to cellulose and lignin. Hemicellulose is easier than degraded other lignocellulosic components in biomass [23]. Rot fungi which is inoculated on the skin of the fruit of the cocoa has different capabilities degrade hemicellulose. Hemicellulose degradation by highest isolates *Tremella sp* and low on *Pleurotus sp* isolates. Hemicellulose is a polysaccharide that is an important part of cell walls and absorbs water with strong [24]. Hemicellulose enzymes like xylanase and beta-D-xylosidase is a polymer of sugar pentose. Enzyme lignocellulosic of boletus is bio-an important commercial product used in a variety of industries and applications including environmental chemicals, fuel, food, wine, brewing and animal feed, textiles and laundry, pulp and paper, agriculture and bioremediation [25]. This application is an indication of *Tremella sp* on the pulp and paper industry waste.

Cellulose is a component in the cell wall of the plant as micro fibril. Biological treatment causes changes in microstructures of cellulose. Rice straw on the crystalline index decreased from 44% to 15% after application of *P. Crysosporium* [23]. In this study, *Pleurotus sp* degrades cellulose cocoa pod husk waste to 32.24%. Lignin is the hardest component to degrade. This can be seen from the low percentage of lignin degradation cocoa fruit skin than other components. Many factors affect the ability of rot fungi degrade lignocellulosic components. These factors, among others, the difference in strain of rot fungi and substrate. The research shows *Pleurotus sp* has the ability to degrade lignin from straw, but not able to degrade lignin in birch hardwood or soft wood pine [26]. Likewise, in this

study, *Pleurotus sp* has the ability to degrade hemicellulose lowest cocoa pod. But the highest on the degradation of cellulose compared *Tremella sp*.

The decomposition of cellulose and hemicellulose by white rot fungi with the same speed, whereas lignin break down more quickly. Cowling (1961) describes a hypha of rot fungi first attack the fingers or vessels or directly penetrate the walls of the cells. The enzyme helps the penetration. The growing hypha in the cavity of the cell degrades the secondary wall from within and beyond the walls of the tertiary outwards. Materials produced from decomposition are complex and can be directly absorbed hypha [24].

3.4. Nutrient content of the Cocoa pod Compost Decomposes *Tremella sp* and *Pleurotus sp*

Nutrient levels of cocoa pod compost inoculated with rot fungi shows the content of the nutrient was able to exempt by microbes. Nutrient content of the cocoa pod is quite high, and reported that 61% of total cocoa fruit nutrients stored in the peel[27]. Table 1 shows the nutrient content in the compost inoculated *Pleurotus sp*. higher than compost *Tremella sp* on 40 days of fermentation, except Mg and S. Nutrient content of compost, however without the rot fungi much lower than both. This shows that there is the ability of *Tremella sp* and *Pleurotus sp* enhance the availability of nutrients in composted cocoa pod husk waste. Nutrient content of compost shows categories are up to very high. Nutrient analysis of compost on this experiment shows moderate to total N content is high, very high P₂O₅, K₂O similarly to enter categories is very high. These categories are retrieved from the level of nutrient elements[28]. The C-organic content of compost on the study also fall into the category of very high.

Nevertheless, the results are higher, namely 33.76% C-organic and N 0.22% after cocoa pod of *Pleurotus pulmonarius* inoculated and incubated for 30 days [33]. Cocoa pod compost pH ranges between 6.89 and 7.69. The reaction of organic material effect on nutrient availability required of microbes. General microbes thriving and active at neutral pH to alkalis (6.5 – 8.5), whereas the process of mineralized optimum at pH around 7.0 [24]. Magnesium and Sulphur is a nutrient that is released in the process of microbe mineralized in addition to N, P, K, and Ca. Mg is an important element as a constituent of chlorophyll and function as cofactors in enzymes. While, S was the instrumental in the formation of disulphide bonds between protein chains [29].

Nutrient content of cocoa pod compost inoculated *Tremella sp* and *Pleurotus sp* has meet the standards laid down by the compost [30], which according to the Indonesian National Standard 19-7030-2004, compost quality standards contain minimum N 0.2%, while the cocoa pod compost generated has rates of N of 0.65-0.60%. Similarly, the levels of P₂O₅ at least 0.1, whereas compost is generated contain P₂O₅ of 4.65% – 6.70%. Standard quality compost for K₂O and C-organic minimum each 0.2% and 9.8% respectively. Nutrient of K₂O and C-organic cocoa pod inoculated composting *Tremella sp* and *Pleurotus sp* respectively range 0.71 - 0.59% and 16.91 – 17.58%. Similarly, the requirement of INS compost Mg levels maximum is 0.6%, while cocoa pod compost has the highest levels of Mg 0.32%. This shows the resulting compost on research is quite standards compliant nutrient quality compost which determined the National Standardization Agency.

