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The Effect of Biofertilizer (*Jakaba*) Fertilizer on Vegetative Growth of Chili Plants (*Capsicum annuum L.*)

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Abstract. Chili (*Capsicum Anuum* L.) is a vegetable commodity with considerable economic value. Agricultural soil that hardens, has a high clay content, does not respond to fertilization, reacts sourly, and is poor in nutrient elements and organic matter, causing many agricultural lands to be less productive and even no longer productive. This research aims to determine whether there is an effect of providing *Jakaba* biofertilizer on the growth of chili plants. This research used a Completely Randomized Design (CRD) with a factorial pattern consisting of 2 factors and 5 replications. The first factor is the fertilizer dose (D), which includes D0 (without fertilizer), D5 (fertilizer dose 5 ml/plant), D10 (fertilizer dose 10 ml/plant), D15 (fertilizer dose 15 ml/plant), D20 (fertilizer dose 20 ml/plant), and D25 (fertilizer dose 25 ml/plant)-planting media (M), which consists of M1 (soil) and M2 (soil: *Jakaba* = 1: 1), is the second component. Plant height is measured in centimeters, while the number of leaves is calculated in strands. The results of the research obtained show that there was an influence that can be seen from the combination of doses of biofertilizer and planting media on the vegetative growth of chili plants, namely the observation of plant height in the 4th week of M2D25 treatment has a value The highest is 10.18 ± 0.19 compared to other treatments, so that based on the Kolmogorov test and followed by the Anova test, it has a significant degree of 0.05, which means Ho is accepted and Ha is rejected. Then, when observing the number of leaves, we looked at the 4th week where the M2D20 treatment had the highest average number of leaves, namely 8.6 ± 0.55 compared to other treatments. So, based on the Kolmogorov test followed by the Anova test, it has a significant degree of 0.05, saying that Ho is accepted and Ha is rejected.

Keywords**:** biofertilizer; chili; *Jakaba*; plant growth

I. INTRODUCTION

Chilli (*Capsicum annum L.*) is a horticultural plant that is very popular among people, especially in Indonesia. Chilies have many benefits, such as being used as a cooking spice, bottled sauce, and various traditional chili sauces [1]. There are many liquid organic fertilizers on the market, but liquid organic fertilizers fermented from leri water are not widely used, especially the mushrooms that grow after fermentation called *Jakaba* (eternal lucky mushroom). *Jakaba* contains 90% carbohydrates in the form of starch, vitamins and minerals, and various proteins. High amounts of carbohydrates will help the process of forming growth hormones in the form of auxin, and gibberellin. These three types of hormones can stimulate the growth of leaf shoots, and transport food to the most important cells of the leaves and stems. The fungus contained in *Jakaba* is very beneficial for accelerating the growth of stunted plants, extending the life of plants, and overcoming fusarium which causes blight in plants.

Fertilizer is an important component in agricultural production, therefore technological innovation in fertilizer (inorganic, organic, and biological) must continue to be developed, both in developing new formulas, increasing effectiveness, and increasing efficiency of use. Increasing the efficiency of fertilizer use based on knowledge of the soil's ability to provide nutrients, the amount of nutrients needed by plants, and the addition of nutrients needed by plants is expected to provide a more rational and location-specific basis for recommendations [2].

Biofertilizer is an inoculant made from active ingredients from living organisms and functions to fix certain nutrients or facilitate the availability of nutrients in the soil for plants

[3]. These microbes include *Azotobacter*, *Azospirillum*, and *Rhizobium*, which can fix nitrogen elements. *Bacillus* and *Pseudomonas* can attach phosphate elements. *Saccharomyces*, *Lactobacillus*, and *Cellulomonas* help in the decomposition process which can produce potassium elements [4].

Biological fertilizers such as nitrogen-fixing bacteria are needed because they are endophytic and increase soil fertility. Biological fertilizers are materials that contain functional bacteria whose addition is intended to facilitate the provision of nutrients for plants. Functional microbes usually added include nitrogen-fixing bacteria, phosphorus-solubilizing bacteria, and phytohormone-producing bacteria, one of which is Rhizobium bacteria [5].

