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The Effect of Various Doses of Trichoderma harzianum on Increasing The Growth of Mung Beans (Vigna radiata L.)

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Abstract—This study aimed to investigate the effect of different doses of Trichoderma harzianum on the germination improvement of mung beans (Vigna radiata L.). The study employed an experimental design with five treatments of different doses of Trichoderma harzianum, along with one control, conducted over a period of 7 days. The control treatment consisted of mung bean seeds (Vigna radiata L.) without the use of Trichoderma harzianum. The observed variables were total plant length, leaf length, leaf width, hypocotyl length, and germination rate (%) during the 7-day observation period with three replications for each treatment. The results indicated that the application of varying doses of Trichoderma harzianum on Vigna radiata seeds for 7 days exhibited differences in vegetative growth variables (average total plant length, leaf length, leaf width) and hypocotyl length compared to seeds without Trichoderma harzianum. However, the germination rate variable showed no significant effect from the application of varying doses of Trichoderma harzianum on Vigna radiata seeds during the 7-day period.

Keywords—dosage; germination; growth; Trichoderma harzianum; Vigna radiata L.

I. INTRODUCTION

Mung beans (*Vigna radiata* L) are one of the most important crops in Indonesia after soybeans and peanuts. Mung bean plants are often considered a people's plant because this plant contains many sources of vegetable protein, vitamins (A, B1, C and E) and other substances. The nutritional content per 100 grams consists of 345 calories, 22 g protein, 1.2 g fat, 62.9 g carbohydrates, 125 mg calcium, 320 mg phosphorus, 6.7 mg iron, 157 SI vitamin A, 0.64 mg vitamin B1, 6 mg vitamin C and 10 g water (Nasution, [1].

According to data from the Central Statistics Agency (BPS) in 2014, Indonesia imported mung beans from several countries. During January-March 2014, 18.64 thousand tonnes entered Indonesia. Indonesia imports from several countries including Myanmar, Ethiopia, Thailand, Australia and Brazil. Imports of mung beans also increased quite drastically in March 2014 compared to the previous month. In February, imports of mung beans were recorded at 6.27 thousand tons. Then there was a rapid increase to 13.96 thousand tons in March. The still high level of mung bean imports reflects the low production of mung beans in Indonesia.

According to Rukmana [2], one of the causes of low yields of mung bean development is due to poor cultivation (without weeding and fertilization). To increase the growth and production of mung beans, it can be done by providing sufficient and balanced nutrients. The main nutrient elements that plants need a lot but whose quantity or availability is often lacking or insufficient in the soil are N, P, and K. Therefore, these three elements are grown in the form of fertilizer [3].

Application of chemical fertilizers can cause a decrease in soil and water quality. Continuous use of chemical fertilizers at

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increasing doses each year can actually cause the soil to become hard and the balance of soil nutrients to be disturbed [4]. The biological properties of the soil decrease so that the activity of microorganisms in the soil is disrupted. Thus, the process of decomposing soil organic matter is hampered and the level of soil fertility decreases. Therefore, to reduce these negative impacts, organic fertilizer containing microbes (biological fertilizer) can be used as an alternative to using chemical fertilizers [5]. Biological agents that can be used in biofertilizer include Trichoderma [6]. Chowdappa et al. [7] reported that *Trichoderma harzianum* were able to increase growth and crop yields by producing phytohormones such as IAA and GA3.

Biofertilizer is defined as a substance containing live microorganisms that colonize the rhizosphere or the interior of plants to stimulate plant growth by increasing the supply of primary nutrients and also providing growth stimulation to target plants. In previous research, the application of microbial fertilizer had been tested on a group of leguminous plants, namely sword bean (*Canavalia ensiformis*) and soybean (*Glycine max* (L.) Merr), the application of microbial consortium fertilizer had been carried out and it was proven that the microbes contained in the biological fertilizer increased plant growth and production. The dose and frequency of giving biofertilizer to plants needs to be considered. Improper dosage and giving biofertilizer only once or twice throughout growth will not increase optimal growth. So it is necessary to conduct research on variations in the combination of doses and frequency of biofertilizer administration on the productivity of mung bean plants (*Vigna radiata* L.) [8]. This study aims to determine the effect of different doses *Trichoderma harzianum* on increasing germination of mung beans (*Vigna radiata* L.).

II. RESEARCH METHOD

Research was carried out at the Microbiology Research Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences. This research was carried out from May to July 2023. The materials used in this research were *Trichoderma harzianum*, *Vigna radiata* seeds, Potato Dextrose Agar (PDA) media, Potato Dextrose Broth (PDB), and soil media. The tools used include measuring calipers, scales, cameras and writing instruments.

