Effectiveness of *Trichoderma viride* (T2) to the Growth of *Acacia mangium* Seedlings

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**Abstract**—Increasing the growth of *Acacia mangium* could be conducted by inoculating of *T. viride* (T2) that is combined with the use of mature manure. This study aimed to improve the effectiveness of *T. viride* (T2) and manure to the growth of *A. mangium* seedlings. The treatments consisted of the media (soil and sand sterile) without treatment as a control, media that were inoculated T2, media that were supplemented mature manure, and the media that were given mature manure and inoculated T2. This study observed during two months. The results showed that the seedlings in media containing manure and T2 had a height (22.57 cm) and diameter (2.67 cm). It was higher than the control treatment and the treatment were only applied T2 or sole manure. In this study, the seedling growth was influenced by the increase in nutrient content (organic C: 1.38%, nitrogen: 0.18% and phosphorus: 144.35 ppm) and the ability of T2 in utilizing nitrogen for its growth and development, which was indicated by the high of T2 spore density.

**Index Terms**—*Acacia mangium*, manure, *Trichoderma viride*

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**I. INTRODUCTION**

The growth of forest more emphasis on the utilization of natural fabrics that can assure the sustainability of the product and the environment. It can minimize the usage of chemicals, such as chemical fertilizers. It too becomes the provision of sustainable forest management that must be fulfilled in stockholders of forests in Indonesia to receive certificates of SVLK (Standar Verifikasi Legalitas Kayu or standard of wood legality verification) and PHPL (Pengelolaan Hutan Produksi Lestari or standard of wood legality verification). The use of natural materials is the use of manure for increasing plant growth (in this case is *A. mangium*).

*A. mangium* is a plant that has been a favorite plant in Indonesia because of multi-product and a short crop rotation. In the cultivation of *A. mangium* have almost no obstacles at every the stage of growth. Even though the quality and quantity of *A. mangium* still need to be improved because the decline of land quality may occur every year and the high threat of stem rot disease on subsequent crop rotation.

The use of *Trichoderma* as a biological agent in various plants has been established as a pesticide [1]-[3] and biofertilizer [2]-[4]. The role of *Trichoderma* is indicated by the production of phytohormone compound and providers of essential nutrients for plants [5].

*Trichoderma* applications that are aggregated with the role of manure as a growing medium become very significant in the cultivation of *A. mangium* in West Kalimantan. This is imputable to the character of land that is dominated by ultisol and acidic soil. The ultisol is a nutrient-poor soil, thus, necessary the addition of nutrients and introduction of soil microbial such as *Trichoderma*. The use of *Trichoderma* local isolates is crucial in West Kalimantan because a local strain has a better ability to adapt to the soil environment.

This study aimed to improving the effectiveness of *T. viride* (T2) and manure to the growth of *A. mangium*. The ability of *Trichoderma* as decomposers of manure can optimize their role as the biofertilizer agents to increase the growth of *A. mangium*. Livestock animals are not much cultivated by the forest communities of West Kalimantan become a limiting factor in the supply of manure for fertilizer, so that the manure application can be combined with the use of soil-borne fungi such as *Trichoderma*.

**II. MATERIAL AND METHODS**

A. *T. viride* (T2) Inoculum

*T. viride* (T2) (isolates collected in the lab. Silviculture Tanjungpura University) were cultured on PDA for 5 days. T2 isolates (5 plug) were cultured on rice medium (1000 ml) which has been sterilized, and incubated for 3 weeks. Then it was inoculated in planting media of (*A. mangium*).

