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The Effect of Coffee Pulp Composition with Consortia Variation of Indigenic Bacteria on Plant Growth of Coffee Breeding

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Abstract*: This study aimed to determine formula and dosage of coffee pulpcompost that is appropriate to the growth of coffee in the nursery phase. The research treatment was a dose of coffee pulp compost with variations of bacterial consortia, using three treatments and one control including, 1) 150 grams of coffee pulp with variations of KA bacteria consortia, 2) 150 grams of coffee pulp with a variety of KB bacterial consortia, 3) 150 grams of coffee pulpwith a variety of consortia of KC bacteria in each treatment there were six replications. The results of the study were found to have an effect on the growth of coffee seedling height and did not significantly influence the growth of the number of leaves of coffee seedlings. This study gives an indication of formula C with 15 indigen bacterial isolates producing the best compost at dose of 150 grams for robusta coffee nursery.

***Keywords* : Coffee Pulp, Indigenic Bacteria, Coffee Breeding**

I. INTRODUCTION

Coffee is a strategic commodity that produces promising foreign exchange, where Lampung is a major coffee production center that continues to increase its production, and 80% more is the plantation coffee from the farmers. Ranging from 40% to 55% of coffee production is in the form of coffee pulpwaste, which has not been used optimally. Coffee pulp contains nutrients such as nitrogen, phosphorus, and calcium which are good for the process of growth and development in the vegetative phase. The volume of coffee leather waste with bioremediation technology can be used as organic compost.Efforts made as an alternative to maintain agricultural production and save the sustainability of sustainable agricultural land use are by reducing inputs from chemicals and switching to the use of compost derived from agricultural waste [1]. The growing coffee production in Indonesia is apparently less followed by good post-harvest coffee handling, especially in the coffee shell, which ranges from 40% to 55% of its production [2].

Consortia is a combination of pure cultures commonly called mixed inoculums. Consortia is a mixture of various species of decomposing microorganisms. The use of the decomposition microorganism method is used so that the degradation process is more effective and efficient, for example, the decomposition of compounds such as carbohydrates and proteins [3]. Paten [4] and [5] obtained an indigen bacterial formula that was able to excrete waste so that the acidity was neutral and the organic matter was broken down.Collaboration between bacteria will further accelerate the complex degradation process of compounds. The process takes place because of the presence of an enzymatic process (extracellular) which will overhaul the compounds in the coffee pulpso as to provide nutrients needed by plants, especially Nitrogen (N).

Nitrogen has a complex cycle in an environment, whether or not the nitrogen content depends on the symbiosis between microorganisms, animals, and plants, but the thing that most plays a role in the degradation process that produces nitrogen in a fertilizer is the ability of bacteria that have the potential to fix nitrogen (N) is in the environment [6]. Bacteria have the ability to increase the efficiency of N-use in the soil. The bacteria uses free nitrogen for protein cell synthesis in which the protein will undergo mineralization in the soil after the bacteria have died. Thus the bacteria play a role in the nitrogen content in the soil needed by plants [7]. The presence of high nitrogen nutrient content is caused by a large amount of carbon in coffee pulp waste so that microbes are used as an energy source to degrade organic matter which turns into CO2 + H2O + Nutrient + hummus + the energy of CO2production will evaporate into the air so the carbon decreases and activates the nitrogen element [8].

The increase in coffee cultivation and the rejuvenation of coffee plants by farmers is certainly one of the things that need to be considered specifically, especially during the coffee plant nursery.

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Based on preliminary study, the research showed that the nutrient content of coffee pulp meets the standard with a nitrogen content of 4%. Therefore the researcher took the title The Effect of Coffee Pulp Compost with the Consortia Variation of Indigenic Bacteria on Coffee Plant Growth of Coffee Seeds (Coffea robusta).

II. METHOD

The study was carried out for 4 months with a time division of 2 months which were used to make coffee pulp compost while the other 2 months were used in observing the growth of coffee seedlings. This research is an experimental and development research. The experimental research is the coffee pulp compost with a variety of consortia of indigenic bacteria on the growth of coffee seedlings (Coffea robusta). This study used a Completely Randomized Design (CRD), with the use of 3 treatments and 1 control with 6 replications.The samples used in the growth of coffee seedlings in each treatment are 1) Coffee seedling plants with 150 grams of compost treatment with variations of KA indigenic bacteria (5 bacteria), 2) Coffee seed plants with 150 grams of compost treatment with variation of KB indigen bacteria (10 batteries), 3) Coffee seed plants with 150 grams of compost treatment with variation of KC indigen bacteria (15 bacteria), the results of this study will be measured by reviewing the aspects of high growth and the number of leaves of coffee seedlings.

