THE EFFECT OF FORMULATION HUMIC SUBSTANCE AND \textit{Trichoderma} sp TO INCREASE PRODUCTION AND GROWTH OF CORN (\textit{Zea Mays} L.)

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ABSTRACT

Research to humic substances and \textit{Trichoderma} sp. formulation in increasing growth and production of maize. This research was done by extracted humic substance from organics matter fractionation methods, using cattle manure. \textit{Trichoderma} sp grew on maize medium and harvested after its density is about $10^{15}$ spores/g. Sweet maize, F1 jago variety, was used as indicator plant. Applications humic substance were 8%, 16%, and 32% according to the recommendation of NPK fertilizer used for maize, and a control without humic substance. The result showed that application 8% humic substance is suitable for plant growth and harvest. However, An efficiency of NPK uptake was increased when we used formulation of humic substances 16% and 32%.

Keywords: formulation, humic substance, \textit{Trichoderma} sp., maize

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INTRODUCTION

Soil fertility and water availability becomes a major problem in the cultivation of crops, including maize. Additions of inorganic fertilizers, such as urea, have negative impact to the soil. Soil compaction due to the continued use of urea affects the inability of the soil to provide nutrients, aeration and water sufficient for plants. Humic substances is one of the organics matter which could improve soil aeration and increase water retention. It has a large adsorption surface area and internal ion that could absorb and save water seven times bigger than clay soil. Humic substances also able to activate biology and physiology processes of organisms in the soil (Hermanto, Dharmayani, Kurnianingsih, & Kamali, 2013).

\textit{Trichoderma} sp. not only act as parasite to the plant pathogens, but able to produce antibiotics as well. Moreover, some strain of \textit{Trichoderma} sp. able to induce systemically and locally of resistance to some specific plant pathogens, also could increase plant growth and development (Ha, 2010). \textit{Trichoderma harzianum} have been tested its ability to control wilt disease caused by fusarium on tomato. \textit{T harzianum} which was combined with organic matter ashes could inhibit the disease progress, incubation period, disease severity and disease rate approximately 36.79-4.30 % (F. R. Rahayuniati & Mugiastuti, 2009). \textit{Trichoderma} sp. has ability in controlling stem rot disease on pepper that caused by \textit{Phytohthora capsici}, effectiveness of control is about 90.86% if combined with legume ashes (Rahayuniati and Kurniawan, 2009). \textit{T harzianum} has ability to increase glycoside, tannin, and saponin on banana plant. Injecting and soaking of plant could increase biochemical resistance of banana to the fusarium wilt (Soesanto & Rahayuniati, 2009).

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Whereas (Manohara, Mulya, Wahyuno, & Noveriza, 2003) said that application of *Trichoderma harzianum* able to suppress stem rot disease on black pepper about 50%. Application of *T. viride* combined with hay compost could reduce *F. oxysporum* intensity on basal stem and vanilla roots as well. (Purwantisari & Hastuti, 2009) showed that Trichoderma have an ability to inhibit *P. infestans* growth on PDA medium. Retardation percentage of *Trichoderma* sp to the growth of *P. infestans* was high. Application of *Trichoderma* sp and *Gliocladium* sp without mixed them was not significant compared with application of mixed *Trichoderma* dan *Gliocladium* sp that could reduce disease intensity up to 90%. *Trichoderma viride, Trichoderma sp* STP5, *Trichoderma STP6b*, and mixed of *T. viride + Trichoderma STP5* able to suppress sheath and leaf blight development up to 50%, and increase plant weight and corn weight as well (R. F. Rahayuniati & Kurniawan, 2015).

However, this research was aiming to combine humic substances and *Trichoerma* sp, in solid formulation to study their influence to the growth and yield of corn. The addition of Trichoderma to the humic substances is intended to obtain Trichoderma positive influence as plant growth promoter, antagonistic fungus against plant pathogens, and inducer of plant resistance as well.

**MATERIALS AND METHODS**

**Preparation of Humic substances**

Fractionation of organic matter derived from cattle manure by adding some alkaline compounds i.e. NaCl pro analyses, H$_2$SO$_4$ pro analyses (96 %, Density: 1.84), H$_2$SO$_4$ 0.05N, K$_2$Cr$_2$O$_7$ 2N, and NaOH 0.1N, Standard solution: Stock: glucose was 1.000 ppm C, and the standard series were 0; 20; 40; 60; 80; 100 ppm C. The material deposited is humic substance. The next step was filtering to obtain pure solid humic substance (Tan, 1993).

**Preparation of isolates Trichoderma sp**

*Trichoderma viride, Trichoderma STP5*, and *Trichoderma STP6* have grown separately on Potato Dextrose Agar (PDA). All three isolates have been tested for their ability as an antagonist and plant growth promoters.

**Preparation of antagonism test**

Tests carried out by growing 3 Trichoderma isolates simultaneously in PDA medium containing humic substances 0%, 8%, 16%, and 32% of PDA weight. Each isolate was cut using a cork drill diameters 5 mm, and was taken using a needle and put on the surface of mixed PDA. All that tests was done aseptically in Laminair Air Flow (LAF). Observations were made on the ability of the Trichoderma isolates to grow and the presence or absence of growth inhibitory activity.

