Effect of bio-organomineral fertilizer on the growth of chili (Capsicum annum l.)

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Abstract. The productivity of chili in 2014-2015 has decreased by 29,411 tons due to conversion of agricultural land. One of the efforts to increase the production of chili is by using latosol acid as a cultivation area. The low fertility of latosol land can be overcome by fertilizing. The purpose of this research was to investigate the role of duckweed and Methylobacterium on chili production which cultivated at latosol soil. The design used was Completely Randomized Design (RAL) with 6 treatments and 4 replications. The treatment consisted of P0 = control, P1 = 50 kg / ha, P2 = 100 kg / ha, P3 = 150 kg / ha, P4 = 200 kg / ha, and P5 = 250 kg / ha. Assumed data were analyzed by using variance analysis (ANOVA), Duncan’s Multiple Range Test (DMRT) with confidence level 95% was used for further analysis. The results showed that fertilizer application can increase the fertility of latosol soil, percentage of chili pepper plant life, height, number of productive branches, number of flower, and amount of fruit.

Keywords: bio-organomineral, chili production, latosol soil

1. Introduction

Indonesia as an agricultural country is a potential area for agrocomplex development. Agriculture has a great role for human life as a source of food needs. One of the potential agricultural products in Indonesia is horticultural crops such as vegetable crops. Unstable climatic changes and conversion of agricultural land in Indonesia are a major problem in horticulture cultivation. Based on statistical data about 180,000 ha of land per year turned into non-agricultural land. One attempt to overcome this is by utilizing the less productive lands in Indonesia, such as the latosol land of 84.63 million ha [1]. Latosol soils are commonly scattered in mountain slopes and mountains, and the soil is acidic. Chili is a plant that is widely cultivated in Indonesia. Domestic chili demand continues to increase as the population increases, indicating that chili is an economical commodity. However, the last three years of pepper plant productivity has decreased. One solution to overcome the low fertility of latosol land and optimization of chili productivity, among others, by fertilizing. The recommended fertilizer is organic fertilizer because it may improve the physical, chemical and biological properties of the soil. One ingredient that may be used as a mixture of organic fertilizer is the L. minor Lemna (duckweed) because it contains macro nutrients, with high N levels obtained from nitrogen fixation in waters [3]. On the other hand, Methylobacterium may increase the tolerance of stress and produce Indole Acetic Acid (IAA) hormone to accelerate plant growth [2]. The purpose of this research was to investigate the utilization of duckweed and Methylobacterium as bio-organomineral fertilizer in pellet form (Pellet
MOSS) to obtain optimal chilli production in acid souros latosol and give dosage recommendation of Pellet MOSS.

2. Materials and Methods
The research was conducted at Greenhouse of Central for Food Crops and Horticulture (BPTPHP) Ungaran, Central Java, Ecology and Plant Production Laboratory, Faculty of Animal Husbandry and Agriculture and Integrated Laboratory Diponegoro University, Semarang, from March to July 2017. Tools used were set of analytical tools, shovels, trays, scissors, sieve, bucket, hoe, trashbag, polybag size 40 cm x 35 cm, manual pelletter machine, scales, hose, stationery, camera. The materials used were Lemna minor, cow dung manure, zeolite, carrier in the form of jackfruit leaf (DN), rambutan (Nephelium lappaceum) leaf (DR), lettuce leaf (DS) and basil leaf (DK), water, chemicals for analysis, isolation and bacterial culturing, planting media in the form of acid sour latosol and curly chilli seeds.

The design of this study used a Completely Randomized Design (RAL) monofactor 6 treatment with 4 replications. The factor is dosage of Pellet MOSS consisting of control (P0), 5 ton / ha (P1), 10 ton / ha (P2), 15 ton / ha (P3), 20 ton / ha (P4), 25 ton / ha (P5). The stages of the research are started with the preparation of chemicals for the manufacture of AMS (Ammonium Mineral Salt) media, Methylobacterium isolate from jackfruit leaf, rambutan leaf, lettuce and basil leaf. The four samples of the Methylobacterium isolate were taken to the Integrated Laboratory to be isolated and identified according to procedure [9]. Methylobacterium is then cultured in accordance with the procedure [11]. The ingredients of the fertilizer were dried and mashed, the composition of Pellet MOSS consisted of a mixture of duckweed (Lemna minor L.), cow manure, zeolite with a ratio of 1: 1: 1 and added 1: 2 tapioca starch composition ratio as pellet adhesive. Bio-organomineral fertilizers were mixed with Methylobacterium culture results then made in pellet form. Curly chili seeds are transferred in pots filled with sterile latosol soil (10 kg), each pot is planted as much as 1 chili seedlings. Pellet MOSS is applied to each pot according to the dosage treatment. Furthermore, observation of growth parameters and crop production every week for 5 weeks. Finished soil used for planting was analyzed to determine the level of fertility differences before and after given Pellet MOSS fertilizer. Parameters observed were germination, plant height, number of flowers per plant, number of productive branches, number of flowers, number of fruit and fruit production. The data obtained were analyzed by using variance analysis (ANOVA) and the data that had real effect were evaluated by Duncan's Multiple Range Test (DMRT) with 95% confidence level.

