**Trichoderma harzianum** as Diplodia Disease Control for Citrus in Swamp Area

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**Abstract**

Citrus is one of horticultural commodities that can be cultivated either on lowlands or highlands, turf area, swamp area, and dry area, with variety suitability. Citrus cultivation on swamp area and dry land usually face problem in Plant Disturbing Organisms and some diseases. Diplodia, or stem end rot is one of diseases that can lower citrus production that causes by *Botryodiplodia theobromae* fungi. Using biological agents as one of disease control is very safe compared to chemical pesticide eventhough applied continuously. Biological agent that is served as biofungal is *Trichoderma harzianum*. This experiment is conducted in tangerin citrus in Barito Kuala (Batola) District, South Kalimantan Province that is dominated by agroecosystem of swamp, in 2017. This study aimed to know the effect of *T. harzianum* to control Diplodia disease in citrus area. Samples are harvested randomly in plants with Diplodia symptoms, and *T. harzianum* then be applied in those plants. Observations are done once every month to count intensity and percentage of disease. The results showed that decline in disease intensity are observed since the third observation after *T. harzianum* application. This can be conclude that *T. harzianum* can control Diplodia in citrus.

Keywords: biofungal, diplodia disease, *Trichoderma*

1. Introduction

The development of citrus as horticultural commodities become a top priority in Indonesia. Citrus itself are the second largest commodity after bananas. Seen from it’s potential, the citrus in South Kalimantan need to be developed (Rusastra, 2016). Barito Kuala (Batola), South Kalimantan, which is a swamp area, become one of citrus area center. Swamp area is land that has excess water from sea tide conditions. Based on the condition of the water, the system grouped into 4 types, namely A, B, C and D. The condition of citrus plantations in Batola, South Kalimantan are an area that are mostly planted in tidal B type, namely swamp areas which are directly affected by tide, but the area is only overflowed by large tides and is not overflowed with small tides (direct tides).

Cultivation of citrus in tidal land generally uses a surjan system with citrus in the mounds and in the tabs they are planted with rice. The constraints in developing agriculture on tidal land, especially in South Kalimantan, are due to the biophysical conditions of the land. Improper management can result in fertility problems. Batola is one of the centers of tangerin citrus in South Kalimantan. The development of
citrus commodities is also accompanied by the development of diseases which can reduce the amount of production. Diplodia bark disease is one of the most feared diseases by citrus farmers, because its attacks can result in the death of twigs, branches, plant stems, and even cause plant death (Salamiah, 2008). Diplodia disease is caused by the polyphag Brotryodiplodia theobromae, which can attack various plants, so the source of the infection is always there (Semangun, 2000). According to Salamiah, et.al. 2008, B. theobromae can also attack avocado and guava plants. Many diplodia diseases in South Kalimantan attack the citrus development centers such as Barito Kuala, Tapin, Banjar, Banjarmasin, Banjarbaru, Hulu sungai utara, Hulu sungai selatan, Tabalong, Kota baru, dan Tanah Laut (Balai Proteksi Tanaman Pangan dan Hortikultura Provinsi Kalimantan selatan (2003) in Salamiah (2008)).

*T. harzianum* as a biocontrol agent has a high ability of antagonists that can inhibition growth of the fungal pathogen. *T. harzianum* fungi antagonist test inhibits fungus Diplodia sp fungi on the 6th day of *T. harzianum* fungi mycelium had filled the petridish cup with an area of 6240mm² mycelium (Sundari et al., 2014). Use of *T. harzianum* which has antagonistic power to control pathogenic fungi. Because of that, this research is aim to determine the potential of *T. harzianum* as biological agent to control diplodia disease in swamp area.

2. Materials and Method

The activity was held from April to December 2017 in the citrus orchard owned by farmers in the citrus crop area of Batola, South Kalimantan Province, as a swamp land location. Preparation of sample *T. harzianum* was taken from the isolates of the Balitjestro Fitopatology Laboratory, and then the multiplication of *T. harzianum* isolates was carried out *T. harzianum* uses Potato Dextro Agar. Results of *T. harzianum* was suspended using distilled water with a density of 10⁷. In the field of sampling in randomly selected diplodia symptomatic disease. The number of plants taken as many as five replications and three units of the plant using a copper fungicide as control. Solution *T. Harzia num* applied to selected citrus plants. Field observations are conducted every two weeks on the intensity and extent of diplodia attacks. The area of attack is calculated by the formula:

\[
I = \frac{\text{Number of plants attacked}}{\text{Number of plant populations observed}} \times 100\%
\]