The research implementation included the multiplication of *Trichoderma harzianum* which was carried out in a sterile laboratory. Before being applied to seeds, the *Trichoderma harzianum* culture is first rejuvenated on Potato Dextrose Agar (PDA) media. After growing, *Trichoderma harzianum* was propagated in liquid Potato Dextrose Broth (PDB) media then incubated on a shaker for 7 days at room temperature at a speed of 150 rpm until the media appeared cloudy and full of *Trichoderma harzianum* growth. The next stage is soil sterilization by sterilizing the soil in an autoclave at a temperature of 121℃, pressure of 15 lbs for 15 minutes. After *Trichoderma harzianum* has been incubated for 7 days, the biofertilizer is ready to be used. The mung bean seeds are mixed with the biofertilizer until evenly distributed, meaning that all the surfaces of the seeds are covered by the biofertilizer. As for the treatment, it is carried out by comparing doses as follows.

1. Mung bean seeds without using Trichoderma harzianum. /control (K)
2. Mung bean seeds using 10ml *Trichoderma harzianum* broth (P1)
3. Mung bean seeds using 20ml *Trichoderma harzianum* broth (P2)
4. Mung bean seeds using 30ml *Trichoderma harzianum* broth (P3)
5. Mung bean seeds using 40ml broth*Trichoderma harzianum* (P4)
6. Mung bean seeds using 50ml *Trichoderma harzianum* (P5)

The variables observed were total plant length, leaf length, leaf width, hypocotyl length and germination capacity (%) during 7 days of observation in each treatment with 3 replications.

III. RESULTS AND DISCUSSIONS

The following is the effect of giving*Trichoderma harzianum* dosage varies against variables for observing plant vegetative growth(average total plant length, leaf length, leaf width) which was carried out for 7 days of observation in each treatment with 3 repetitions.

Table1. Average total plant length, leaf length, and leaf width *Vigna radiata* for 7 days of observation

Treatment	Total length (cm)	Leaf length (cm)	Leaf width (cm)
Control	23,167	2,433	1,000
P1	26,000	4,333	1,325
P2	26,333	3,467	1,233
P3	25,500	3,633	1,200
P4	25,750	4,000	1,233
P5	23,433	2,767	1,100

From the measurement results, the administration of *Trichoderma harzianum* doses varies on the observed variable of plant vegetative growth (total plant length, leaf length, leaf width) it appears that there is an influence in each treatment. The average total length of *Vigna radiata* in treatment P2 was the highest among the other treatments, namely 26.333 cm. Giving the *Trichoderma harzianum* to P2 had the greatest influence on the average leaf length, namely 4,333 cm and the largest leaf width, namely 1,325 cm compared to other treatments. Meanwhile, the control treatment had the lowest influence onaverage total plant length, leaf length, leaf width during 7 days of observation. This is in accordance with the statement of Pratama et al. [9], thatuse of Trichoderma spp. will produce decomposing enzymes that can decompose organic matter, this decomposition will release the nutrients bound in complex compounds to become available, especially the elements N and P. Nitrogen functions to form the formation of green leaf substances (chlorophyll) and improve plant vegetative growth such as plant height, number of leaves and leaf area index. Pandya & Saraf [10] reported that T. asperellum is known as a biological control against several pathogens and has been proven to be able to increase plant growth and yield by producing phytohormones such as IAA and cytokinins.

Hypocotyl Length

The following is a graph of varying doses of *Trichoderma harzianum* on the effect on the variable observing hypocotyl length in *Vigna radiata* for 7 days.