This research was conducted to determine the effect of coffee pulp compost with a variety of bacterial consortia on the growth of coffee seedlings, consortia of bacteria to the growth of coffee seedlings, this is shown in Figure 1 and Figure 2 about the growth in height of coffee seedlings and the number of leaves of coffee plant seeds as follows.

Variations in Consortia of Bacteria Against Nitrogen (N) Content in Coffee pulp Compost

Consortia is a combination of pure cultures commonly called mixed inoculums, consortia is a mixture of various species of decomposing microorganisms. The use of the decomposition microorganism method is used so that the degradation process is more effective and efficient, for example, the decomposition of compounds such as carbohydrates and proteins [3]. Collaboration between bacteria will further accelerate the complex degradation process of compounds. The process takes place because of the presence of an enzymatic process (extracellular) that will overhaul the compounds in the coffee pulpproviding nutrients needed by plants, especially Nitrogen (N). Nitrogen has a complex cycle in an environment, whether or not the nitrogen content depends on the symbiosis between microorganisms, animals, and plants, but the thing that most plays a role in the degradation process that produces nitrogen in a fertilizer is the ability of bacteria that have the potential to fix nitrogen (N) is in the environment [9]. Bacteria have the ability to increase the efficiency of N-use in the soil. The bacteria use free nitrogen for protein cell synthesis where the protein will undergo mineralization in the soil after the bacteria have died, thus the bacteria play a role in the nitrogen content in the soil needed by plants [7]. The presence of high nitrogen nutrient content is caused by the large amount of carbon in coffee pulp waste so that microbes are used as an energy source to degrade organic matter which turns into CO_2 + H_2O + Nutrient + humus + the energy of CO_2 produced will evaporate into the air. Likewise, the carbon decreases and activates the nitrogen element [8]. Based on this statement, microorganisms can degrade organic matter so as to provide nutrients in coffee pulp compost needed by plants such as nitrogen (N).

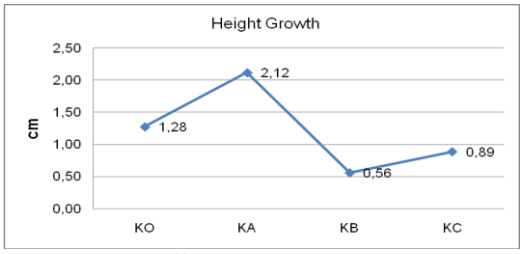

Diagram 1. The coffee seedling plant growth in 2 months

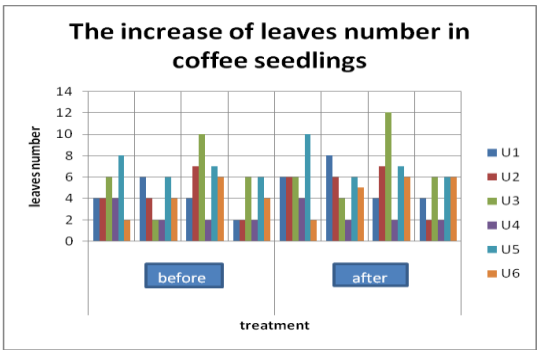

Diagram 2. Leaves measuremntfrom time to time

Required Nutrient Needs for the Coffee Seed Plants Based on the Availability of Content in Coffee Pulp Compost

Plants need nutrients as their food for the life needs of these plants, especially nitrogen (N). Coffee plants at the age of 4-6 months are plants that are still in the vegetative phase, which the growth of roots, stems, height, and number of leaves will determine whether or not the seeds will be used for agriculture. Of course, superior seeds are indeed a necessity in the field of agriculture that will determine production in the future. Therefore breeding is an important thing to consider in Indonesian coffee farming.

Maintenance of seedling age plants will determine the quality and quantity of coffee farming. Things that need to be considered in the process of maintaining coffee seeds are especially in fertilization. Giving the right fertilizer dosage will certainly affects the growth of coffee seedlings, especially in the height and number of leaves. The dosage of fertilizing coffee seedlings is good if there are elements of C 2% and N, P, K insufficient to high criteria [10]. When the nutrient needs are met, the success in obtaining superior coffee seedlings can be reviewed from the height and number of leaves. The criteria of superior seeds that can be planted for agriculture based on plant height are presented in diagram 3 about the criteria for coffee seedlings which are ready for planting from seedlings. The growth is around 4-6 months.

Tabel 1.Criteria for Coffee Seed Plants Readiness to Plant from Seedlings Aged 4-6 Months

Measurement criteria	Height (Cm)	Diameter (Mm)	Number of Leaves (pcs)

Good (A)	> 12	> 3,0	>11
Average (B)	8-10	1,5 - 2,0	9 – 8
Poor (C)	< 8	< 1,5	< 8
Result	8-12	-	< 8

Source[11].