3. Result and discussions
Pellet MOSS and latosol soil media have been analyzed the nutrient content of N, P, K, C-organic and organic material (OM), the following are data obtained:

| Material   | Content (%) |
|------------|-------------|
|            | N  | P  | K  | C-Org | OM  |
| Pellet MOSS| 4.27 | 0.70 | 1.01 | 4.50 | 45.11 |

The results of nutrient content analysis showed that the nutrient content contained in MOSS pellets is well characterized by high levels of N, P, K, C-organic and OM. This condition may stimulate vegetative growth and generative of chili plants. This is in accordance with the opinion of [5] that the addition of organic fertilizer can enrich the OM and C-organic as a soil enhancer. The results showed that the content of N = 1.45%, P = 0.21, K = 1.18, C-Organ = 4.50, OM = 45.11. In accordance with the opinion of [1] explains that organic fertilizer with a mixture of natural minerals can enrich nutrient content and high organic matter in meeting the nutritional needs of soil and plants.
3.1. Soil fertility
The results of soil fertility showed N content on latosol soil that has been applied pellet MOSS were as follows:

![Figure 1. N content of soil after planting.](image)

Based on the graph of NIAL analysis of MOSS pellet, it was found that the highest N at treatment P5, P4 were 3.2% and 3.1% respectively. The content indicates that the higher the dosage of the pellet MOSS given the higher the N content on the soil that pellet MOSS was applied.

3.2. Growing Power (GP)
Based on the observation of chili pepper seed germination indicated that germination process progressed faster ie age 7 Day After Seeding (DAS) from 12 - 30 HSS on Pellet MOSS treatment. The observed plant germination parameters are presented in the following observation table (Table 2)

| Parameter      | Treatment |
|----------------|-----------|
|                | P0  | P1  | P2  | P3  | P4  | P5  |
| DB (%)         | 74  | 79  | 80  | 82  | 86  | 88  |

It shows more and more dosage of MOSS pellet given then the higher the germination power of the plant. The amount of germination is due to the bacteria Methylobacterium spp. In a MOSS pellet that can increase the vigor or germination of a seed. This is in accordance with [2] these bacteria produce growth hormone trans-zeatin cytokines and auxin of indole acetic acid (IAA), Those two bacteria stimulate seed germination, and plant development.

Table 3. F test values on observed parameters.

| Source of Variance | PH  | TI   | NPB  | TF   |
|--------------------|-----|------|------|------|
| Treatment          | 2.43* | 2.36* | 3.66* | 1.22* |

* = Significant; Ns = not significant

3.3. Plant Height (PH)
Based on the high growth chart of the 75 HST chilli plant shows that the more doses of MOSS pellets were given the higher the increase in plant height (Figure 2).
Figure 2. Charts of High Chill Plants at 75 DAP.

The best plant height was found in P5 dose, there is real difference between P0 and P4 and P5. Increased growth of pepper plants was not significant (P> 0.05). The best high growth can be obtained because of the high N content in lemna minor in MOSS pellet composition which is 6% [7] that can spur the vegetative growth of pepper plants so that the more optimal the dosage of MOSS pellet is given the higher the plant growth resulting from.

3.4. Number of Flowers (NF)
Based on the chart the number of flowers of chili plants at 75 DAP shows that the more dosage of MOSS pellets given the more the number of flowers produced. The parameters of the number of plant flowers observed are presented in the graph as follows (Figure 3).

Figure 3. Graph of Chili Plant Flower Amount 75 DAP.