Table 1. Nutrient content of Cocoa Pod decomposed by rot fungi after 40 days of fermentation.

Nutrient Content	Without Fungi	<i>Tremella sp</i>	<i>Pleurotus sp</i>
pH	8.02 ^a	8.21 ^a	8.12 ^a
C-organics (%)	10.36 ^a	16.91 ^b	17.58 ^b
N-total (%)	0.50 ^a	0.60 ^a	0.65 ^b
C/N	24.00 ^a	25.00 ^a	26.00 ^a
P ₂ O ₅ (%)	4.65 ^a	5.84 ²⁵	6.70 ^b
K ₂ O (%)	0.33 ^a	0.59 ^{ab}	0.71 ^b
Mg (%)	0.10 ^a	0.32 ^{ab}	0.28 ^b
S (%)	0.09 ^a	0.22 ^b	0.19 ^b

Note: Number followed by the same letter in the same column are not significantly different according to Tukey HSD at 95% confidence level.

3.5. Growth of Cocoa Seedling

Application of compost is fermented by rot fungi as the medium to growth of two varieties cocoa seedling show in Table 2.

Table 2. Growth analysis two varieties of cocoa seedling in the medium of cocoa pod husk waste inoculated by rot fungi

Growth Analysis	Variety	Cocoa pod husk waste			
			Without Fungi	<i>Tremella sp</i>	<i>Pleurotus sp</i>
LAI	Sulawesi 1	Without P	1.21 ^{eA}	0.83 ^{aB}	0.88 ^{aA}
		With P	1.09 ^{bcB}	1.15 ^{dA}	0.80 ^{aA}
	Sulawesi 2	Without P	0.83 ^{aA}	0.86 ^{aA}	0.92 ^{abA}
		With P	0.93 ^{abA}	0.79 ^{aA}	0.86 ^{aA}
Root-shoot ratio (g)	Sulawesi 1	Without P	2.90 ^{bA}	3.96 ^{fB}	3.06 ^{cA}
		With P	3.69 ^{dA}	2.22 ^{aA}	4.02 ^{fA}
	Sulawesi 2	Without P	3.91 ^{eB}	3.75 ^{deA}	3.04 ^{aA}
		With P	2.54 ^{bA}	3.59 ^{dA}	4.65 ^{gB}
Root dry weight (g)	Sulawesi 1	Without P	0.35 ^{bA}	0.31 ^{abB}	0.42 ^{cA}
		With P	0.33 ^{abA}	0.46 ^{cA}	0.29 ^{aB}
	Sulawesi 2	Without P	0.33 ^{abB}	0.32 ^{abA}	0.33 ^{bA}
		With P	0.47 ^{cA}	0.32 ^{abA}	0.35 ^{aA}
130R (g.m ⁻² .day ⁻¹)	Sulawesi 1	Without P	0.51 ^{aA}	0.52 ^{aA}	0.52 ^{aA}
		With P	0.52 ^{aA}	0.51 ^{aB}	0.52 ^{aA}
	Sulawesi 2	Without P	0.52 ^{aA}	0.52 ^{aA}	0.52 ^{aA}
		With P	0.52 ^{aA}	0.51 ^{aB}	0.51 ^{aA}
11R (g.m ⁻² .day ⁻¹)	Sulawesi 1	Without P	0.66 ^{ab}	0.82 ^{aB}	0.87 ^{bA}
		With P	0.71 ^{abB}	0.70 ^{abB}	0.72 ^{abA}
	Sulawesi 2	Without P	0.74 ^{abB}	0.59 ^{aB}	0.74 ^{abA}
		With P	0.76 ^{abB}	0.66 ^{aB}	0.63 ^{aA}

Notes: Number followed by the same letter in the same column (capital letters) and the same row (lower case letters) are not significantly different according to Tukey HSD at 95% confidence level.

Table 2 shows the highest LAI of cocoa seedling varieties Sulawesi 1 on compost *Tremella sp.* The production of IAA and GA₃ hormone by *Tremella sp.* was higher in comparison with those from *Pleurotus sp.* (Figure 1). The hormone has essential role in the growth and development of roots and shoots, even in stress of conditions. Research showed sorghum seeds germination rate and seed of wheat reached 75% with the application of IAA produced by *F. oxysporum*, and stress on salinity [35]. *Tremella sp.* compost application on cocoa seedling varieties Sulawesi 1 also showed the highest root dry weights. Compost derived from *Tremella sp.* induced the production of GA₃ higher than compost of *Pleurotus sp.* (Figure 1). Acid forms lateral roots reviving [12]. The existence of the rooting ability of plants absorb pushing nutrient around the plant. This is closely related to the ability of seedlings of cocoa obtained the nutrient for growth. Mobilization of N, P, and K of compost to the system increases with the presence of rooting materials topsoil. This led to the high rate of NAR on the compost by *Tremella sp.* on varieties Sulawesi 1 (Table 2). Figure 2 clearly depicted that the type of type of compost has a good capability in degrades cellulose and hemicellulose. The ability of these elements will liberate degrades the C, H, and N were needed as a source of energy for the microorganisms.