Based on Table 3, it can be explained that the results of research on coffee pulp compost with variations in the indignation of indigenic bacteria on plant height growth were found to be moderate in the level of good criteria because the height of coffee seedlings in the research results varied greatly from 8 cm to 12 cm height. While coffee leather compost with variations of the indigenic bacteria consortia on the growth of the number of leaves in this study fell into poor criteria, particularly the average number of leaves is less than 8 pieces.

2. The Effect of Coffee PULP Compost with a Variety of Consortia of Bacteria Against the Height of Coffee Seed Plants

Based on the results of SPSS output in table 1 above, the Sig. 0,000 <0,05 so that H0 is rejected which means that there is an influence of Pulp Compost Variation with a variety of consortia of Coffee Bacteria Against High Coffee Seed Plants. Organic fertilizers are fertilizers obtained from composting the remaining material of living things that undergo fermentation processes which are assisted by degradation agents such as potential microbes, with the aim of helping the degradation process of complex molecular macro compounds into simpler compounds. So that the compost is able to provide enough nutrients as a need for coffee seedlings and is able to help the process of growing coffee seedlings.

The use of coffee leather compost as an effect of plant growth seen from plant height can be explained that there is an effect of coffee pulp compost on plant height. This can be revealedfrom coffee pulp compost of the KA treatment which has a very good high growth in a period of 2 months which is 2.12 cm, in contrast to the other treatments at KO, it only has an average growth of 1.2 cm and KB is only 0, 58 cm and KC only 0.82 cm.

The amount of food needed by the nursery requires planting media with good physical, chemical, and biological properties. The nursery medium that is often used is a layer of topsoil mixed with organic fertilizer to obtain media with good fertility [12] . Based on the above statement, it can be explained that a good nursery process is a nursery that has a planting medium with humus properties or with sufficient nutrients so that it can meet the needs of plants at the age of growth. In addition, one of the supporting factors is the availability of nutrients available in compost, with good composting procedures and the provision of microbial agents that degrade complex compounds that have the potential to become agents that will change compounds to be simpler. The microorganisms that help the degradation process are consortiums of indigenic bacteria, consortia is a mixture of various potential agents (religious) which is expected to accelerate the rate of fermentation and produce an appropriate quality standard [13]. With the help of the process of degradation from consortia, PLW bacteria can increase the degradation process to take place maximally so that the nutrient content in compost becomes higher.

The use of more consortia of indigenic bacteria will certainly increase the power of degradation to a maximum level. In this study, there were 15 types of bacterial isolation and divided into 3 types of treatment. The use of 5 bacteria in the training treatment and 1 type of isolateare potential to process organic materials, namely isolates 3. Treatment of KB using 10 types of bacterial isolates is potential to process organic materials 3.8 and 10, while the treatment of KC, there are 4 types of potential bacterial isolates in processing organic matter from 15 types of bacterial isolates (Sutanto: 2011). Other bacteria except isolates 3,8,10 and 13 only have the potential to treat amillum and protein. It is expected that the more mixing of potential bacteria, the higher the yield of nutrients contained in coffee pulp compost.

The use of more microbial consortia tends to give better results than the use of a single isolate because it is expected that the enzyme work of each type of microbe can complement each other to survive using nutrient sources [14]. In connection with this research, the most potential bacteria containing treatment is KC treatment which has 4 bacteria that have the potential to process organic matter and 11 bacteria have the potential to process amillum and protein.So, the results can be proven that the Nitrogen content studied in KC treatment is 7.2%. Whereas the KA treatment which only contained 5 types of bacterial isolates consisted of 1 bacterium which has the potential to process organic matter and 4 processed starch and protein containing only Nitrogen as much as 6.2% while the KB treatment was 6.9% with 10 types of bacterial isolates consisting of 3 bacteria which could potentially process organic matter and 7 process starch and protein.

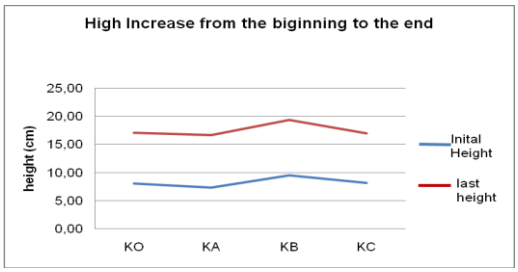

Diagram 3.The Increase of biginning and ending measurement

Based on the picture above it can be explained that coffee pulp compost with a variety of bacterial consortia affects the height of coffee seedling plants, indicated by the high increase of coffee seedlings in each treatment.

