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Research paper

The Effectiveness of Trichoderma sp. on Organic Cayenne Pepper Production

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Abstract

Trichoderma sp. has the properties as an agent of controlling plant diseases and may also serve to provide nutrients for cayenne pepper. Knowing the excellent nature of Trichoderma sp. leads to itssignificance on doing a research on optimizing the role of Trichoderma sp. for the organic cayenne pepper. This study aims to find out doses of Trichoderma sp. needed for cayenne pepper best growth. Trichoderma sp. with a total population of 5.7 x 108cfu/cc was given to compost. Every 500 g of compost, was given 0, 5, 10, 15,20 cc Trichoderma sp.The study was conducted in a green house from March to September 2016. The experiment used completely randomized design with 5 treatments (Trichoderma dose of 5 cc of compost, 10 , 15 , 20 cc and without Trichoderma), and repeated 6 times. The results show that the higher the dose was given, the better the plant grew. The number of leaves and flowers of cayenne pepper increased, and the best one was on the plant with 20 cc of compost.

Keywords: *dose, compost, Trichoderma sp*

1. Introduction

Cayenne pepper (Capsicum frutescens) is one of the commodities whose very high economic value in Indonesia. Most of them are cultivated commercially. Cayenne pepper is a horticultural commodity and serves as a consumption crop for people. In Indonesia, the people begin to choose organic plant products for having healthy life.

Trichoderma sp. is one of the microorganisms that hasability as an agent controlling plant diseases and can also serve to provide nutrients for cayenne pepper. Research conducted by Irianti and Suyanto on the utilization of fungus Trichoderma sp. and Aspergillus sp. as a decomposer on rice straw composting shows the result that the decomposition in the treatment of straw, manure and bran in the ratio 2: 1: 1 and Trichoderma sp. has better result than usage Aspergillus sp. or the mixture of both Trichoderma sp. and Aspergillus sp.[1] It also informed that the two microorganisms did not occur competition. Trichoderma sp. in the process of decomposition various organic materials produces organic compound that act as growth stimulant, accelerate the flowering process, increase biosynthesis of biochemical compounds, inhibit pathogens, increase production of secondary metabolite compounds [2].The results of Herlina and stated that Trichoderma harzianum has potential as an active compost on pepper crop to keep soil fertility and control plant pathogen [3]. Sutarini et al in her research about layu fusarium disease on Chili (Capsicum annuum L.) by using both compost and manurecombined with Trichoderma sp. at green house gives very good results, because Trichoderma sp. ableto inhibit the growth of the fungus F. oxysporum f.sp. capsici with a large percentage of 86.05% [4]. Dwiastuti et al. also proved in her research that Trichoderma sp. has a very effective ability to control wilt disease Fusarium spp.Similarly [5]. Darini et al . of her research recommends that the combined both Trichoderma sp . and Mikoriza sp. can be used as an alternative fungicide to control Fusarium in ginger plants [6].

Trichoderma sp. as a disease control agent in plants, its ability has been widely studied. Mechanism of inhibition of Trichoderma sp. to S. roflsii infection according to Berlian et al., may occur through several mechanisms, such as by producing gliotoxin and viridian compounds which are toxic for other fungus [7]. Purwantisari and Hastuti also stated that Trichoderma sp. is one of the fungus in the soil and has a very beneficial role, as it can be antagonists to fungus pathogens of cultivated plants [8]. Djunaedy also stated that Trichoderma sp. is one of the pesticide agent of fungus group Trichoderma sp. The mechanism of control is specific and can also increase production of the plant [9]. Thus,the fungus Trichoderma sp. becomes superior to be used as a biological control agent.

Colletotrichum capsici fungus is the main cause of fruit rot disease in pepper crop [10]. Fungus C. capsici can survive on the remains of diseased plants. When the state of the environment is very supportive, such as high humidity, then disease will spread rapidly from one land to another land. Results of research conducted by Herwidyarti et al . indicated that the severity as the effect of Antraknosa disease attack caused by C. capsici on the pepper crop can reach up to 44. 0% [11].