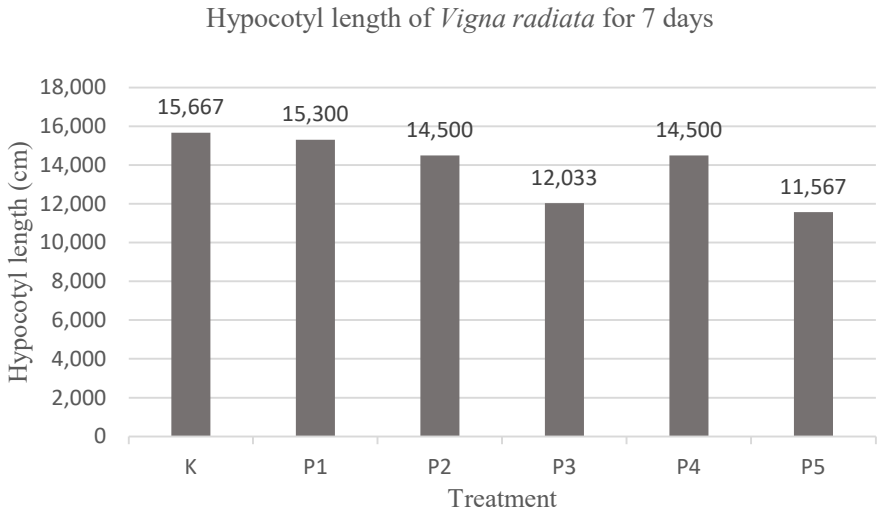

Fig 1. Hypocotyl Length of *Vigna radiata* for 7 days

From the research results, administering varying doses of *Trichoderma harzianum* had an influence on the variable observing hypocotyl length. In Figure 1, it can be seen that the administration of the *Trichoderma harzianum* resulted in variations in the length of the *Vigna radiata* hypocotyl. And from figure 1 it can be seen that there was a shortening of the hypocotyl in *Vigna*

radiata after administration of the *Trichoderma harzianum* compared to the control. This can be seen in figure 1 which shows the highest average hypocotyl length of 15,667 cm in treatment K or control, a treatment without using the *Trichoderma harzianum*. .

This is in line with Sutedjo's [11] statement that in general Trichoderma spp. has the ability as a biofertilizer where, Trichoderma spp. can produce organic compounds that are able to dissolve P bound to Al and Fe so that they are easily absorbed by plants. Trichoderma spp. also as a potassium solvent it can produce organic acids [12]. Organic acids produced by Trichoderma spp. such as citrate and oxalate can break down potassium minerals into potassium ions so that they can be utilized by plants [13]. According to Pandya & Saraf [10] T. asperellum has also been proven to be able to dissolve phosphate so that it is available to plants. In addition, the applied T. asperellum showed an increase in the elements Ca, Mg, K and N. The nutrients P and K can stimulate root growth, increase flowering, strengthen leaves, flowers and fruit, help form proteins and carbohydrates so that they can produce more seeds. , cooking seeds and pods so as to increase the weight of the filled pods. These could be factors that influence the observed variables of hypocotyl length in *Vigna radiata*.

Germination Viability

The following is a graph of varying doses of *Trichoderma harzianum* on the effect on germination of *Vigna radiata* for 7 days.

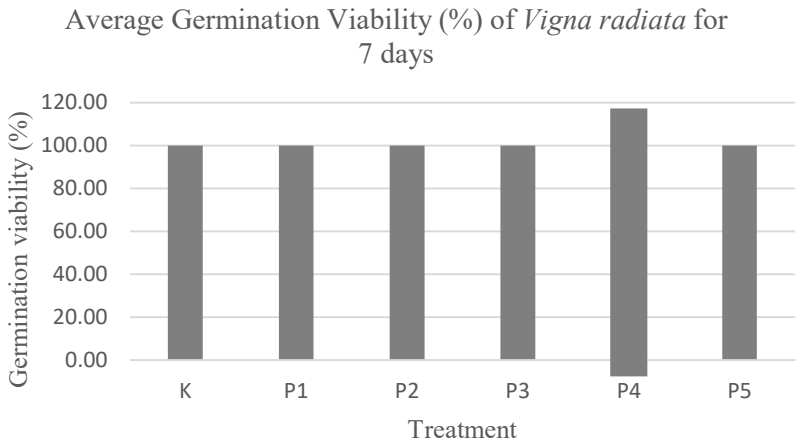

Fig 2. Average germination viability of *Vigna radiata* for 7 days

From the results of observations, varying doses of *Trichoderma harzianum* had an effect on germination of *Vigna radiata* for 7 days.It appears that it doesn't have much of an effect on germination. This is in line with Supoto [14], that germination is not only influenced by nutritional factors (biofertilizer), but is also determined by conditions including light, temperature, water and humidity because this factor is the main factor that influences germination at the beginning of growth. Water is an important factor for the process of seed germination. Water absorption by seeds is influenced by two factors, namely the nature of the seed itself, especially its protective skin, and the amount of water available in the surrounding medium. The amount of water needed depends on the type of seed. Soil moisture and humid air have a good effect on growth. Humid places are beneficial for plants where they can get water more easily. therefore providing optimal environmental conditions can accelerate germination[15].

IV. CONCLUSION

Based on the results of the research and discussion above, it can be concluded that giving varying doses of *Trichoderma harzianum* to *Vigna radiata* seeds for 7 days showed differences in vegetative growth variables (average total plant length, leaf length, leaf width) and hypocotyl lengthcompared to seeds that do not use the *Trichoderma harzianum*. Meanwhile, the germination variable had no influence on giving varying doses of *Trichoderma harzianum* to *Vigna radiata* seeds for 7 days.

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