

# Effect of Tricoderma and Organic Fertilizers on Vegetatif Growth of Black Pepper (*Piper nigrum* L.) under Field Condition

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**Abstract.** Black pepper is a high nutrient demanding crop. However, over utilize of chemist fertilizer may give a negative impact to the environment and human health. Therefore, fertilizer use and management is crucial infortance to sustain growth and high yield. This Field experiment is carried out to study the effect of Tricoderma harzianum and liquid organic fertilizers on vegetatif growth of Black Pepper. The study was conducted for 4 months. The research method is design by Randomized Block Design (RBD) Factorial two factors. Factor I is apply Tricoderma dose 50 g, 75 g and 100 g per plant. The second one is use Liquid organic fertilizers (LOF) and the treatments were repeated three times. Parameters observed are the time of emergence of tendrils, spiraling length, number of tendrils, number of leaves and number of productive branches. The observed data obtained were statistically analyzed using analysis of variance and further tested by Tukey's HSD Test at 5%. The result of this research is expected to have a better effect of Tricoderma and one of the liquid organic fertilizers on vegetatif growth of black pepper in the field. Therefore, Biological Agent and organic fertilizer can be an alternative way to substitute NPK fertilizer that can reduce the chemist fertilizer utilization. In conclusion, to achieve high growth performance, organic fertilizer alone is insufficient whilst integrated fertilization gave a signifcant increase in yield and growth of black pepper.

Keywords: Tricoderma, black pepper, Liquid organic fertilizer

## Introduction

The low productivity of pepper (*Pepper nigrum* L.) in Indonesia is caused by various problems. One of the main problems faced by the pepper farmers is the high cost of production due to the increasing trend of using inorganic fertilizers. Moreover, Black pepper is a high nutrient demanding crop. It requires large quantities of nutrients to maintain significant growth and yield. It has been estimated that the nutrient uptake of a mature stand of pepper amounts to 202kg N, 13kg P, 156 kg K, 18 kg Mg, and 68 kg Ca per hectare per year (Yap, 2012). However, over utilize of chemist fertilizer may give a negative impact to the environment and human health.

Another factor that causes low pepper production is the infection of several pathogens such as *Phytophthora* sp. and parasitic nematodes that cause symptoms of pepper plants. Pathogen attack on pepper plants in the form of stem stem rot (BPB) caused by *Phytophthora capsici* (Wahyuno et al., 2010) is a problem that has received much attention. The attack on the leaves will cause patches that extend throughout the leaf surface, while attacks on the base of the stem and roots can cause plants to die (Manohara et al., 2005).

Conventional crop protection has been predominantly based on the use of chemical pesticides to control plant diseases and pests, a practice that can produce negative effects to the end user and the agro-ecosystem, including inhibition of pollinators, useful predators/parasitoid and beneficial microbial communities (Sheridan, et. al., 2014). Current trends in pepper cultivation, fertilizers, and widescale applications of broad-spectrum organophosphate pesticides could result in a degrading ecological environment besides shortening the lifespan of pepper vines (Megir and Paulus, 2011)..

The use of biological pesticides as an alternative to synthetic pesticides in agricultural production is rapidly increasing due to public concerns about human health, safety of agri-food products consumed and impact to the environment (Sheridan, et. al., 2014). Efforts to increase soil fertility in supporting plant growth, namely by using *Trichoderma sp* as a biological agent that helps degrade organic matter so that more nutrients are available for plant growth (EPA. 2000; Lehar, 2012).

The ability of *Trichoderma sp.* reduce the incidence of disease directly through the mechanism of moderate parasitism indirectly through competition in space and nutrition. Hartmann (2006) explained that the ability of *Trichoderma sp.* as a biocontrol agent caused by hydrolytic enzymes that are constitutively produced and detect the presence of other fungi by capturing the signal of the released molecule.