Study of Alfizar et al. showed the result that the growth of pathogen C. capsici, Fusarium sp. and S. rolfsii can be inhibited by Trichoderma sp. on in vitro research [12]. Inhibitory power of Trichoderma sp. against the three pathogens is highest in C. capsici followed by Fusarium sp. and the smallest on S. rolfsii. The growth of C. capsici may be hampered, because the fungus Trichoderma sp. grows faster and can release toxins that lead to poor growth and even death of its host or pathogens that can cause plant disease.

In 2014, there was conducted research on the effects of varieties and compost dose with Trichoderma harzianun on the growth and yield of chili (Capsicum annuum L.), shows that the dose of compost enriched with microorganisms T. harzianumhas very significant effect on the amount of fruit, fruit weight and chilies red per plant [13]. The growth of pepper crop in the field with the composting of Trichoderma sp. conducted in 2015 showed good results on observation variables of height plants, number of leaves and fruit [14].

Based on the significant role of Trichoderma sp. to keep soil fertility, the ability of Trichoderma sp. is not as a pathogen, especially in cayenne pepper, thus it is necessary to be exploited its potential for doing further study about "The Effectiveness of Trichoderma sp. on Production Organic Cayenne Pepper".

2. Method

Research carried out in the laboratory of Agriculture Faculty of Universitas Muhammadiyah Sidoarjo and Green house at Perning Mojokerto in March - September 2016. Materials needed in this research are: Potato Dectrose agar media, alcohol, aluminum foil, cotton, sterile distilled, compost, soil, manure, polybag size 40 x 20, cayenne pepper seed variety of CF 291. The tools required in this study are: outoklaf, entkash, incubator, petri dish, ose needle, bunsen lamp, hand sprayer, hoe, stationery, and others.

This study used Completely Randomized Design with 5 treatments and 6 repititions. Each repetition consists of unit of experiment with each of these using 3 polybags. Placement of each polybag is done randomly, the treatment consists of several doses Trichoderma sp. 5.7 x 108 cfu / cc on compost 500 g , namely:

O = Without Trichoderma sp.(as the control)
A = 5 cc
B = 10 cc
C = 15 cc
D = 20 cc

Implementation of research, land used as a growing medium originating from a land was never given chemical fertilizers and pesticides, mixed with manure and compost with a ratio of 1: 1: 1. Planting media sterilized first. Trichoderma sp. according to the treatment given on 500 g of sterile compost and incubated for 7 days, then added to the planting medium in polybags. Observation conducted on the growth of cayenne pepper aged 30, 60 and 90 days after planting on the variables of plant height, number of leaves, number of flowers, and at the time of crop production to the number of fruit, fruit weight and dry seed weight. The results will be analyzed by using ANOVA. Then, if there is significant effect, will proceed with the test the smallest real difference or 5% LSD.

3. Results and Discussions

Results of observation on the average height of plants, the number of leaves, the number of flowers on the growth of cayenne pepper ages 30, 60 and 90 days after planting are presented in Tables 1, 2 and 3.

Table 1:. The Average Plant Height of Cayenne Pepper with Various Doses of *Trichoderma* sp.

Dose of *Trichoderma* sp. (cc)	Height of Plant (cm)		
	30 DAP	60 DAP	90 DAP
0	29.33 d	50.00d	70.00 c
5	30.00 cd	50.17cd	70.17 c
10	30.33 bc	51.33 bc	71.67 b
15	31.00 b	51.83 b	73.83 b
20	35.83 a	56.17 a	75.00 a
LSD 5%	0.874	1.209	1.224

Table 2:. The Average Number of Leaves of Cayenne Pepper with Various Doses of *Trichoderma* sp.

Dose of *Trichoderma* sp. (cc)	Number of Leaves		
	30 DAP	60 DAP	90 DAP
0	22.00 c	41.67 d	67.17 c
5	23.00 c	43.67 c	67.50 c
10	29.83 b	49.00 b	70.67 b
15	30.67 b	49.83 b	71.00 b
20	44.83 a	66.00 a	84.63 a
LSD 5%	1.090	1.247	0.906

Table 3:. The Average Number of Flower of Cayenne Pepper with Various Doses of *Trichoderma* sp.