Facts in the field are expensive chemical fertilizers, while many circulate about the use of Biofertilizer organic fertilizers that are widely used by farmers but have not been scientifically tested, facts in the field also show that many agricultural lands are less productive and no longer productive. It is caused by damage or degradation of land. Many farms have hardened, have a high clay content, react negatively to acid, are low in nutrients and organic matter, and do not respond well to fertilizer [6], so this study aims to determine whether there is an effect of applying *Jakaba* Biofertilizer on the growth of chili plants.

II. METHODS

From June to July of 2022, the research was conducted in Pinamorongan Village, Tareran District, Regency, South Minahasa. The tools and materials in this research were: chili seedlings, polybag, bucket, bar, leri water, serial lime, MSG, sugar, bran, chili seeds, though, and bamboo root.

Research Data Collection Procedure

Procedures for making Biofertilizer

The rice washing water was poured into a bucket and covered with a soft, porous cloth and then tied with a rope this was stored in a humid room and not exposed to light, during the storage process the bucket must not be moved, and stored for 3 to 4 weeks.

Chili Seeding Stage: Sowing Chilies

Good quality chilies were then peeled to get seeds. The seeds were sun-dried a container was added with soil and fertilizer. Seeds were planted at one-centimeter depth and covered with soil. The seeds were positioned in an area shielded from the sun and rain. After 25 days or 3 weeks of waiting for the seeds to germinate, they were moved to a polybag.

Treatment Stage

Polybags were divided into two treatments, namely (1) polybags filled with soil; and (2) polybags filled with a mixture of soil and compost (1:1). Biofertilizer was given to chili plants in polybags by pouring (flushing) the planting medium at a dose of 5 ml, 10 ml, 15 ml, 20, and 25 ml per plant, fertilizer was given 4 times, namely after transplanting, 7 days after transplanting, 14 days after transplanting, and 21 days after transplanting.

Observed Variables

Chili plant growth data was obtained through plant height data (cm) which was measured from the base of the stem to the tip of the highest shoot and measurements were carried out every week. The number of leaves (strands) was calculated by adding up all the leaves on the plant and is done every week.

Data Analysis Technique

The data analysis technique in this research begins with descriptive analysis, namely interpreting the output from the analysis of biofertilizer administration on the growth of chili plants. Then proceed with statistical analysis using the Two-way Analysis of Variance (ANOVA) test and the Independent-Samples T-test with the assumption that the data was normally distributed. The research data was obtained from data on plant height (cm), and number of leaves (strands).

III. RESULTS AND DISCUSSION

The Effect of a Combination of Biofertiliser Doses and Planting Media on the Growth of Chili Plants

Plant height

The results of plant height at different fertilizer doses are shown in Table 1 and Figure 1. Table 1 and Figure 1 show that the combination of biofertilizer doses and planting media have different average height values for chili plants. In the 4th week of observation, the M2D25 treatment had the highest value compared to other treatments, 10.18 ± 0.19 cm. Meanwhile, treatment M1D10 has the lowest value, 9.12 ± 0.16 cm. Taller plants can provide better yields per plant compared to shorter plants. This is because taller plants can prepare their vegetative organs better so that more photosynthate organs are produced [7, 8].

Data on the combination of doses of biofertilizer (biofertilizer) and planting media on chili plant height obtained were subjected to statistical data analysis. The results of the Kolmogorov-Smirnov Test showed that the data on chili plant height values were normally distributed (appendix 6). The Two-Way Analysis of Variance (ANOVA) test, with a significance (α) level of 0.05, was used to continue the study.

TABLE 1
EFFECT OF BIOFERTILIZER FERTILIZER DOSE ON CHILI PLANT HEIGHT (cm)

Treatment	Observation (week)			
	1	2	3	4
MID0	7.18 ± 0.08	8.26 ± 0.09	8.76 ± 0.09	9.26 ± 0.11
M1D5	7.50 ± 0.10	8.56 ± 0.15	9.04 ± 0.24	9.70 ± 0.16
M1D10	7.74 ± 0.15	8.12 ± 0.15	8.46 ± 0.15	9.12 ± 0.16
M1D15	7.70 ± 0.16	8.08 ± 0.24	8.52 ± 0.29	8.98 ± 0.36
M1D20	7.82 ± 0.08	8.16 ± 0.23	8.62 ± 0.19	9.32 ± 0.13
M1D25	8.04 ± 0.18	8.38 ± 0.19	8.76 ± 0.13	9.18 ± 0.19
M2D0	7.38 ± 0.08	8.46 ± 0.11	8.92 ± 0.29	9.76 ± 0.11
M2D5	7.84 ± 0.18	9.00 ± 0.29	9.22 ± 0.08	9.60 ± 0.24
M2D10	8.10 ± 0.16	8.62 ± 0.22	8.96 ± 0.19	9.38 ± 0.19
M2D15	8.06 ± 0.21	8.30 ± 0.27	8.84 ± 0.34	9.60 ± 0.16
M2D20	8.14 ± 0.11	8.58 ± 0.22	9.10 ± 0.16	9.66 ± 0.23
M2D25	8.26 ± 0.11	8.66 ± 0.11	9.40 ± 0.22	10.18 ± 0.19

