Effect of *Trichoderma* sp. secondary metabolite on the increase in leaf number of coconut plant

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Abstract. Objectives of this study was to analyze the increase in the leaf number of coconut palm due to the application of solution containing secondary metabolite of *Trichoderma* sp. Twenty plant samples were divided into 2 groups, 10 plants with 1800 cc of *Trichoderma* sp. secondary metabolite (treatment) and 10 plants without the application that secondary metabolite (control). The average age of plants used was 5 years. Results of this study showed that there was a tendency of increased leaf number in plants with the application of secondary metabolite of *Trichoderma* sp. The increase of leaf number of treatment group was 3-6 leaves, while in the control group it was only 3-4 leaves in 6 months.

1. Introduction
Coconut palm (*Cocos nucifera*) is one of the plantation crops that plays an important role in the economy in Indonesia. Indonesia's climate conditions are very suitable for the growth of coconut plants. The total area of coconut plantations in Indonesia according to Central Statistics Agency of Jepara Regency, 2017 is 3,544,393 hectares and total production was 2,871,280 tons, while in 2017 the production decreased to 9,662.56 tons.

In the community-owned coconut plantations in the village of Jerukwangi, Jepara there are still some obstacles that hamper the production. One of them is pest attack *Oryctes rhinoceros* and *Brontispa* sp. These pests cause the leaves to become damaged so that photosynthesis is disturbed [1]. Damage due to attacks of *Oryctes rhinoceros* has a distinctive characteristic, the leaf shape with triangular cutouts like the letter "V". The condition of damage to the leaves of coconut palms due to pest attack needs to be improved by increasing the growth of new leaves.

*Trichoderma* sp. is one of the most popular genera of fungi as a biological control agent. It can be used as a bioantagonist and biofertilizer to fertilize plants to get good quality plant seeds. *Trichoderma* sp. is applied directly to the soil on low-sized plants, herbal plants such as chili, tomatoes, and tobacco. In perennial plants that have hard stems, *Trichoderma* sp. is processed into a liquid formula that is packaged into a secondary metabolite solution of *Trichoderma* sp. The secondary metabolite solution is applied by stem infusion [2]. The use of *Trichoderma* sp. can cause plants to be more resistant to pests, increase plant productivity and generate the safe agro-ecosystems [3] [4].

The secondary metabolites of *Trichoderma* sp. have not been tried to be applied to coconut palms. The research objective was to analyze the development of new leaves of coconut palm due to the application of a secondary metabolites of *Trichoderma* sp. The development of new leaves was expected to restore plants from pest’s attack.
2. Methods
This research was conducted in April - October 2018, in the community-owned coconut plantation of Jerukwangi Village, Bangsri District, Jepara Regency. Secondary metabolite solution of *Trichoderma* sp. was obtained from BPTPHP (The Center of Food Crop, Horticulture & Plantation Protection) Salatiga which contains sugar, rice-washing water and coconut water. Plant samples used were ± 5 years old coconut early maturing variety with an average height of 5 m. The number of plants used was 20 plants, consisting of 10 plants for treatment (application of solution containing secondary metabolites of *Trichoderma* sp) and 10 plants as a control. As many as 1800 cc of *Trichoderma* sp. was applied to each plant by means of stem infusion.

Plant stems were drilled with a slope of ± 45 ° and height from the ground was ± 10 cm, with a hole diameter of 1 cm and a depth of 10-15 cm (half of the circumference of stems). As many as 1800 cc *Trichoderma* sp. secondary metabolite solution was applied into the plant through a 2 m long and 1 cm in diameter hose. In order to slow down the dropping speed, the end of the hose that went into the stem was blocked with cork pieces. The other end was associated with the bottle cap used for the solution. The bottle contained a solution of secondary metabolite *Trichoderma* sp. was put it in a black plastic bag to avoid the direct sunlight, then it was hung on the fronds of a coconut tree. Observations were made once every 1 month for 6 months by counting and recording the number of new leaves that appear.

3. Results and Discussion
The results showed that the average number of leaves of coconut palm had increased after the application of a secondary metabolite solution of *Trichoderma* sp. In the treatment group, the number of new leaf increased by 3-6 leaves per plant for 6 months of observation. In the control group, there were 3-4 new leaves per plant. Addition of a solution containing secondary metabolites through xylem added the nutrients to the plants. That condition is due to the secondary metabolite solution of *Trichoderma* sp. that can support plant growth, because its organic material content provides the nutrients for plants [2]. The role of the biological agent of *Trichoderma* sp. as a plant growth stimulator gives a positive influence on plant growth [5]. The fungus *Trichoderma* sp. can increase plant growth by getting into plant tissues and diffusing growth hormones [6]. The use of *Trichoderma* sp. causes increased leaf growth [7].

![Figure 1](image_url)

**Figure 1.** The average number of new leaves of coconut plants every month for six months

According to Siahaan [8], a particular formulation of *Trichoderma* sp. gives a real increase in the number of leaves. Endophytic fungi *Trichoderma* sp. produces biologically active compositions, including alkaloids, paxillins, lolitrems, and tetra none steroids [9]. The processes of development in plants developed by auxin hormones, such as stem elongation, fruit development, and growth [10].
Trichoderma sp. is able to support plants to produce gibberellic acid hormone (GA3), indolasetat acid (IAA), and benzylaminopurin (BAP) in larger amounts, so that plants become more optimal, fertile, healthy, sturdy, and finally developed in plant resilience [11]. Coconut early maturing variety is a group of coconuts that have a relatively young flowering age, and irregular flowering that is 3-5 years old.

According to Vinale [12] Trichoderma (T. harzianum strains T22, T39 and A6, and T. atroviride strain P1) have been investigated for their effect on plant growth promotion, example for Pisum sativum, Lycopersicum esculentum, and Brassica napus seedling. In the results of the study, plants that were given a secondary metabolite solution of Trichoderma sp. were faster in the process of emergence of new leaves and flowers compared to control plants. The fungus Trichoderma sp. apparently can trigger the flowering earlier. Flowers from two plants (treatment group) appeared in the 3rd month, while in control plants the flower did not appear until the 6th month. In the treatment group, the flower was developed faster. According to Vinale [13] the Trichoderma genus are well known producers of secondary metabolites affect the metabolism of the plant. Metabolites to induce host resistance and/or to promote crop yield.

According to Salisbury and Ross [14] Trichoderma sp. can stimulate flowering because this fungus releases chemical substances or hormones that are diffused into plant tissue. Trichoderma sp. secondary metabolite solution contains plant hormones, organic compounds that are synthesized in one part of the plant and transferred to another part, and at very low concentration is capable of producing a physiological response. The response can be in the form of stem, leaf, root, flower or fruit growth [14]. Trichoderma sp. is able to trigger plants to produce the gibberellic acid hormone [11]. Based on experiments, the hormone gibberellins can develop the structure of reproductive organs (flowers) in young plants [10]. This is consistent with the results of this study that the plants treated with secondary metabolite solution of Trichoderma sp. can develop flowers in the 3rd month by 0.2% of the total sample of plants while there are no flower developed in control group. Another influential factor is the injury to the stem that trigger the buildup of auxin hormone which can stimulate plants to form flowers. At low levels, auxin will regulate physiological processes and stimulate the plant growth. Thus, According to Vinale [15] Trichoderma secondary metabolites that affect plant metabolism.

4. Conclusion
Solution containing secondary metabolite of Trichoderma sp. applied through coconut stem infusion has a tendency to influence the development of young leaves of coconut palms.

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