Dose of *Trichoderma* sp.(cc)	Number of Flower		
	30 DAP	60 DAP	90 DAP
0	0	1.00 c	5.33 e
5	0	1.50 c	6.50 d
10	0	2.67 b	9.67 c
15	0	3.17 b	16.17 b
20	0	10.00a	30.00 a
LSD 5%		0.813	0.789

The highest growth of cayenne pepper is 75 cm which are showed on observation time of 90 days occurred in the treated plants by Trichoderma sp. as much 20 cc in compost. The highest number of leaves was 84.63 leaves which produced by treated plants giving of Trichoderma sp. as much 20 cc in compost, then the highest amount of flowers occured in plants treated by giving Trichoderma sp. 20 cc on compost at the age of 90 days after planting as many as 30 flowers / plants. From the result of observations of cayenne pepper can be known that giving the dose of Trichoderma sp. on the media has a good influence. This is in line with Marwan who stated that the treatment of Trichoderma compost doses can increase production and suppress the intensity of plant disease attacks on peanuts [15]. Potential Trichoderma sp. as a fertilizer and biological pesticide was also raised by Lopez et al. that Trichoderma given as much as 30 g / l of water is potentially good as a biological fertilizer in green mustard plants and can be used as a biocontrol agent because it can inhibit the growth of pathogenic Rhizoctonia sp. and Fusarium sp., respectively 39.0 and 24.0 % [16].

Table 4:. The Average Number of Fruit, Fruit Weight and Seed Dry Weight of Cayenne Pepper with Various Doses of *Trichoderma* sp.

Dose of *Trichoderma* sp. (cc)	NumberFruit Of LeavesWeight (g)	Dry (g)	Seed Weight (g)
0	79.33e	54.74 e	4.11 e
5	87.50 d	66.50 d	5.99 d
10	99.67 c	88.70 c	9.76 c
15	121.50 b	134.87 b	28.73 b
20	149.33a	185.17 a	45.56 a
LSD 5%	2.342	2.171	0.394

Results of observations on average number of fruit , fruit weight, andseeds weight in various treatments dose of Trichoderma sp. can be seen in Table 4. The highest number of fruit, fruit weight and weight of dry seed mostly occurred in plants treated by giving Trichoderma sp. as much 20 cc / 500 g compost . This results show that influence of giving Trichoderma sp. is very significant on the cayenne pepper and the dosecan also be seen that the higher the dose has a high influence as well. The giving of Trichoderma sp. as much as 20 cc / 500 g compost able to increase the availability of nutrients in organic cultivation media of cayenne pepper. This is consistent with the research result of Lehar that Trichoderma sp. which are given in the potato plant on one week before planting, and after the plant grows, then given once of every two days until the plant is 70 days after planting, showed very good growth of the potato plant [2].

In all treatments in all observations from the beginning of the growth until the cayenne pepper produces, it showed that on the

early growth, it has low influence, because on the early cayenne pepper growth,response of Trichoderma sp. still need time to propagate in organic fertilizer, and it also serves as decomposer organic matter provide nutrients for cayenne pepper. This can show the important role of microorganisms in organic fertilizers, because it can help the metabolism in the soil. So that, the soil is able to provide the nutrients needed by plants. Herath et al. stated that Trichoderma sp. is one of the soil fungus which most widely used because of its potential as biocontrol, so that many researchs have been conducted related to the effect of Trichoderma sp. on various types of plant pathogens [17].