In addition, efforts to overcome pepper disease need to be accompanied by improvements in technical culture, namely the provision of nutrients to improve plant resistance (Manohara, et al., 2005) through the provision of fertilizers that meet the needs of plants. Currently most farmers are still dependent on inorganic fertilizers because they contain several nutrients in large quantities, even though if inorganic fertilizers are used continuously it will have a negative impact on soil conditions (Indriani, 2004). Liquid organic fertilizer (LOF) has become a practical choice for some farmers lately. The advantages of liquid organic fertilizers are nutrients contained in them that are more easily absorbed by plants (Murbando, 1998) and some LOFs contain growth regulating substances.

Therefor, liquid organic fertilizer use and management is crucial importance to sustain growth and high yield in Pepper vine. This Field experiment is carried out to study the effect of *Tricoderma harzianum* and liquid organic fertilizers (LOF) on vegetatif growth of Pepper vine.

## Materials And Methods

The research was carried out during the periode of January to August 2018 at the Field Laboratory of Agriculture Faculty Muslim Indonesia University in Padanglampe, Pangkep Regency South Sulawesi. Soil and compost analysis was carried out in the Laboratory of Soil Science, Faculty of Agriculture, Hasanuddin University, Makassar. The particle size analysis showed that the texture of this brownish yellow soil was clay loam and had a pH of 6.5 (Table 1).

The research was a field experiment and method was design by Randomized Block Design (RBD) Factorial two factors. First factor were apply Tricoderma doses 50 g, 75 g and 100 g/plant. The second one were use two type of Liquid organic fertilizers (LOF) that are Lestari Green (A) and Digrow (B), each LOF was applied with a concentration 1% with a volume of about 250 ml /plant. LOF was appied 15 days after NPK fertilizer and repeated every 15 days. NPK fertilizer (16 : 16: 16) 100 g and 5 kg compost were added to each plant as base ferlizer and apply at same time with Tricoderma.

Table 1. Chemical and Physical Characteristics of Soil (depth 0-25 cm) before Treatment

Soil Characteristics	Soil (depth 0-25 cm)
pH (H <sub>2</sub> O)	6.5
C-Organik (%)	2.14 (medium)
N-total (%)	0.18 (low)
C/N ratio	12,0 (medium)
P <sub>2</sub> O <sub>5</sub> (ppm)	12.9 (low)
Exchangeable K <sup>+</sup> (cmol(+)/kg)	0.3 (medium)
Exchangeable Mg <sup>2+</sup> (cmol(+)/kg)	1.6 (sedang)
Exchangeable Ca <sup>2+</sup> (cmol(+)/kg)	6.5 (sedang)
Exchangeable Na <sup>+</sup> (cmol(+)/kg)	0.4 (medium)
CEC	20.07 (medium)
BS (%)	44.0 (medium)
Clay (%)	28 (clay loam)
Silt (%)	32 (clay loam)
Sand (%)	40 (clay loam)

Pepper vines of the Natar 1 varieties  $\pm$  18 months old (from the Center for Plantations Research and Development, Bogor) were planted rows with spacing of 2.5 m x 2,5 m between and within the rows, with a population of 1,600 plants per hectare. The site was divided into three blocks or replicates. Each block contained twelve treatments and 5 plants of *Piper nigrum* were randomly selected to reseave treatments.

Parameters observed were the time of appear of shoots, length of shoots, number of shoots, number of leaves and leaves area. The observed data obtained were statistically analyzed using analysis of variance and further tested by Tukey's HSD Test at 5%. The soil was analyzed for the physical and chemical properties before and after the treatment and the compost was analyzed for nutrient content.

## Results and Discussion

Application of LOF type has a significant effect on the time of buds appear, but the application of trichoderma has no significant effect on the time of buds appear. Likewise, the interaction between trichoderma dosage and LOF type had no significant effect on the time of buds appear (Table 2).

Table 2 shows that the type of LOF B was produces the fastest of time of shoot appear that is 16.40 days after application. This result was significantly different from the control (without LOF), but is not significantly different from other LOF type applications, which are 17.16 days.

