Effectiveness of Soil Conditioner for the Growth of Acacia Seeds in Dystropepets

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Abstract. *Acacia mangium* is one of the vegetation that can grow on dystropepts, but its growth has not shown the right quantity and quality. This is caused by the deficient nutrient in dystropepts. To increase productivity can add soil conditioners. The purpose of this research was to obtain an effective soil conditioner for acacia growth in dystropepts. This experimental research using complete randomized design. Factors studied were K = Control, A = Bacteria 10 gr, B = Trichoderma 10 gr, C = Mycorrhiza 40 gr, D = NPK fertilizer 20 gr, and E = Manure 200 gr. Dystropepts soil used as much as 1,000 gr for each treatment. Each treatment is repeated 5 (five) times. The observation variables consisted of height and number of leaves. The results showed that the treatment of adding conditioner significantly affected the growth of acacia seedlings in dystropepts. The addition of trichoderma is the best treatment for increasing seedling height (3.0) and number of leaves (7.4). Soil conditioners from microbes and fertilizers are effective for stimulating the growth of acacia seeds in dystropepts.

1. Introduction
Dystropepts soils are mild weathered climatic soils with low base-saturation values. On the upper slopes and small hilly areas, dystropepts, deep cross-section, textures vary from smooth to rough, well drained. Dystropepts, in the USDA soil classification system are included in the Inceptisol order. Inceptisol is young soils which are the newly developed genetic horizon [1]. Dystropepts are scattered in the HTI area of West Kalimantan, into the clayey texture class. The results of previous studies Suryantini et al. [2], showed that at a depth of 50 cm there were no spodic or illuviation results from both the Al and Fe elements. The content of Al exchanged is very small (<1.0), as well as for Fe whose value is <50 ppm. The soil structure has not yet been formed so it is concluded that this type of soil is nutrient poor. As a result, vegetation diversity is very low. Some vegetation that can grow are acacia (*Acacia mangium*), temau (*Cratoxylon* sp), cengkodok (*Melastomamalabothricum*), entuyut (*Napenthes* sp.), Graminae, Pteridophyta, and putrimalu (*Mimosa pudica*). The vegetation structure that grows the most is the seedling level followed by the sapling and pole level. Very rarely found tree-level vegetation structure. In addition to low vegetation, the results of Suryantini et al. [2], also found a low diversity of microbes such as fungi and bacteria in soil dystropepts. The existence of this type of land in West Kalimantan is relatively high, so that relatively no management is carried out.

Efforts to improve dystropepts soil can be done through a silvicultural approach through planting species that are resistant to land with extreme conditions. One of the plants that can be chosen is acacia (*Acacia mangium*). Acacia does not require high growth requirements. This species can grow on nutrient-poor soils, Imperata grasslands, logged areas, eroded soils, rocky soils and also on alluvial soils. This plant species grows well in laterite soils, which are soils with high iron oxide and aluminum content [3]. However, this species is intolerant of the saline environment and shade. Under the shade,
mangium will grow stunted and thin [4]. The reason for the selection of acacia is also based on the discovery of this species in dystropepts even though the number of individuals is rare but it is assumed that acacia plants can survive in dystropepts soils. But the condition of the land that has not been formed perfectly causes the possibility of failure in efforts to plant and improve the land. Land improvement can be done by adding soil conditioner to growing media such as the addition of microbes and fertilizers. Interaction between microbes and plants is needed especially in the formation of soil-microbial aggregate type soil aggregates. Crop cultivation practices (such as silviculture) will increase aggregate stability through changes in the composition of soil metabolites to the structure of microbial composition. Seed germination, seedling height and acacia stem diameter increased (36% and 25%, respectively) when inoculated with Trichoderma. Economically there was also an increase in productivity of NZ $ 2.5 million per year [5].

The purpose of this research was to obtain effective soil conditioner for acacia growth in dystropepts. Soil conditioner used are microbes (bacteria, trichoderma, and mycorrhiza), organic fertilizer (manure), and inorganic fertilizer (NPK). The results of this study are expected to be applied to dystropepts soils that spread in the West Kalimantan HTI area so as to increase dystropepts soil productivity and increase production and quality of HTI plants, especially acacia. Increasing land productivity is the first step in an effort to increase the resilience and independence of food and forest products.