Note: *I* = percentage of attack

The percentage of diplodia disease attacks was observed using scores with the following ranges:
- Score 0: 0% attack
- Score 1: 1-10% attack
- Score 2: 11-25% of attacks
- Score 3: 26-50% attack
- 4: 50% score and above

The intensity of diplodia disease attacks is calculated by the formula:
\[ P = \frac{(n_1 \cdot v_1) + (n_2 \cdot v_2) + (n_3 \cdot v_3) + (n_4 \cdot v_4) + (n_5 \cdot v_5) \ldots}{N \cdot V} \times 100\% \]

Note: 
- \( P \) = Percent Intensity of diplodia attacks
- \( n \) = category of severity of diplodia attacks
- \( v \) = number of plants per category of attack severity
- \( N \) = Number of plants observed
- \( V \) = Number of categories of attacks

3. Results and Discussion

Citrus plants infected with fungi \( B. \) theobromae has symptoms of injury and decompotion in the stem of the plant. In the wet type the disease secretes a golden liquid called blendok/gom, beginning with the stems of the plant which are cracked with skin, stems, or the death of the shoots of plants (Salamiah, 2008).

![Figure 1. Symptoms diplodia disease in citrus plants in the farmers' land of Batola, South Kalimantan Province.](image)

The survey results before the application in Batola, South Kalimantan province as tidal land, the attacked of diplodia disease were around 40% (Figure 1.). There is a wide range of attacks observed in each two weeks of observation with the result that there is a decrease in the percentage of attacks from the first two weeks of observation until the last observation which decreases to 0% (Table 1).

<table>
<thead>
<tr>
<th>Observation to ...</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of attack (%)</td>
<td>46.67</td>
<td>53.33</td>
<td>16.67</td>
<td>10.00</td>
<td>6.67</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application</th>
<th>% of diplodia disease attacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper Fungicide</td>
<td>I</td>
</tr>
<tr>
<td>T. Harzianum</td>
<td>24.44</td>
</tr>
<tr>
<td>T. Harzianum</td>
<td>15.56</td>
</tr>
</tbody>
</table>
Observation of application *T. harzianum* (P3) and fungicide as control (P1) gives the results of the effect in decreasing the level of diplodia attacks. *T. harzianum* is more effective in reducing diplodia attacks which occur in plants that reach to 0%. *T. harzianum* as a biological agent can suppress purification caused by fungi *B. theobromae*, which can reduce the percentage of such disease attacks (Table 2.). At banana *T. viridae* can reduce decompotion due to *Lasiodiplodia theobromae* mushrooms of 29.07 to 65.06% (Mortuza and Ilag, 1999). The decreased levels of the attack on crops that applied by *T. harzianum* is lower than controls (Figure 2.) and the decreases every two weeks.

### Table 3. The Result test T-test (α = 5%) *T* biocontrol applications. *harzianum* and copper fungicides on citrus plants

<table>
<thead>
<tr>
<th></th>
<th>Test Value = 0</th>
<th></th>
<th></th>
<th>95% Confidence Interval of the Difference</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t</td>
<td>df</td>
<td>Sig. (2-tailed)</td>
<td>Mean Difference</td>
<td>Lower</td>
</tr>
<tr>
<td>Fungicide</td>
<td>2.982</td>
<td>5</td>
<td>.031</td>
<td>12.96296</td>
<td>1.7868</td>
</tr>
<tr>
<td>Trichoderma</td>
<td>2.218</td>
<td>5</td>
<td>.077</td>
<td>7.59259</td>
<td>-1.2082</td>
</tr>
</tbody>
</table>

The results of the 95% of T-test resulted in a significant difference between control and *T. harzianum*. The *harzianum* gave results that were significantly different, the differences were noticeable from the Sig values below 1 (Table 3). This means that in testing using *T. harzianum* as biocontrol and copper-based fungicides show significant results between the two. *T. harzianum* including easy organic material and relatively cheap compared to fungicides which include chemical pesticides that have an effect on plants. *T. harzianum* as a biocontrol is a biological pesticide which does not have any side effect on even though given in plant with an excess amounts. Biological agents when used tend to be safer than synthetic and non-toxic chemical agents (Soetanto, 2013).
4. Conclusion

*T. harzianum* as a biocontrol can control diplodia disease in citrus plants in swamp areas of South Kalimantan. The reduction of diplodia disease attacks can reach to 0%.

References