Trichoderma of 100 gram /plant showed the fastest effect of time of shoot appear, which averaged 16.81 days. Mean while the time of shoot appear was the slowest from the treatment without trichoderma, which was 18.15 days. The relationship between trichoderma with the time of buds appear produces linnear with regression equation as shown in Figure 1.

Table 2. Effect of *Trichoderma* sp and LOF on time of shoot appear (days) at 10 weeks after application

Dose of Trichoderma	Type of LOF			Means	HSD 5%
	Without LOF	A	B		
Control (No <i>Trichoderma</i> )	18.86	18.27	17.33	18.15	
50 g/plant	18.27	17.39	15.99	17.22	
75 g/plant	17.44	15.73	17.44	16.87	
100 g/plant	18.31	17.16	14.85	16.81	
Means	18.22 <sup>a</sup>	17.16 <sup>ab</sup>	16.40 <sup>b</sup>		1.47

Means in the same column/row with different letters are significantly different at 0.05% using Tukey's HSD Test.

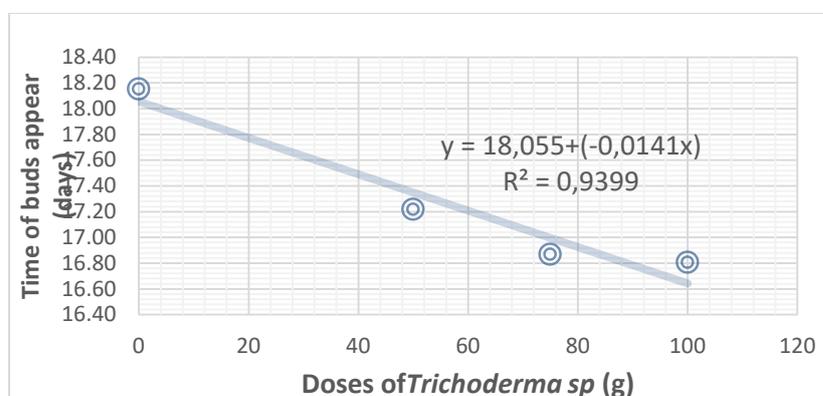


Figure 1. Relationship between doses of *Trichoderma* sp with the time of buds appear of *Piper nigrum* L.

Table 2. Effect of *Trichoderma* sp and liquid organic fertilizer on length of shoot (cm) at 10 weeks after application

Dose of Trichoderma	Type of LOF			Means	HSD 5%
	Without LOF	A	B		
Control (No <i>Trichoderma</i> )	19.74	25.04	22.14	22.97 <sup>b</sup>	4.41
50 g/plant	21.37	22.79	25.54	22.90 <sup>b</sup>	
75 g/plant	20.69	25.26	24.83	23.59 <sup>b</sup>	
100 g/plant	26.92	31.36	27.49	28.59 <sup>a</sup>	
Means	22.18 <sup>b</sup>	26.11 <sup>a</sup>	25.25 <sup>ab</sup>		3.45

Means in the same column/row with different letters are significantly different at 0.05% using Tukey's HSD Test.

The results showed that there were no interaction between trichoderma application with LOF type, but a significant effect on the application of single factor trichoderma dose and type of LOF. Table 2 shows that trichoderma 100 grams / plant gives the best effect on the growth of shoot length of 28.59 cm and a significant difference with the treatment without trichoderma and other doses of trichoderma. The best shoot length was produced

by the treatment of LOF A type of 10.00 ml / liter with a value of 26.11 cm and was significantly different from without LOF. There is no significant difference between the treatment of LOF type A and B for shoot length.

Table 3. Effect of *Trichoderma sp* and liquid organic fertilizer on sum of shoots at 10 weeks after application

Dose of Trichoderma	Type of LOF			Means	HSD 5%
	Without LOF	A	B		
Control (No <i>Trichoderma</i> )	2.75	3.94	4.03	3.57 <sup>b</sup>	0.97
50 g/plant	3.67	3.64	4.11	3.81 <sup>ab</sup>	
75 g/plant	3.03	4.68	3.75	3.82 <sup>ab</sup>	
100 g/plant	4.33	5.56	4.07	4.65 <sup>a</sup>	
Means	3.45 <sup>b</sup>	4.46 <sup>a</sup>	3.99 <sup>ab</sup>		0.76

Means in the same column/row with different letters are significantly different at 0.05% using Tukey's HSD Test.