Generally, the different varieties of cocoa seedlings do not cause physiological response differences. It can be seen from the difference between the values of their CGR which is not much different. CGR correlation with age of the plant is dry weight increase of plants per cm² of area per day with a period of 3 weeks. Value added is measured at the time of growth (formation of vegetative parts) cocoa plants on the compost and giving of various media P. The highest CGR in cocoa seedling varieties Sulawesi 1 on the medium compost *Pleurotus sp.* Nutrient analysis of *Pleurotus sp.* compost indicated a higher nutrient content than compost *Tremella sp.* It can be seen at Table 1. The content of N, P, and K were higher on compost *Pleurotus sp.* which needed by crops. N is an important element of the constituent amino acids, nucleotides, and nucleoprotein, as well as essential for the cleavage and the enlargement of cells for growth [12]. P is one of the essential macro nutrient required in carbohydrate metabolism. Preparation of sucrose and hexoses requires high energy phosphate required leaf cells [32]. K plays an important role in photosynthesis because it directly increases the growth and yield of photosynthesis from the leaves translocation [12].

However, the nutrient contained in the organic material can be used only when in the form provided. The decomposition of organic materials in microbiology is an important step to release the nutrients in remaining organic material in a form that can be utilized plant [6]. Growth of shoots hypha or mycelium to cause physical pressure coupled with spending on an enzyme that dissolves cell walls of the wood chain [32]. Some enzymes degradation organic materials produced by *Pleurotus eryngii*, *P. ostreatus*, and *Bjerkandera adusta* [33]. Nutrient content of compost by *Pleurotus sp.* showed the highest of shoot-root ratio on cocoa seedlings. Shoot-root ratio showed how big the result of photosynthesis that accumulated on the parts of plant organ. This shows the ideal plant growth that reflects the process of absorption of nutrient elements. Dry weight through the process of photosynthesis more translocation to the section of heading from to plant roots [12]. The researched that given 100 g cocoa pod husk per poly-bag increased the shoot-root ratio of cocoa seedlings [34].

The difference varieties do not give the significant affect to growth of cocoa seedling. Sulawesi 1 and Sulawesi 2 actually has long been known by cocoa farmers in Sulawesi Island, about 30 years ago. Both these varieties released in 2008 as the superior varieties. Sulawesi 1 which was also known as PBC 123, was optimal production in the fifth year after planting with the potential production of 1.8-2.5 tonnes/ha. It was quite tolerant of pests of Cocoa pod borer and diseases of the Vascular Streak Dieback (VSD). Morphology of the grooves are less assertive, rounded fruit shape, fruit tip obtuse, base fruit blunt without bottlenecks, seasonal harvest, harvest time is long, the young leaves colour is red maroon, a young fruit of brownish red colour, the colour of a ripe fruit is orange, branches that form leading up to the top.

Sulawesi 2 variety also known as BR 25, potential production of clones around 1.8-2.7 tonnes/ha in the fifth year, it is quite tolerant of VSD's attack. The grooves of the fruit is clearly, pointed fruits, bear fruit almost all year long, rough skin surfaces, colour flus was red yellow, harvest

time is short, branching a lot more lead laterally. The colour of the fruit ripe is orange, fruit resembling a blunt and the base of the neck of the bottle [35].

4. Conclusions

Tremella sp had the higher levels IAA and GA₃, higher than *Pleurotus sp*. The concentrations of IAA and GA₃ produced by *Tremella sp* were 2,444 µgL⁻¹ and 4,111 µgL⁻¹, while the IAA and GA₃ produced by *Pleurotus sp* respectively are 1,794 µgL⁻¹ and 2,551 µgL⁻¹. It was similarly with the ability to degrade hemicellulose on the cocoa pod. However, *Pleurotus sp* capable of producing compost with higher nutrient levels and had the ability of degradation of cellulose and hemicellulose higher than *Tremella sp*. The use of compost fermented with rot fungi medium of cocoa seedling has the significant effect to the LAI, NAR, CGR, root-shoot ratio, and root dry weight of cocoa seedling, compared the compost without fungi. Nevertheless the difference in varieties of cocoa had no significant effect on growth of cocoa seedlings.

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