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Different Compost Materials Used as Source of Organic Matter in Production of Chili Pepper

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ABSTRACT

Compost has been commonly used as the primary organic matter in organic plant production, especially in vegetable production. Different sources of compost materials give different medium structures and chemical characteristics. The objectives of this research were: 1) to evaluate the response of growth and yield of chili pepper to a rate of compost and source of animal waste which were used as compost; 2) to determine the optimum rate of fertilizer for the highest growth and yield of chili pepper. The research was carried out from November 2015 until March 2016. Compost material treatments consisted of cow dung, empty palm oil bunches, and mixed of vegetable residue and weeds. The compost rate treatments consisted of 0 ton ha^{-1}, 10 ton ha^{-1}, 20 ton ha^{-1}, and 30 ton ha^{-1}. No interaction between the two treatments was found to influence plant growth and yield variables. The type of compost materials affected plant height of 5, 6, and7 weeks after transplanting. Cow dung as a source of compost showed the best effect in increasing chili plant height. Plant height, the number of plant dichotomous, and plant canopy responded linearly to the increase of the compost rate. The usage of compost at 20 ton ha^{-1} and 30 ha^{-1} resulted in higher fruit length, the number of fruit, and fruit weight per plant.

INTRODUCTION

Chili is a potential horticultural crop in Indonesia due to the high consume various products and servings. In addition, the growing of population bring the impact on the higher demand on chilli. Researches on chilli then become important to support quantity as well as quality in sustainable and eco-friendly framework.

Researches on chilli especially those in Bengkulu area of Indonesia have been performed such as chilli genetic improvements (Ganefianti, 2000; Ganefianti and Fahrurrozi, 2018; Herison *et al*., 2014), and chilli production technologies (Handajaningsih *et al*., 2015). Most experiment aspects on production technology are related to the strategy in reducing input of synthetic fertilizers as well as synthetic pesticides. The usage of organic matters for agricultural practices can improve physical, chemical, and biological properties of the soil. The process of decomposition of organic materials in the soil needs the involvement of microbes such as bacterial activity, fungi, and other microorganisms. Increased activity of microorganisms present in the soil aims to increase the humus as the product of decomposition so that the roots of plants can obtain nutrients easily for the growth process. A research conducted by Nurahami *et al*. (2011) showed that organic fertilizer is

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effective to increase plant growth and yield of chili pepper.

Organic materials such as empty palm oil bunches, weed mix with vegetable waste and animal/livestock manure can be used as source of compost. Oil palm empty fruit bunch (EFB) contains essential nutrients for plants and can be applied to various crops as organic fertilizer. In 1 ton of oil palm empty bunches (EFB) contains nutrients equivalent to 3 kg Urea, 0.6 kg RP, 12 kg MOP, and 2 kg kliserit (PR PTPN XIII, 2008). Several beneficial EFB properties to support the growth of crops, include: (1) improve the structure of mild clay soil, (2) help the solubility of nutrients needed for plant growth, (3) homogeneous and reduce the risk of plant pests, (4) not easily washed by pervasive water in the soil and (5) can be applied in any season (Wardani, 2012).

According to Yuliarti (2009), organic materials from crop residues such as potatoes, carrots, eggplant, cabbage and mustard which have been decomposed or fermented can strengthen soil aggregate, increase water absorption, improve drainage and soil pores. Handajaningsih *et al.* (2015) studied 4 types of organic materials used as fertilizer in the cultivation of chili plants showed that the fertilizer derived from manure + the rest of the plants had an significant growth effect on the number of dichotomous branches and high dichotomous plants compared to other treatments. Nutrient content of organic waste consists of 0.09% nitrogen, 0.36% phosphorus and 0.81% potassium.

Manure is an organic fertilizer from the fermentation of solid and liquid (urine) of livestock. Besides containing macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), manure also contains micronutrients such as calcium (Ca), magnesium (Mg), and sulfur (S). In this research, cow manure was used as source of compost due to its high availability. The results of Jedeng's research (2011) showed that the types of fertilizer applied to sweet potato plant effected the number of plant leaves, fresh weight of plant bulbs, tuber fresh weight and dry weight. Research objectives are to evaluate the growth and yield response of chilli to different source of compost materials, and to find its optimal rate for growth and yield of chili.

MATERIALS AND METHODS

This research was conducted from November 2015 until March 2016. The study was conducted Bengkulu City, The altitude of the area was 10 m above sea level with flat topography , Ultisol type.

The study used Completely Randomized Design, set of two factors. The first factor was source of compost materials, consisting of Cow, Oil palm empty bunches, and Mixed of vegetable residues and weeds. The second factor was the dosage of compost, consisting of 0 ton ha^{-1}, 10 tons ha^{-1} or 400 g $polybag^{-1}$, 20 tons ha^{-1} or 800 g $polybag^{-1}$ and 30 tons ha^{-1} or 1200 g $polybag^{-1}$. Two plants were put in each combinations with 3 replications.