2. Method

2.1. Materials
The tools used in this study are digital scales, shovels, polybags with a size of 20 cm × 20 cm, sprayers, rulers, tallysheets, scissors, and analytical scales. The materials used are soil dystropepts, acacia seeds (Acacia mangium Willd.) ± 3 (three) months old, mycorrhiza, trichoderma, bacteria, NPK fertilizer (15-15-15), and manure.

2.2. Procedure

2.2.1. Preparation
Preparation includes the preparation of planting media and acacia seeds. The planting media used are dystropepts soil originating from the Dusun Padek Bonti, Sanggau, West Kalimantan. Dystropepts soil weighed 1,000 gr, then mixed with soil conditioner according to treatment. Soil conditioner used are bacteria, trichoderma, mycorrhizae, NPK fertilizer, and manure. Soil microbes such as bacteria, trichoderma, mycorrhiza use a collection of isolates from previous studies. NPK fertilizer and manure used are commercial fertilizers. The age of acacia seedlings used is 3 (three) months, uniformly high, fresh, and not affected by disease pests.

2.2.2. Weaning
Acacia seedlings are transferred to the prepared treatment media. The transfer of seeds is done in the afternoon to reduce the occurrence of evaporation of acacia seeds.

2.2.3. Maintenance
Maintenance of acacia seedlings includes watering twice a day, in the morning and evening. Watering is done by considering the condition of the growing media in the polybag.

2.2.4. Observation and Data Collection
Observations were made for 3 (three) months of observation. Observed variables measured are: seedling height and number of leaves. Acacia seedling height measurements were carried out after transplanting. Observation and high data collection are done every 2 (two) weeks for 3 (three) months. Height measurements are carried out using a bar from the base of the stem that has been marked with paint (1 cm above the media) to the point where apical shoots grow. The increase in the number of
leaves is obtained by calculating the difference in the number of leaves at the beginning of the observation with the end of the observation.

2.2.5. Experiment Design and Data Analysis
The research method uses an experimental design in the form of a randomized complete design with 6 (six) treatments. Each treatment consisted of 5 (five) replications. The treatments consisted of: K = Control, A = Bacteria 10 gr, B = Trichoderma 10 gr, C = Mycorrhiza 40 gr, D = NPK fertilizer 20 gr, and E = Manure 200 gr. Treatment effects were analyzed using analysis of variance (Anova) and if significant continued with Duncan's test to see the difference between treatments.

3. Results and discussions
The addition of several soil conditioner treatments to soil dystropepts showed significant results on the growth of seedling height and number of acacia leaves (Table 1).

| Treatment   | Height increase (*) (cm) | Increased number of leaves (*) |
|-------------|--------------------------|-------------------------------|
| K (Control) | 1.2                      | 3.6                           |
| A (Bacteria)| 1.4                      | 4.2                           |
| B (Trichoderma) | 3.0                  | 7.4                           |
| C (Mycorrhiza) | 2.6                    | 3.0                           |
| D (NPK)     | 0.0                      | 0.0                           |
| E (Manure)  | 2.4                      | 7.4                           |

(* ) = significant

Treatment B (Trichoderma) is the highest mean value for the increase in seedling height of 3.0 cm and the number of leaves of 7.4 strands. The treatment with the lowest value is in treatment D (NPK). In addition to trichoderma, other microbes such as mycorrhiza and bacteria also provide a mean increase in good seedling height of 2.6 cm and 1.4 cm (Figure 1 and Figure 2). Fungi are known as a group of microbes that are more stable to environmental changes than bacteria. Not only known as biocontrol agents [6, 7] and plant growth promoters [8], fungi also have the ability to accumulate against heavy metals, Fe and volatile compounds. In soil ecosystems, fungi have an important role as agents of soil aggregation through the process of decomposition of organic matter [9].

