

Original Paper

The Potential of *Trichoderma sp.* as Biological Agent to Support the Germination of Corn Seeds (*Zea Mays*)

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Abstract -- This research is motivated by the fact that corn seeds in storage are often characterized with low seed viability and infected by diseases so that the seeds grow abnormally and even die. Corn seeds have thick/hard cell walls. It is acknowledged that the corn seed walls contain cellulose, which can be broken down by microorganisms. One such microorganism is the *Trichoderma* fungus, which is also a biological agent. This study aims to analyze the effect of the biological agents *Trichoderma sp.* on corn seed germination and identify the best concentration of *Trichoderma sp.* against corn seed germination. The corn seeds used in this study were locally grown, which had been stored for 6 months. The seed coating (bio seed coating of local corn) was tested at several concentrations of *Trichoderma sp.* (treatment), namely without treatment (control), 5g, 10g, 15g, and 20g. Each concentration was repeated 4 times, using several parameters to analyze normal sprouts and germination capacity. The analysis results confirmed the potential of *Trichoderma* biological agents on corn seed germination. The T1 treatment with 5g *Trichoderma* biological agents significantly improve corn seed germination.

Keywords: corn seed, seed coating seed, *Trichoderma sp.* viability

I. INTRODUCTION

Farmers on agricultural land in North Maluku mostly cultivate corn. Corn is a food crop that once dominated food staple in 2016-2019 in West Halmahera (Jailolo) [7]. The local government expects that farmers can innovate to increase corn productivity to reach production goal of 12 tons/ha, while farmers can only produce 5 tons/ha [1]. The need for fast planting material to meet the substantial demand will be constrained by the duration of seed germination. The use of seeds as plant propagation needs special treatment before the seeds are planted because they have a very hard skin structure. The entire seed germination takes at least three months if the seeds do not obtain special treatment. This period is called the dormancy period, which is caused by the physical structure of the seed, which eventually inhibits water imbibition [2]. Contents that physical dormancy can be distorted by microorganisms, in that the activity of these fungi can help

shorten the dormancy period. *Trichoderma sp.* is a fungus capable of producing cellulosic enzymes. Cellulosic enzymes are able to degrade cellulose located in plant cell walls. *Trichoderma sp.* is also known to play the role as a biological fertilizer in decomposing organic matter in the soil as well as a biological agent in controlling soil borne diseases or root diseases [9]. In addition, according to [4], the fungus grows in the testa seed erodes and cracks the hard skin. This can reduce mechanical resistance to seed germination with physiological dormancy. One way to bring biological agents to seeds is through seed coating. This method is considered better because farmers can plant seeds without administering additional treatment [10]. According to [3], seed coating is a method to improve seed quality by adding organic matter to the coating formula. Seed coating can control and improve germination and has the potential to be used for inoculating seeds with living microorganisms, which can protect seeds from pests and plant diseases during nursery phase and outset of growing season, increase seedling vigor, and reduce the use of chemical pesticides during planting [8].

II. RESEARCH METHODOLOGY

The research was carried out in the Agrotechnology laboratory of the Faculty of Agriculture, UNKHAIR. This study employed a completely randomized design (CRD). The study involved several treatments involving *Trichoderma sp.* at different concentrations, ranging from 0 g, 5g, 10g, 15g, to 20g. Each treatment was repeated 4 times, so there were 20 experimental units, and one treatment involved 20 corn seeds, resulting in a total sample of 400 corn seeds.

Description:

T0 = control bio seed bio seed coating

T1 = 5g *Trichoderma*

T2 = 10g *Trichoderma*

T3 = 15g *Trichoderma*

T4 = 20g *Trichoderma*

A. Research Procedure

The Preparation of Corn Seeds

Corn kernels used in this study were locally grown by corn farmers in Ternate city. These seeds had large size as these were

sorted in consideration of involving physiologically matured seeds. The seeds used in the present study had been stored 6 months.

The Production of Trichoderma sp.

Upon preparing *Trichoderma* sp. seed coating material, pure cultures of *Trichoderma* were obtained from agricultural soil cultures. For further dilution aiming at 10⁷ to obtain pure isolates, these seeds were isolated in PDA media, taken and propagated in rice media. The finished *Trichoderma* sp was separated according to the treatment and processed to seed coating.