B. Experiment Site

*A. mangium* seeds were sown in sterile sand medium. After eight days later, seedlings were moved to the planting medium that had been processed. Previously, Ultisol soil, sand and manure were sterilized. Soil and sand in the ratio 3: 1 wt / wt, were mixed into a polybag (20 x 20 cm) as a planting medium. The treatments consisted of: 1) without manure and T2 or control; 2) sole manure (50 g / polybag) (P); inoculation of T2 (5 g inoculum / polybag) (T); 4) manure (50 g / polybag) + T2 (5 g / polybag). Each treatment was repeated 5 times. Watering was done 2 times a day (sunrise and afternoon). The treatments were created with a completely randomized design.
C. Analysis of Data

Variable of observations consisted of height and diameter of seedlings, soil analysis (C / N ratio and $P_2O_5$) and spore density of T2. The data were examined using analysis of variation (ANOVA), succeeded by Duncan test.

III. RESULTS

A. Effect of T2 and Manure to the Growth of A. mangium Seedlings

Effect of manure and $T. viride$ (T2) can be measured in the growth of plants (seedlings height and diameter). Fig. 1 showed that the manure and inoculation T2 significantly affected to the height ($\rho > 0.05$) and diameter ($\rho > 0.05$) seedlings in two months of observation.

The application of manure + T2, seedlings were higher (22.57 cm in height) (Fig. 1) and larger (2.69 cm in diameter) (Fig. 2) than the treatment of sole manure or T2. But treatments that sole manure (P) and sole T2 (T), did not show any significant differences with the control.

The diameter growth is secondary growth that can significant effect to the older age seedlings. In Fig. 2 indicated that the combination of T2 and manure to accelerate the growth of secondary A. mangium seedlings (in the seedling age of 3 months).

B. Effect of T2 and Manure to Soil Nutrition

Increased growth of seedlings in the treatment of T2 + manure (TP) was affected by increasing nutrient C, N, and P. Table I showed that the increasing of N content in treatment TP (0.18%) were consistent with the increasing of C-organic content (1.38%). The ranges of C / N ratio was 7.50 – 8.00, lower than the C / N ratio standard by SNI (10 – 20) [6]. N content at higher control (K = 0.16%) than the media were given manure (P = 0.08%) and T2 (T = 0.06%). While the content of P on the lower control (K = 3.75) compared to all treatment.

<table>
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<tr>
<th>Treatments</th>
<th>Nutrient with treatment medium</th>
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<tr>
<td></td>
<td>C-organic (%)</td>
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<tr>
<td>Control (K)</td>
<td>1.27</td>
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<tr>
<td>P</td>
<td>0.63</td>
</tr>
<tr>
<td>T</td>
<td>0.45</td>
</tr>
<tr>
<td>PT</td>
<td>1.38</td>
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There was an increase phosphorus (66.44 ppm) in planting medium by the addition of manure, than controls (3.75%) and treatment of sole T2 (5.55 ppm). Media with the addition of manure + T2 had the highest availability of phosphorus (144.35%) than the other discourses. This suggests that phosphorus is essential for seedling growth.

The treatment of manure and T2 had highest of the T2’s growth ($3.60 \times 10^6$ spores/ml) than the others (Fig. 3). $T. viride$ (T2) density in control treatment ($2.25 \times 10^6$ spores/ml), sole manure ($2.55 \times 10^6$ spora/ml) and sole $T. hamantum$ (T3) did not significantly different. $T. viride$ (T2) in control and sole manure treatment might be caused by contamination when $T. viride$ (T2) inoculated.

IV. DISCUSSION

The previous research explained that $T. viride$ (T2), $T. hamantum$ (T3) and $T. virens$ (T5) had not shown a significant effect on the height and diameter of A. mangium seedlings [7]. Likewise with this survey, where
inoculation of sole T2 was not significantly different with the control treatment (Fig. 1 and Fig. 2). Inoculation T2 with the addition of manure showed the most effective to the control treatment (Fig. 1 and Fig. 2). Inoculation T2 inoculation of sole T2 was not significantly different with treatment of manure and T2 (PT).

The effect of T. viride (T2) and manure to the growth of seedlings should consume a long time of observation. It is caused by forest plants such as A. mangium, has a long crop rotation. Therefore further study needed on the dosis of T. viride (T2) and manure effective to increase the growth of A. mangium on the ultisol soil in West Kalimantan.

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