Source: primary data processed by researchers in 2023
Information: D0= without fertilization, D5= biofertilizer dose 5 ml/plant, D10= biofertilizer dose 10 ml/plant, D15= biofertilizer dose 15 ml/plant, D20= biofertilizer dose 20 ml/plant, D25= biofertilizer dose 25 ml/plant M1= soil media, M2= soil media: *Jakaba* (1:1)

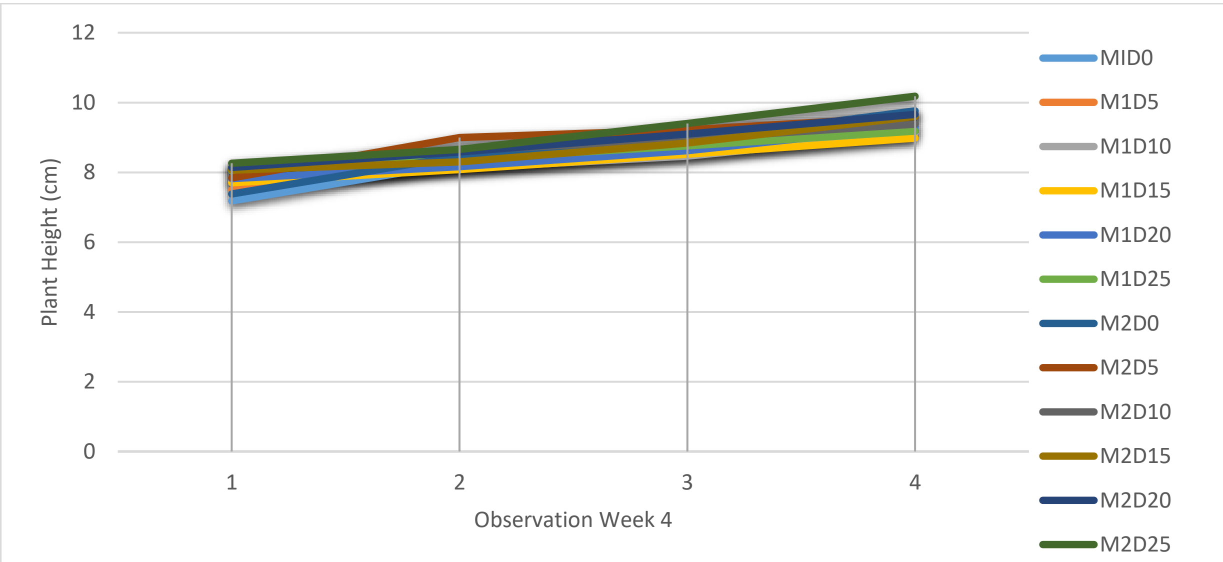

Figure 1. Diagram of the influence of the combination of biofertilizer doses and planting media on the average height of chili plants in the 4th week

Number of Leaves

The results of the number of plant leaves at different fertilizer doses are shown in Table 2 and Figure 2. Table 2 and Figure 2 show that the combination of biofertilizer doses and planting media have different average height values for chili plants. In the 4th week of observation, treatmentM2D20 had the highest average number of leaves compared to other treatments, namely 8.6 ± 0.55. Meanwhile, treatment M1D15 has the lowest value, 6.8 ± 0.84."According to [3], if a dose of biological fertilizer (biofertilizer) is given to soil media mixed with Jakaba (1:1), then plant growth will be optimal. The organic material in compost acts as a source of energy and food for soil microbes so that it can increase the activity of these microbes in providing plant nutrients [9].