The role of Trichoderma sp. is very significant to help the growth and production of cayenne pepper, because without the addition of inorganic fertilizers and the use of inorganic pesticides, the growth and production of cayenne pepper is very good, which it is without disturbed by plant pest organisms. Agarwal et al. stated that the biocontrol agent is much preferred to be used for controlling pathogens in plants effectively [18]. It has been seen from the results of the screening show that the interaction of Trichoderma sp. on pathogens is able to suppress the growth mycelia of pathogen such as Aspergilllus niger, Chaetomium sp. and Penicilium sp. significantly. Moreover, Herath et al. has test the pathogenicity of Trichoderma sp. in 7 pathogens namely Fusarium oxysporum, Rhizoctonia solani, Colletotrichumgloeosporioides, Curvularia lunata, Corynespora cassiicola, Rigidoporus microporus and Phytophthora meadii [17]. Not only that, it also observed the production of chitinase and glucanase, the pathogenesis test was very positive of the 7 pathogens, and the highest pathogenicity occurred in Rhizoctonia solani (72.66% ± 7. 6). With this success, it is recomended that T. erinaceum can be utilized for controlling R. solani than other pathogenic fungus that have been tested. This is due to the effect of the production time of chitinase and β-1,3-glucanase of the Trichoderma species is faster than production of chitin and β-1,3-glucan pathogens, so that the strength of pathogen cell wall is weakens and its growth becomes constrained.

Trichoderma sp. is commonly known as microorganisms that can be used as material of biopesticide, biofertilizers, promote growth and as a stimulant of natural resistance. It has been seen in the treatment without giving Trichoderma sp., the growth of pepper crop showed poor results and some even got the disease. This is due to the ability of Trichoderma sp. to protect the plants, promote growth and pathogenicity, so that it can improve the nutrients present in the soil media and play a role in decomposition and biodegradation [19].

The role of Trichoderma harzianum Rifai as bio fertilizer has been studied on its utilization in improving the growth of plant Eruca sativa which is planted on a media containing a mixture of metals copper and zinc as sulfate salts [20]. The result is the biofertilizer fungus T. harzianum can increase the growth and biomass of Eruca sativa L. which planted on soil contains a mixture of different concentrations of copper and zinc. Trichoderma has no negative effect on healthy roots, but it can minimize the adverse effects of the presence of metals on the soil, as well as increase the uptake of other metals such as magnesium and silicon. By the ability of Trichoderma sp., it is also seen in the observation of the growth and development of cayenne pepper treated by various doses of Trichoderma sp. showed good results. The average number of fruit, fruit weight and seeds weight can be seen in Table 4.

The result of all observations consist of plant height, number of leaves, number of flowers , number of fruit, fruit weight and dry weight of cayenne pepper, showed that dose of Trichoderma sp. of 20 cc / plant showed the highest yield. This is in line with Kusuma that Trichoderma sp. besides used as a biological controller, it is also able to give a positive influence on the growth of plants, roots and yields [21]. This is because the compost Trichoderma sp .has some advantages: Trichoderma does not produce toxins, environmentally friendly and it does not distrub other organisms that give benefit for the plant. It also agrees with Sitepu et al., that Trichoderma sp. is able toproduce cellulase enzymes that serve to break down n cellulose into glucose, so it can be used as a source of energy by plants [22]. The amount of energy produced by Trichoderma sp. also can be seenon the observation of the number of fruit that produced by pepper cropwith the treatment high dose of compost 20 cc / 500 g, it showed two fruits of cayenne pepper on the observation 90 days after planting. This is also agreed with Irianti and Suyant stated that the fungus Trichoderma sp. can serve as a decomposer in the manufacture of organic fertilizers, and can also accelerate the process of overhauling organic materials into mineral materials (nutrients) that are needed by plants [1]. In line with this, Goenardi stated that Trichoderma sp. is one of the active ingredients of superior microorganisms which plays role in degradation process of lignin and cellulose on the SuperDec formula (Super Decomposer) with P. chrysosporium and T. pseudokoningii microorganisms made by Indonesian Plantation Biotechnology Research Institute [23].

4. Conclusion

The given of Trichoderma sp. as much 5 , 10 , 15 , 20 cc on compost for the cayenne pepper which planted in polybags showed the plant growth, such as plant height, number of leaves, number of flowers and number of fruit, then the best one was on the plant with 20 cc of compost.

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