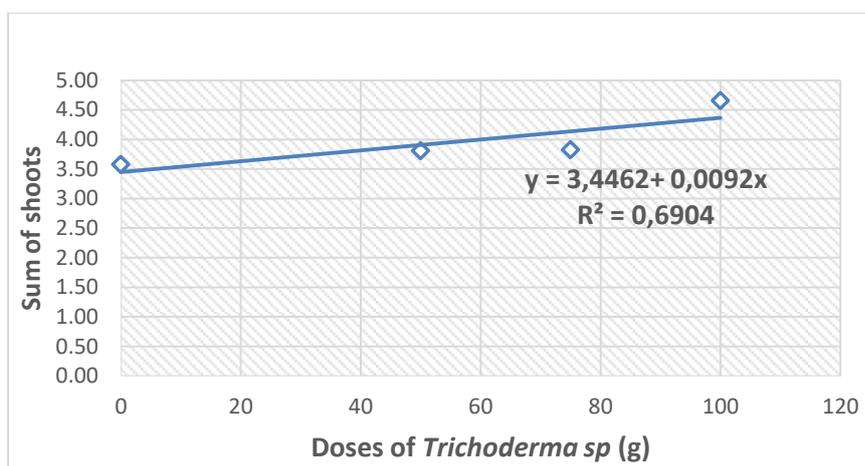


Figure 2. Relationship between doses of *Trichoderma sp* with the sum of shoots appear of *Piper nigrum* L.

The results of observation and analysis of variance showed that there was a significant effect on trichoderma treatment and LOF type on the number of *Pepper nigrum* buds, but there were no interactions between these two factors. Table 3 shows that trichoderma treatment of 100 grams /plant produced the best effect on the number of shoots, which was 4.65 and significantly different from the number of shoots in the treatment without trichoderma. However, trichoderma treatment of 100 grams /plant was not significantly different from other trichoderma dose treatments (Table 3). The treatment of LOF types also has a significant effect on the number of pepper shoots. LOF Type A, gives the highest number of shoots that is 4.46 and shows a result that is significantly different from treatment without LOF, but not significantly different from other LOF. The relationship between treatment of trichoderma with the sum of shoot indicated by linear with the regression equation as shown in Figure 2.

Table 4. Effect of *Trichoderma* sp and liquid organic fertilizer on sum of leaves at 10 weeks after application

Dose of Trichoderma	Type of LOF			Means	HSD 5%
	Without LOF	A	B		
Control (No <i>Trichoderma</i> )	5.60	9.94	10.43	8.66 <sup>b</sup>	3.13
50 g/plant	9.15	9.66	7.80	8.87 <sup>b</sup>	
75 g/plant	8.42	10.46	8.72	9.20 <sup>b</sup>	
100 g/plant	12.99	14.76	10.07	12.61 <sup>a</sup>	
Means	9.04	11.21	9.25		

Means in the same column/row with different letters are significantly different at 0.05% using Tukey's HSD Test.

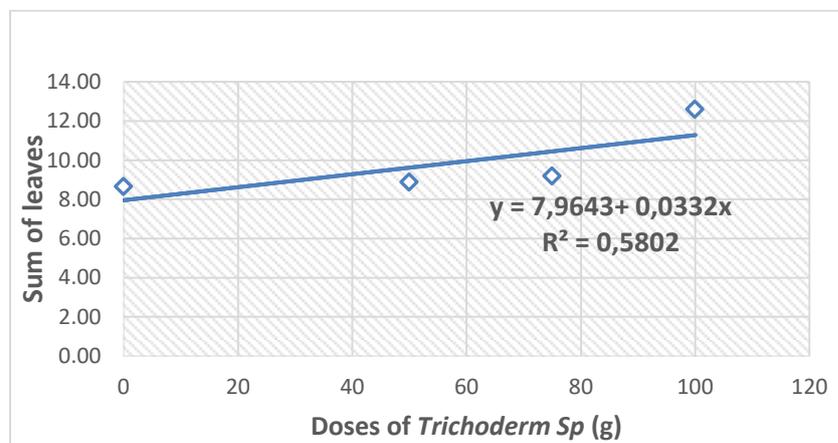


Figure3. Relationship between doses of *Trichoderma* sp with the sum of leaves of *Piper nigrum* L.