The data on the combination of doses of biofertilizer (biofertilizer) and planting media on the number of chili plant leaves obtained was subjected to statistical data analysis. Because the results of the Kolmogorov-Smirnov Test showed that the data on chili plant height values were normally distributed (appendix 6), the result was continued with the Two-way Analysis of Variance (ANOVA) test which had a significance degree (α) is 0.05.

TABLE 2
THE EFFECT OF BIOFERTILIZER DOSE ON THE NUMBER OF LEAVES OF CHILI PLANTS (STRANDS)

Treatment	Week 4 Observation			
	1	2	3	4
MID0	4.0 ± 0.00	5.4 ± 0.55	6.6 ± 0.89	7.2 ± 0.84
M1D5	4.6 ± 0.55	5.6 ± 0.55	6.0 ± 1.00	7.2 ± 0.84
M1D10	4.6 ± 0.55	5.4 ± 0.55	6.4 ± 0.55	7.2 ± 0.85
M1D15	4.4 ± 0.55	5.4 ± 0.55	6.2 ± 1.30	6.8 ± 0.84
M1D20	4.8 ± 0.45	5.8 ± 0.45	6.4 ± 0.55	7.0 ± 0.71
M1D25	4.8 ± 0.45	6.0 ± 1.00	6.6 ± 0.55	7.4 ± 0.89
M2D0	5.6 ± 0.89	6.6 ± 0.89	7.2 ± 0.45	7.6 ± 055
M2D5	5.4 ± 0.55	6.2 ± 0.84	6.6 ± 0.55	7.8 ± 0.45
M2D10	6.0 ± 0.71	7.0 ± 0.71	7.2 ± 0.45	7.6 ± 0.55
M2D15	6.2 ± 1.10	7.0 ± 1.00	7.0 ± 0.71	7.4 ± 0.55
M2D20	6.2 ± 0.84	7.2 ± 0.45	7.8 ± 0.45	8.6 ± 0.55
M2D25	6.2 ± 0.84	7.4 ± 0.89	7.8 ± 1.30	8.2 ± 0.84

Source: primary data processed by researchers in 2023

Information: D0= without fertilization, D5= biofertilizer dose 5 ml/plant, D10= biofertilizer dose 10 ml/plant, D15= biofertilizer dose 15 ml/plant, D20= biofertilizer dose 20 ml/plant, D25= biofertilizer dose 25 ml/plant M1= soil media, M2= soil media: *Jakaba* (1:1).