**Formulation**

Three isolates of Trichoderma was mix grown in the sterilized corn medium and incubated for 11 days. At the time of the application it mixed with solid humic substances that has been sterilized. Approximately 20 grams of *Trichoderma* was applied per plant, and the density of Trichoderma’s spores is 10$^{15}$ spores/g. The Number of Humic substances used 0%, 8%, 16%, and 32% respectively based on the NPK recombination used for maize. NPK was gained from fertilizer namely Urea 350 kg/ha, SP36 100kg/ha and 100kg KCl/ha.

**Field Aplication**

Experiment was done at the controlled field. Sweet corn seed cultivar was Jago F1. Number of seed two for each hole planting, with six replications three treatments and one control. Total numbers of plant were 96 plants. Environmental design used was randomized block design (RBD) . Application of the mixture was done at the time of planting as much as 8%, 16 %, and 32 % of recommended used of NPK. Parameters measured were plant height, dry weight, nutrient uptake of NPK and maize cob.
RESULT AND DISCUSSION

Experiment of three isolates of *Trichoderma* which was grew in medium with humic substances showed that they can grow together, with no inhibition of growth (Figure 1).

The growth in the PDA medium with humic substances is better than the growth in the medium without humic substances. Humic substances contain Na, K, Ca, Mg, N and micro nutrients i.e. Fe, Cu and Zn (Muzakky, Taftazani, & Pramana, 2001). *Trichoderma* able to decompose organic matter from the growth medium, and provide nutrients for itself. Fe, Mn, Zn, and Phosphate in humic substances were required for *Trichoderma* growing (Altomare, Norvell, Bjorkman, & Harman, 1999). Humic substances affect environmental conditions for humic substance pH range 5.8 -6.2. Growth capability also supported by the acidity of the medium pH ranging from 5.0 to 7.2 which is ideal for the growth of *Trichoderma* (Hamzah, Buzarin, Hamid, Thmanomar, & Senafi, 2012).

Humic substances and *Trichoderma* formulation were tested in the field based on the concentration of humic solid 8%, 16% and 32% which was equivalent to the dosage of

![Figure 1. Growth of *Trichoderma* (A) in PDA without humic substances; (B) growth in the medium with humic substances](image)

![Figure 2. Humic substances and *Trichoderma* formulation impact to the Plant growth](image)
NPK fertilizer needs (R. F. Rahayuniati & Kurniawan, 2015). Application of humic and Trichoderma formulation into the soil before planting have affected to the plant height (Figure 2).

Application of humic substances and Trichoderma formulation into the soil before planting, affected to the dry weight of plant. Application of 8% humic substances give the best result compared to other treatments (Figure 3).

Application of humic substances and Trichoderma formulations into the soil before planting have affected to the Nitrogen, Phosphate, and photasium uptake. Application of 8% humic substances give the best result (Figure 4, Figure 5, Figure 6).

Application of 16% and 32% humic substances caused productivity tend to be decline in comparison with the application of 8% humic substances. Application of excessive humic substances does not provide a significant increase to the growth of maize. Absorption of plant nutrients based on the needs of the plant, when it was much availability in the soil does not make the plant grow beyond the ability of the growth. Availability of plant nutrients in the soil in accordance with the law of minimum Liebig’s (van der Ploeg, Bo’hm, & Kirkham, 1999). This study showed, the formulation of 8% humic substances and Trichoderma $10^{15}$ spores/g is the best formulation that can be applied to the maize.

Application of humic substances and Trichoderma formulation before planting, affected to the increase of corn. Application of 8% humic substances give the best result (Table 1).

![Figure 3. Dry weight of plant after application of humic substances and Trichoderma sp formulation](image3)

![Figure 4. Nitrogen uptake on plant](image4)

![Figure 5. Phosphate uptake on plant](image5)

![Figure 6. Photassium uptake on plant](image6)
Table 1. Dry weight of cob

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dry weight cob</th>
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<tbody>
<tr>
<td>0%</td>
<td>215.58 d</td>
</tr>
<tr>
<td>8%</td>
<td>274.80 a</td>
</tr>
<tr>
<td>16%</td>
<td>269.53 b</td>
</tr>
<tr>
<td>32%</td>
<td>260.05 c</td>
</tr>
</tbody>
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Formulation of humic substances and 
Trichoderma can help absorption of nutrients effectively. The formulation of 8% humic substances and 
Trichoderma $10^{15}$ spores/g was effectively to the absorption of nutrients from soil, and reduce the need of NPK fertilizers by 8%. Other benefits of the application of humic substances and 
Trichoderma are Trichoderma play a role as an antagonistic microbe and provide nutrients in the soil by it decomposition activities, so it becomes available for plants.

Trichoderma is a plant growth promoter also. Trichoderma is capable to produce IAA, gibberellins and other phyto hormones that can spur the growth of plants and increasing their resistance to environmental stress (Topolovec-Pintarić, Žutić, & Đermić, 2013). Another effect of this formulation is proven by increasing of the resistance of maize, from plants that are susceptible to the tolerant one. By applied the formulation, plants become tolerant to the major pests that plants that attacked plant (R. F. Rahayuniati & Kurniawan, 2015).

The use of 8% humic substances also mean a reduction in the use of fertilizers, especially NPK at 28 kg/ha from 350 kg/ha, reduced use of phosphorus by 12 kg/ha of a requirement of 150 kg/ha and potassium 8 kg/ha of the need 100 kg/ha.

CONCLUSION

1. Application of the formulation of 8% humic substances and 
Trichoderma $10^{15}$ spores/g can improve plant growth, nutrient uptake and yield of maize

2. The formulation of humic substances and 
Trichoderma effective in increasing the production of maize and reduce the use of chemical fertilizers NPK

REFERENCE