Bio Seed Coating of Trichoderma

Bio seed coating material mixed with tapioca was then coated on the walls of corn seeds containing 14% moisture. The procedure began with coating corn seeds with *Trichoderma* according to treatment. These seeds were then left for ± 5 minutes and placed in a container (germinator) according to treatment. Observations were made for 14 days.

B. Observation Parameters

The observation of *Trichoderma viride* fungal responses toward the viability of corn seeds includes normal germination, abnormal germination, germination, maximum growth potential, growth speed, and vigor index.

Normal Sprouts (NS)

Normal sprouts show the potential to develop further into normal plants (Stefan 2013). The formula for calculating normal sprouts is as follow:

$$NS = \frac{\sum \text{Normal sprouts}}{\sum \text{Total seeds}} \times 100 \%$$

Germination Rate (GR)

Germination rate is determined based on the percentage of normal germination on day 5 (observation I) and day 7 (observation II) after the seeds germinated. The final germination is calculated by the formula:

$$GR = \frac{\sum NS I + NS II}{\sum \text{Germination}} \times 100 \%$$

Given:

GR :Germination rate

NS I :The number of normal sprouts in the first observation

NS II :The number of normal sprouts in the second observation

The criteria for selecting normally germinated seeds are those whose main structures (root system, embryonic shaft called epicotyl and hypocotyl, and cotyledons) show the ability to develop into normal plants if planted in the field in a suitable environment.

Maximum Growth Potential (MGP)

Maximum growth potential was measured by counting the number of sprouts that grew normally or abnormally at 7 DAG's (days after germination). The maximum growth potential is calculated by using the formula below:

$$MGP = \frac{\sum \text{Grown Seeds}}{\sum \text{Germinated Seeds}} \times 100 \%$$

Growth Simultaneity (GS)

Simultaneous growth was calculated based on the percentage of normal sprouts at 4 DAP. Observations were made on the number of normal seedlings between the first and second counts. Simultaneous growth is calculated by the formula:

$$GS = \frac{\sum \text{The number of GS's on DAP 4}}{\sum \text{Germinated seeds}} \times 100\%$$

Vigor Index (VI)

The observation of the vigor index was carried out by focusing on the number of normal sprouts on the first count, namely day 5 (observation I) (ISTA, 2010).

$$VI = \frac{\sum \text{GS in the first observation}}{\sum \text{Total seeds}} \times 100\%$$

III. RESULTS AND DISCUSSION

A. The Potential of Trichoderma sp. as Natural Agent toward Normal Sprouts of Corn Seeds

The results of the analysis showed that *Trichoderma* bio seed coating generated satisfactory effect on the maximum growth potential. The maximum growth potential analysis data is presented in Figure 1:

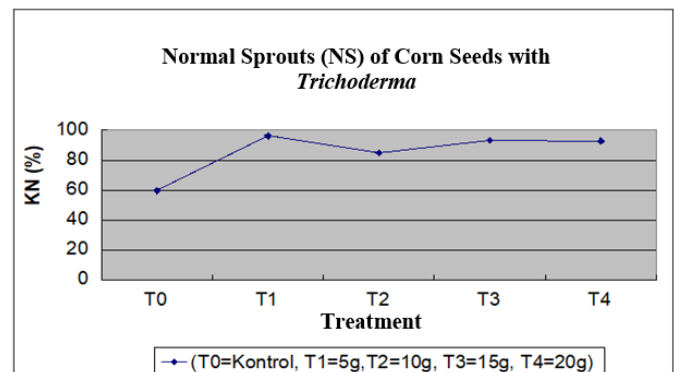


Figure 1. Normal Sprouts (NS) of Corn Seeds with *Trichoderma*

The highest number of normal sprouts was found in T1 with 5 gr *Trichoderma*, which was evident from the 4 to day 10 with a value of 77% - 98%. This presence of normal sprouts resulted from the germination assisted by *Trichoderma*. *Trichoderma* is a biological agent that can help seed germination because this fungus contains cellulose enzymes that can erode the cell walls of the seed coat to speed up the

plant germination [11, 12]. *Trichoderma* is a mold or a type of fungus capable of producing cellulosic enzymes. Cellulosic enzymes are able to degrade cellulose, which is located in plant cell walls [5]. According [4], fungus grows in the testa seed erodes and cracks the hard skin, thereby potentially reducing mechanical resistance to seed germination with physiological dormancy.