The amount of nitrogen element is expected to supply the food requirements needed by coffee seedlings. Nitrogen is a nutrient that is very necessary for plant growth such as the roots, stems, and leaves, besides the availability of nutrients in the soil will also affect the quality and quantity of plants which will also affect plant height, number of leaves, dry weight and wet weight [15]. Meanwhile, according to [16] states that the supply of nitrogen available from the planting medium (soil) will increase the rate of photosynthesis so that the growth of coffee seedlings will take place well. Plants that get enough N supply can stimulate the vegetative growth of plants, including increasing plant height, making plants greener because they contain chlorophyll, and are a constituent of protein and fat [17]. Based on this reason, it can also be attributed to the results of research where nutrient adequacy in coffee pulp compost is very influential on coffee seedlings.

Besides, the plants at the age of seedlings also need nutrients such as nitrogen in the amount of capacity that is still little more because of the age of the seeds between 1-4 months but the excess nutrients in it will also adversely affect the growth of coffee seeds. This is evidenced by the maximum growth within a period of 2 months from the KA treatment with a Nitrogen content of 6.2%, namely the average increase in height reaching 2.12 cm. Whereas KO growth which has a smaller Nitrogen content of 5.2% only has an average growth of coffee seedlings of only 1.28% while the treatment using coffee leather compost with the highest Nitrogen nutrients does not have significant growth, namely in KB 0, 56 cm and KC 0.89 with a greater nitrogen content that is KB 6.9% and KC 7.3%.

Judging from the differences in the high growth of coffee seedlings which are nutrient-affected such as nitrogen (N) contained in compost, it can be explained that proper use of doses will certainly affect the growth of coffee seedlings, in the sense that the use of fertilizing doses is sufficient (no less and no more) . The advantages and disadvantages of nutrients needed by plants will also negatively affect plant growth. Nitrogen (N) nutrient deficiency in plants will certainly cause, slow growth, chlorotic leaves (yellow), leaves become narrow, leaves are short, and yellow quickly and eventually die [18]. Whereas excess nitrogen nutrients will make the leaves become dark green, and the plant's high growth will be hampered because the plant exceeds the point of the need for coffee seedlings.

3. The Effect of Coffee Pulp Compost with the Consortia Variation of Bacteria on the Number of Leaves of Coffee Seed Plants

The results of the coffee PULP compost hypothesis with the consortia variation of the bacteria have no effect against the growth of the number of leaves of coffee seedlings.Based on the research that has been done by using compost with a variety of consortia that there is no significant effect on the number of leaves of plant samples in each treatment. Provision of coffee leather compost with a variety of consortia does not stimulate the addition of the number of leaves on coffee seedlings.

Coffee pulp compost with a variety of bacterial consortia does not have an effect on the number of leaves of coffee seedlings.It is shown that the number of leaves is proven by testing the hypothesis by analyzing the Kruskal Willis calculation. Although it did not show a significant effect on the number of leaves, coffee pulp compost with a variety of consortia of bacteria appeared to have more influence on the level of fertility and leaf color. Beside, the greater nutrient content is not the most important factor in increasing height but it becomes an influence on leaf fertility, leaf color and thickness of KB treatment with Nitrogen 6.9% and KC with Nitrogen content of 7.3% shows the color of leaves that are very fertile with color dark green by showing very much chlorophyll content. But not in the KO treatment with 5.9% sebesic Nitrogen content and 6.2% train with no content indicating the fertility rate of coffee seedlings, coffee leaves are only small and thin and the leaves are slightly yellow although very influential on plant height. The high nitrogen content in coffee pulp compost adds stimulation to vegetative growth in coffee seeds but not in the number of leaf strands but in the physical form of coffee seedlings [20]. The things shown in coffee seedlings are in the KB treatment and KC treatment because of the high nitrogen content in the KB and KC treatment which reaches 6-7%, making the physical properties of the leaves become thick and dark green, the leaves show that growth can be said to have fertility high.

III. PRACTICAL APPLICATION

The results of the study were found to have an effect on the growth of coffee seedling height and did not significantly influence the growth of the number of leaves of coffee seedlings. This study gives an indication of formula C with 15 indigen bacterial isolates producing the best compost at dose of 150 grams for robusta coffee nursery. This could be viewed into the variations in consortia of bacteria against nitrogen (n) content in coffee pulp compost. As a result, the required nutrient needs for the coffee seed plants based on the availability of content in coffee pulp compost. Moreover, the effect of coffee pulp compost with a variety of consortia of bacteria against the height of coffee seed plants the effect of coffee pulp compost with the consortia variation of bacteria on the number of leaves of coffee seed plants.

IV. CONCLUSION

Based on the results of the research that has been done, it can be concluded that:

1. There is an influence of coffee pulp compost with a variety of consortia of indigen bacteria on the growth of coffee seedlings.
2. There is an effect of the dosage of coffee pulp compost with variations in the consortia of indigen bacteria on the growth of coffee seedlings.

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