The ability of microbial accumulation especially fungi as a result of cell wall components (polysaccharides, lipids, proteins) can bind heavy metals including hydroxyl carboxylates, amines and
phosphate groups [10]. There are two groups of fungi that play a role in soil aggregation and accumulators of heavy metals in the soil, namely soil fungi and endophytes. Fungi that have the ability to aggregate soil particles are dominated by mycorrhizal groups, both endomycorrhizal and ectomycorrhizal [11]. Utilization of Arbuscular Mycorrhizal Fungi (AMF) has been proven to be very instrumental for plants in increasing nutrient uptake because AMF can increase the surface area of absorption of the root system. Enchannment land aggregation will have a positive impact on movement of air and water so that it does not can also directly reduce the erosion. Therefore, the presence of mycorrhizal symbiosis thus will bring benefits for land and the environment. Mycorrhiza increase plant growth on low soil fertility, land degraded, and helps expand rooting system function in obtaining nutrition [12]. AMF in a root system, increases the growth of acacia seedlings rather than individual inoculations, as does T. reseei inoculation and mycorrhizal fungi (Rusulla sp.) in pine seedlings [13]. Trichoderma has a positive influence on plant growth. Trichoderma inoculation increases the height and number of roots of seedling plants [13] and acacia [14]. Mbariki [15] found that Trichoderma inoculation increased the effective nutrient content and the soil enzyme activity to repair soil and promote plant growth. Wagner [16] and Yadav [17] found that Trichoderma inoculation increases nutrient content and microbial biomass in addition to improving the soil microbial community structure.

The effect of bacteria on soil aggregation is influenced by the texture and availability of nutrients in the soil. Soil bacteria fill the soil's pores and attach themselves to the surface of micro-aggregates in the form of individual cells, micro-colonies or biofilms. Bacteria will decompose organic materials to form organic minerals. Organic minerals associated with soil particles form stable aggregates (2-20 µm in diameter and 20-250 µm in diameter) [18]. Rhizobium bacteria is a type of microorganism that is used as an inoculum in biological fertilizers. Rhizobium has the role of tethering free N2 from the air. This bacterium is used to fertilize legume plants such as beans [19]. According to Manalu [20] the use of Rhizobium helps the growth of Acacia crassicarpa during the seedling period and can reduce the use of urea fertilizer. Acacia is a legume plant that can be symbiotic with bacteria. Planting legumes is very useful in increasing the carrying capacity of land to support sustainable and environmentally friendly forestry businesses. The inoculation with Sinorhizobium americanum could improve the Acacia farnesiana growth and re-establishment of important plant-soil interactions in degraded areas, being recommendable technique for land restoration [21].

The addition of manure and NPK fertilizer aims to add nutrients to soil dystropepts and improve soil properties. Manure also gives a good effect on increasing seedling height (2.4 cm) and increasing number of leaves (7.4 strands). Manure has a function to improve soil structure and soften soil due to its high organic matter content [22]. Growth of 5 (five) seedlings (Acacia mangium Willd, Acacia hybrid, Acacia auriculiformis A. Cunn. Ex Benth, Albizia lebbeck (L.) Benth, dan Leucaena leucocephala (Lam.) showed a positive correlation with various doses of manure fertilizer [23]. The addition of NPK fertilizer aims to increase the content of macro nutrients in the soil so that it can increase plant growth [24]. However, the addition of NPK soil conditioner in this study amounting to 20 gr / 1,000 dystropepts is not effective in increasing the height of seedlings and the number of leaves due to causing death in plants. This is likely caused by overdosing. Seed death begins with the lower leaves. On the edge of the leaf looks brown and spreads to the middle of the leaf to the leaf bone. Acacia resistance that can grow on media dystropepts can be recommended as a pioneer plant for increasing soil productivity through improved soil aggregation.

4. Conclusion
Based on the results of the research, soil conditioner is effective in influencing the growth of seedling height and number of acacia seedling leaves. Soil conditioners from microbial trichoderma and fertilizers from animal manure provide better mean values for increasing seedling height and number of acacia seedling leaves.

Acknowledgments
Forestry faculty of Tanjungpura University for supporting research funding (PNBP DIPA).
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