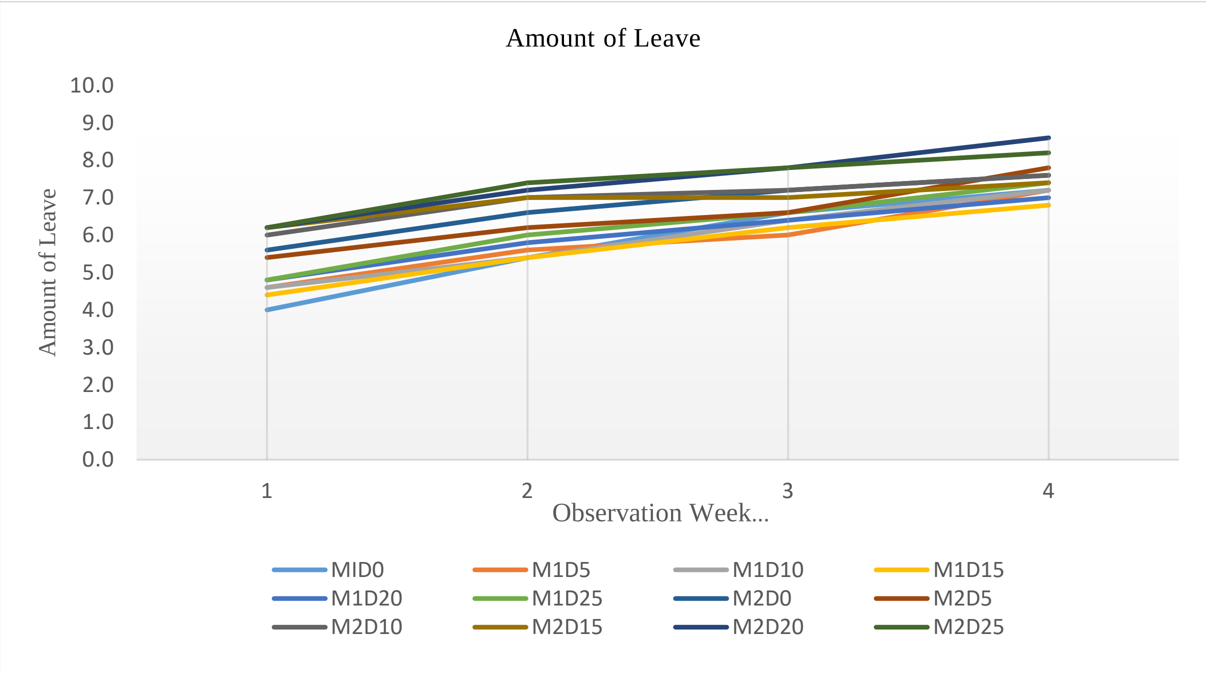

Figure 2. Diagram of the influence of the combination of biofertilizer doses and planting media on the average number of leaves of chili plants in the 4 weeks

Discussion

Based on the results of statistical data analysis, the combination of the dose of *Jakaba* fertilizer (biofertilizer) and planting media does not affect the number of leaves, or plant height. This is possible because of the high standard deviation value in each treatment combination, causing no effect on the combination treatment of biofertilizer doses and the use of planting media on all chili plant growth responses.

Descriptively, in all chili plant growth responses, the combination of applying *Jakaba* fertilizer at various doses with soil planting media showed better results when compared to the use of soil mixture planting media: compost (1: 1). This is possible because the *Jakaba* used was still a little or less, so the use of *Jakaba* as a planting medium has a better influence when compared to soil planting media because the organic content in the compost has not been completely decomposed so that nutrients for plants are also lacking which causes the growth of chili plants is also less optimal [3].

In response to the number of leaves, the M1D5 treatment showed higher results when compared to other treatments. This demonstrates that bacteria included in biofertilizers can offer nutrients that are collected by the soil and subsequently absorbed by plants. Negatively charged soil colloidal particles are more likely to bind nutrients to these particles, this is especially important in retaining nutrients from leaching. Thus, the soil becomes rich in nutrients useful for plants [10].

In the high response of plants, the M2D10 treatment showed the highest yield compared to other treatments. This shows that even though the compost used is less mature, applying biofertilizer at the appropriate dose, can improve the condition of the growing media so that plant growth can also be optimal. Microbes in the provision of biofertilizer with a dose of 10 ml/plant may be able to utilize the nutrients contained in the compost as well as possible so that it can grow optimally and can improve the condition of the planting media mixture of soil and *Jakaba* (1: 1) which is still not better [3], if the dose of *Jakaba* fertilizer (biofertilizer) is given to soil media mixed with *Jakaba* (1: 1), then plant growth will be optimal. Organic matter in compost acts as a source of energy and food for soil microbes so that it can increase the activity of these microbes in providing plant nutrients.

Jakaba contains organic matter that plays a major role in improving the physical, chemical, and biological properties of the soil. *Jakab* added to soil media will several times undergo a phase of remodeling by soil microorganisms to become soil organic matter. In addition, *Jakaba* acts as a binder for primary granules into secondary grains of soil in the formation of steady aggregates. This situation has a great influence on porosity, water storage and supply, soil aeration, and soil temperature [3, 11].

In the high response of plants, M2D5 treatment showed plant height yields that were almost the same as M2D15 treatment, this is possible because M2D5 treatment is less able to provide nutrients needed for optimization of plant growth. In the M2D15 treatment, the high competition between microbes for nutrients causes microbial nutritional needs to be less fulfilled, resulting in microbes functioning less optimally [3], nutrition is an important factor that microbes must fulfill because these nutrients can be used for microbial growth and metabolism to maintain microbial life. Taller plants can provide better yields per plant compared to shorter plants. This is because higher plants can prepare their vegetative organs better so that more photosynthetic organs will be produced [3, 12].

IV. CONCLUSION

The effect of the combined dose of biofertilizer and planting media on the growth of chili plants (*Capsicum annum* L.) in the M2D25 treatment has the highest value compared to other treatments, namely 9.76 ± 0.115 cm. Meanwhile, treatment M1D10 had the lowest value, namely 9.12 ± 0.16 cm, and in the plant media treatment, the number of leaves increased M2D20 has the highest value when compared to other treatments, namely 8.6 ± 0.55. Meanwhile, treatment M1D15 has the lowest value, 6.8 ± 0.84 strands.

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