During the process of composting, the decomposition of materials was accelerated by EM4. The chili seedlings were raised in seed tray using mixed media consisted of topsoil, sand and rice husk (1: 1: 1). The 4 weeks old seedlings were transplanted in 30 cm x 40 cm polybags, one plant per polybag.

Fertilizer was incorporated 3 weeks after transplanting using Urea 12 g , TSP 8 g, and KCL 8 g each polybag. Weeds were controlled during the experiment. The presence ofpest and disease were eradicated chemically. Harvesting was done when the chili fruit showed 25%. or more red color. Harvesting was ended after one month period.

Growth and yield variables which were observed included plant height, the degree of leaf greenness, leaf, Leaf area, number of branches of the dichotomous, area of plant canopy, time of flowering time of harvest , number of fruit per plant, fruit weight , fruit length, fruit diameter (and fruit weight per-plant. The Data were analyzed statistically using analysis of variance. Polynomial Orthogonal was used to find the optimum dose of compost. Furthermore, the Least Significant Different was used to compare the means among the source of compost materials.

RESULTS AND DISCUSSION

The results of variance analysis showed that the dosage of organic matter influenced plant height of week 4, week 5, week 6, week 8, fruit length, number of dichotomous branches and plant canopy area. Organic doses do not affect plant height of week 1, week 2, week 3, week 9, greenish leaves, leaf area, flowering day, harvest day, fruit count, fruit weight per plant, fruit diameter and weight per fruit.

Provision of organic matter influenced the growth of plant height at week 5, week 6, and week 7. The result showed no interaction

between organic matter and natural matter dosage (Table 1).

Plant Response to the Dose of Compost

The pattern of the growth of plant height is shown on Figure 1-5. At week 1 to week 3 the dose of compost is not responded yet by the plant. Organic material is known to have slow release nutrients. Besides, at the beginning of the plant growth, nutrient is not a limiting factor. The effect of compost rate is clear after 4 weeks of the plant age. The compost rate of 30 tons ha^{-1} produced the highest plant, contrast to 0 compost which produce the lowest plant

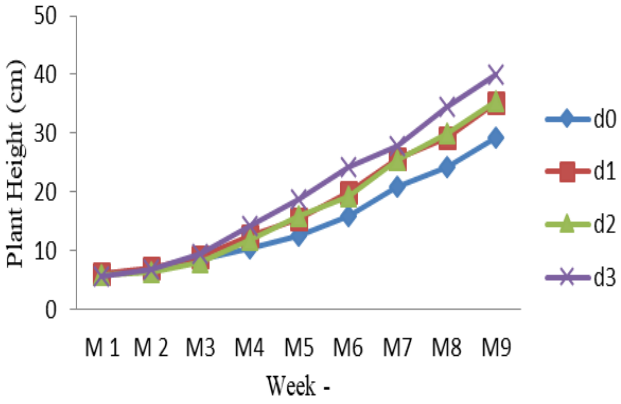

Figure 1. The respon of plant height to the dose of compost.

The results of the orthogonal polynomial test figured out that plant height responded linierly to the dosage of compost

The highest growth of plant 5 week after transplanting was at application of 30 tons ha^{-1} compost with height 13.84 cm, while the lowest plant was at 0 tons ha^{-1} which only reached 10,627 cm. In week 7, the highest growth of the plants was 34.17. Meanwhile, with no compost treatment (0 tons ha^{-1}) the height of plant only reached 24.69 cm. There was no difference among the compost rate to