The results of observation and analysis showed that trichoderma treatment had a significant effect on the number of leaves, but there was no interaction between trichoderma treatment with LOF type. There is no significant effect on the single factor type LOF. The test results in Table 7 show that the treatment of trichoderma 100 grams /plant produces the best effect and there is a significant difference in the number of leaves that is 12.61 sheets. Trichoderma application on pepper plants showed a close relationship to the number of leaves and the regression equation can be seen in Figure 3.

The results of observation and analysis of the number of leaves showed that the treatment of LOF types had a significant effect on leaf area, but the interaction between trichoderma dosing and LOF type had no significant effect on the leaf area of pepper plants. Trichoderma application also has no significant effect on leaf area. The test results in Table 5 show that the type of LOF A gives the best effect on leaf area, namely 57.67 cm<sup>2</sup> and significantly different from the control (without LOF) with a leaf area of 45.55 cm<sup>2</sup> and not significantly different from LOF B type treatment.

The highest number of leaves in Trichoderma treatment was 100 g/plant in the rhizosphere of pepper plants, presumably because these isolates were best at increasing root length which affected nutrient uptake and water from the soil, compared with Trichoderma 50 grams / plant and without Trichoderma. The more doses of Trichoderma

that are applied, the more will be symbiotic with the roots of pepper plants, according to Hajieghrari's (2010) statement that the application of Trichoderma to corn seed plants will increase the conductivity of stomatal, which will affect nutrient uptake that affects plant growth.

Table 5. Effect of *Trichoderma sp* and liquid organic fertilizer on leaf area (cm<sup>2</sup>) at 10 weeks after application

Dose of Trichoderma	Type of LOF			Means	HSD 5%
	Without LOF	A	B		
Control (No <i>Trichoderma</i> )	5.60	9.94	10.43	8.66 <sup>b</sup>	3.13
50 g/plant	9.15	9.66	7.80	8.87 <sup>b</sup>	
75 g/plant	8.42	10.46	8.72	9.20 <sup>b</sup>	
100 g/plant	12.99	14.76	10.07	12.61 <sup>a</sup>	
Means	9.04	11.21	9.25		

Means in the same column/row with different letters are significantly different at 0.05% using Tukey's HSD Test.

Trichoderma treatment application provides a significant effect on the variable growth of pepper plants. Trichoderma with a dose of 100 g/ plant can respond well to the growth of pepper plants and produce pepper plants with the highest shoot length of 28.59 cm, the highest number of shoots is 4.65 shoots and the highest number of leaves is 12.61 sheets. This indicates that the presence of nutrients and growth hormone substances contained in trichoderma 100 grams which is able to increase the growth of pepper plants compared with without trichoderma (control).

*Trichoderma sp* is able to increase plant growth directly or indirectly. Indirectly is by suppressing the pathogen by colonizing the area around the root of the plant and then invading the shallow layer of the root cortex, so that the space for the pathogen decreases which results in the absorption of nutrients not disturbed and the growth of pepper plants will be good (Taufik (2011).

## Conclusion

Based on the results of the experiment it was concluded that (1) the application of Trichoderma 100 grams / plant gave the best effect on the growth of pepper plants, namely the length of the shoot, the number of shoots and the number of leaves; (2) The application of liquid organic fertilizer type A 10.00 ml / liter of water gives the best effect on the growth of pepper plants, namely the length of the shoot, the number of shoots, when the shoots appear and the area of the leaf; (3) There is an insignificant interaction between Trichoderma and the type of liquid organic fertilizer to pepper plant growth variables.

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