B. The Potential of *Trichoderma* sp. as Natural Agent toward Germination Rate of Corn Seeds

The analysis results of the germination showed that *Trichoderma* generated a fine effect. The data backgrounding this finding is shown in Figure 2.

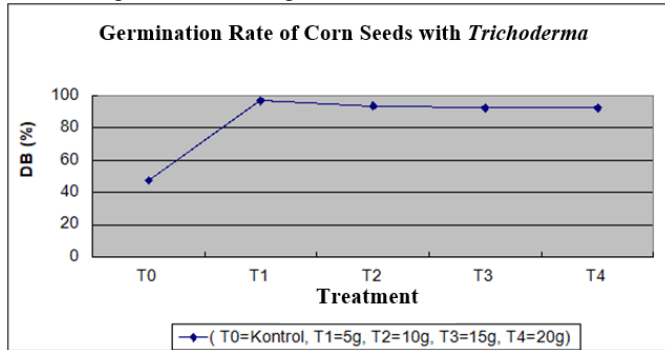


Figure 2. Germination Rate of Corn Seeds with *Trichoderma*

Figure 2 shows the average germination of corn seeds in treatment T0, which is identified as the lowest average, namely 47.5%. This is because T0 involved only some germinated seeds, so that the germination rate only reached 47.5%. The seeds in the T0 treatment did not grow. Due to the damage to the seeds, there were even undamaged seeds which could not germinate in the near future. Seeds of this nature are commonly referred to as fresh seeds, which do not grow. These seeds are usually still in dormancy. Usually the dormancy period is caused by several factors, one of which is a resistant or impermeable seed coat, for that an enzyme is needed that is able to erode the seed coat so that it can accelerate seed germination.

C. The Potential of *Trichoderma* sp. as Natural Agent toward Maximum Growth Potential of Corn Seeds

The results of the analysis showed that *Trichoderma* bio seed coating generated satisfactory effect on the maximum growth potential. The maximum growth potential analysis data is presented in Figure 3:

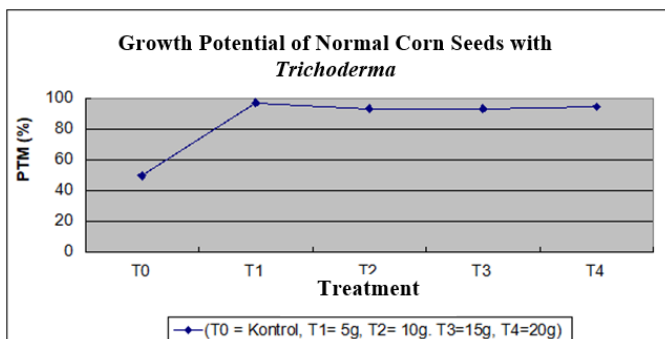


Figure 3. Growth Potential of Normal Corn Seeds with *Trichoderma*

The average germination of corn seeds in treatment T0 was the lowest, namely 47.5%. This was because T0 only showed some seeds germinated, which only reached 47.5%. The seeds in T0 treatment did not grow. Because of the damage to the seeds, there were even undamaged seeds, which could not germinate in the near future. These seeds are commonly referred to as fresh seeds which do not grow. These seeds are usually still in dormancy. The dormancy period is generally driven by several factors, one of which is a resistant or impermeable seed coat. To that end, an enzyme is needed to erode the seed coat so that it can accelerate seed germination. *Trichoderma* is a fungus that has cellulosic enzymes that are able to degrade the seed coat to accelerate germination. According to [5], *Trichoderma* is a mold or a type of fungus that is capable of producing cellulosic enzymes. Cellulosic enzymes are enzymes which are able to degrade cellulose located in plant cell walls.

In T1, T2, T3 and T4 treatments, the germination rate was not significantly different because these also involved *Trichoderma* to assist the germination. T1 with 5g *Trichoderma* had the highest percentage of germination rate. By implication, this concentration involving *Trichoderma* has the potential to increase the germination rate of corn seeds. This is because during germination the plumules are not inhibited by the *Trichoderma* layer, which covers the corn seeds.