Based on the result of data analysis, it is known that the highest amount of flower is found in dose P5, there was significantly difference between P0, P1 and P5. The use of MOSS pellets was an impact on the growth of generative pepper plants is not significant (P> 0.05). This is supported by research of [6] organic fertilizer with doses of 30 ton / ha produced yield of crop production from eggplant family of 13 ton / ha.
3.5. Number of Productive Branches (NPB)

Based on the graph the number of productive branches of chili plants 75 DAP indicates that the more dosage of MOSS pellets increase the number of productive branches. The parameters of the number of plant flowers observed are presented in the graph as follows (Figure 4).

![Figure 4. Number of Productive Branches of Chili Plants at 75 DAP.](image)

The result of the data analysis revealed that the largest number of branches was found in the dosage of P5, there was a significant difference between P0, P1, P2, P3 and P5. Use of MOSS pellets Impacted significantly on the production of chili (P <0.05). Indicates that the giving of organic fertilizer in the form of cow dung can give significant difference in the number of productive branches with the average number of branches as much as 82.88. Cattle manure can increase soil fertility so that it can improve the growth and yield of plants in the form of the number of productive branches. It is also supported by [4] treatment of cow manure significantly affect the number of branches at age 75 days.

3.6. Total of Fruits

Based on the graph the number of pepper plants of 75 DAP shows that the more dosage of MOSS pellets given the more number of fruit produced. The parameters of the number of plant flowers observed are presented in the graph as follows (Figure 5).

![Figure 5. Chili Plant Amount 75 DAP.](image)
The result of data analysis showed that the highest amount of fruit was found in dose P5, there was a significant difference between P0, P1 and P5. The use of MOSS pellets has resulted in a significant increase in pepper production (P <0.05). Better chili pepper production is found in P5 treatment, this is due to the high dosage of MOSS pellets providing sufficient nutrient availability for generative growth. This is supported by the opinion of [2] which states that organic fertilizer is the main source of macro nutrients such as N, P, K, Ca, Mg, and S as well as essential micro nutrients to enhance vegetative and generative growth of chili plants.

4. Conclusion
Based on the results of the research can be concluded that the application of MOSS pellet can improve soil fertility, germination, growth and production of chili. Pellet MOSS has the potential to be developed as a qualitative bio-organomineral fertilizer with a dose of fertilizer recommendation of 25 tons / ha.

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References
[1] Fadila R 2015 Response of IF8 and lantern varieties of rice to the application of organo mineral fertilizer and biofertilizer to incepticol Situgede, Bogor. J. Tropica. 1 55 – 74.
[2] Hayati E, T Mahmud, and R Fazil 2012 Effect of organic fertilizer and varieties on growth and yield of pepper plant (Capsicum annum L.). J. Floratek. 7 173 – 181.
[3] Kim K, W Ying, dan P Trivedi 2010 Synergistic effects of inoculating arbuscular mycorrhizal fungi and Methylobacterium oryzae in strains on growth and nutrient uptake of red pepper (Capsicum annum L.). J. Plant and Soil. 327(1) 429 – 440.
[4] Nopriani U, P D M H Karti, and I Prihantoro 2014 Productivity of duckweed (Lemna minor) as a forage alternative feed of livestock at different light intensities. JITV. 19(4) 272 – 286.
[5] Prasetya M E 2014 Effect of pearl NPK fertilizer and cow manure on growth and yield of red curly pepper varieties of Arimbi (Capsicum annum L.). J. AGRIFOR. 13(2) 191 – 199.
[6] Prihandini P W and T Purwanto 2007 Technical guidance of composting made from cow dung. Ministry of Agriculture: Center for Livestock Research and Development.
[7] Pujisiswanto H and D Pangaribuan 2007 Effect of dosage of cow manure on growth and production of tomato Lampung fruit. University of Lampung, 17 – 18 November 2008.
[8] Subhan N, Nurtika, and N Gunadi 2009 Tomato plant response to the use of compound fertilizer npk 15-15-15 on latosol soil in the dry season. J. Horticultur. 19(1) 40 – 48.
[9] Sukmadi R B 2013 The activity of fitohormone indole-3-acetic acid (IAA) from several isolates of rhizosphere and endophytic bacteria. J. Science and Technology. 14(3) 221 – 227.
[10] Suryanti T and Priyanto 2013 Elimination of Heavy Metal Cadmium In Wastewater Using Water Plants. J. Environmental Engineer. 4(3): 143 – 147.
[11] Wibowo R S 2011 Influence of Methylobacterium spp Applications. And Dose of N, P, K Fertilizer on Rice Plant Growth (Oryza sativa L.). Essay. Faculty of Agricultur. Bogor Agricultural Institute. Bogor.