D. The Potential of *Trichoderma* sp. as Natural Agent toward Growth Simultaneity of Corn Seeds

The analysis results showed that the effect of the *Trichoderma* bio seed coating on the simultaneous growth was significant. Simultaneous growth data is presented in Figure 4 below.

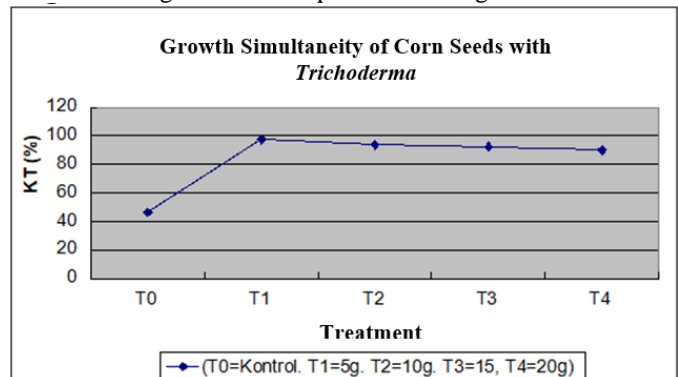


Figure 4. Growth Simultaneity of Corn Seeds with *Trichoderma*

Figure 4 shows the test results of T0 having the lowest level of simultaneous growth with a percentage of 46.25%, this shows that in the treatment the percentage of simultaneous growth of corn seeds is very low. There is a low percentage because many seeds do not grow at the same time, seeds which grow at the same time because the seeds have low viability. Seeds with low viability usually have been stored for a long time and will regress. Seed deterioration is a decline in the physiological quality of seeds, which can cause overall changes in the seeds, both physical, physiological, and chemical which results in a decrease in seed viability [6].

E. The Potential of *Trichoderma* sp. as Natural Agent toward Vigor Index of Corn Seeds

The analysis results showed that the effect of *Trichoderma* bio seed coating on the vigor index was markedly significant. Vigor index is presented in Figure 5.

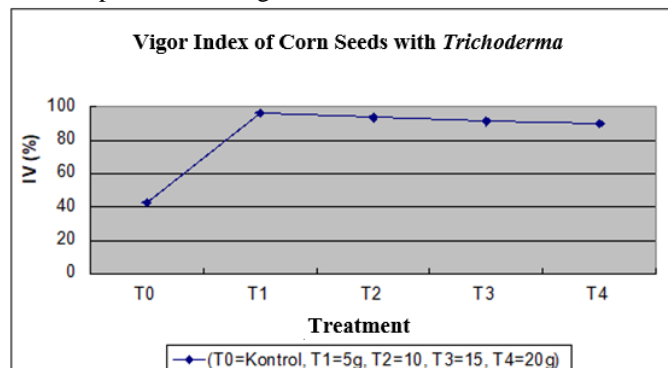


Figure 5. Vigor Index of Corn Seeds with *Trichoderma*

Figure 5 Shows T0 (without *Trichoderma*) has a very low effect and is very significantly different from all treatments with an average of 42.5% while T1 (5g *Trichoderma*) has the highest value with an actual vigor index average of 96.25% of all treatments. The vigor index is a comparison between the number of normal sprouts on the first count and the total number of seeds germinated. The results of the t-test test showed that the lowest percentage of vigor index was in T0 (without *Trichoderma*) with a percentage of 42.5%, which was significantly different from the other treatments with *Trichoderma* at 90%. This was because the T0 treatment did not contain the required enzymes to stimulate the sprout growth, so the percentage of normal sprouts was very low.

IV. CONCLUSION

The present study has acknowledged the potential of *Trichoderma* sp. as biological agent on the germination of corn seeds. The findings have demonstrated very significant effect on corn seed viability particularly in terms of normal and abnormal germination, growth potential, level of uniformity, and vigor index, each of which has been confirmed in treatment involving *Trichoderma* sp. Seeds stored for 6 months can still be used providing that these are treated using *Trichoderma* with

the seed coating method at 5g concentration, which has been found significantly better than other concentrations. Giving *Trichoderma* can also keep the seeds free from disease during storage.

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