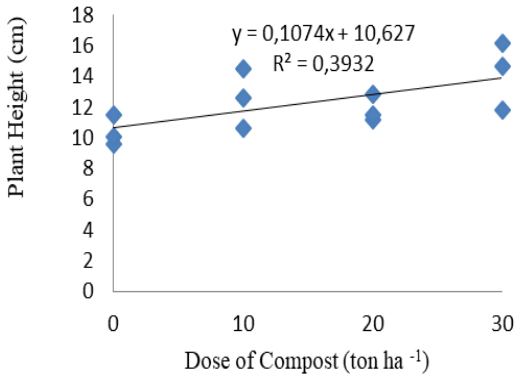

Figure 2. Plant height at week 4 at different rate of compost

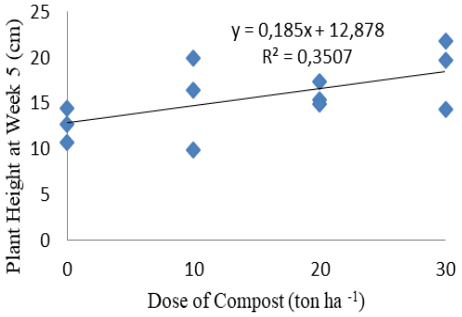

Figure 3. The respon of plant height at weet 5 to the dose of compost

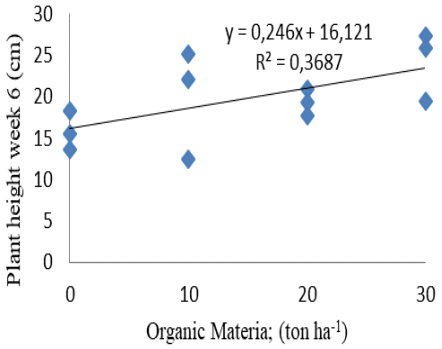

Figure 4. The respon of plant height at weet 6 to the dose of compost.

plant height at week 9, which indicated that plants reached the maximum height.

Andayani and Sarido (2013), stated that the growth of curly chili plants treated with organic fertilizer with a dose of 20 tons ha^{-1}

Table 1. Mean comparison of plant height at week-5, week-6, and week-7 according to LSD-test.

Compost Materials	Plant Height (cm)		
	Week - 5	Week -6	Week-7
Cowdung	17.91 a	22.93 a	28.79 a
Oil Palm Empty Fruit Buch	14.93 b	18.26 b	23.89 ab
Vegetable Residu and Weeds	14.10 b	18.22 b	22.12 b

Note: the numbers followed by the same letter in the same column are not significantly different from the BNT further test at the level of 5%, T.T = Height of Plant.

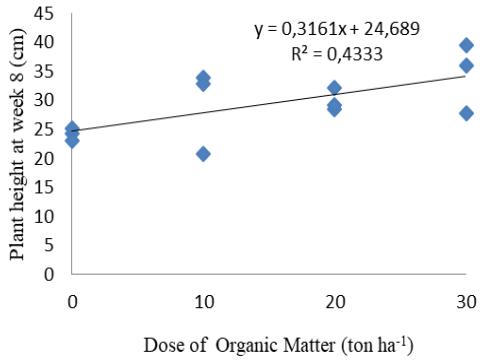

Figure 5. Response of plant height at week 8 to the dose of compost

gives the best effect to plant height of 30 dap, time to 80% flowering and time of the first harvest.

Similar to the trend of plant height, number of dichotomous and plant canopy area responded linierly to the rate application of compost (Fig.6 and Fig.7).

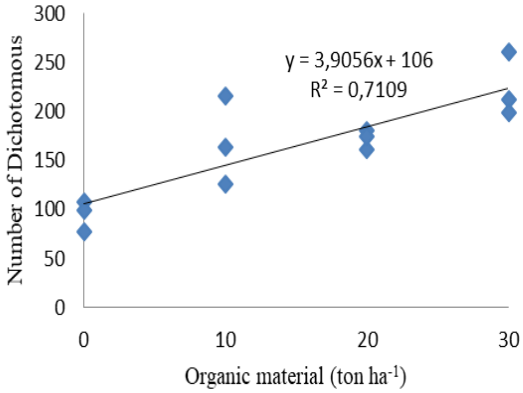

Figure 6. Number of dichotomous at different rate compost material

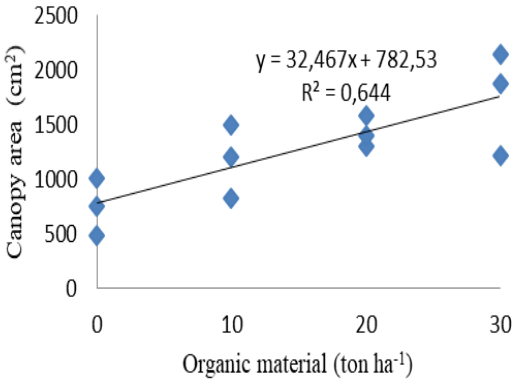

Figure 7. Relationship between canopy area and rate of organic matter.

The use of organic material can increase nitrogen supply because N is the most necessary macronutrient for the vegetative growth process. Figure 6 shows the most significant number of branches of the dichotomies is in the treatment of compost fertilizer with a dose of 30 tons ha^{-1}, the average number of branches of the dichotomous reaches 223,168 units and the lowest quantity of branches dichotomy in the treatment of 0 tons ha^{-1} with the average number of branches of the dichotomy reach 106 chapters. The result of Hasanudin (1996) study, stated that the availability of nutrients, water, soil physical properties, and environmental factors in the cultivation of plants significantly affect the growth and development of plants. The higher the nutrient content of N in organic fertilizer, the better the plant growth because of the N element for the chili plant serves as a cell constituent, assisting in the formation of proteins, enzymes, and metabolic processes. The number of branches of dichotomies in chili plants is suspected because it is influenced by plant height where the meristem shoot buddies are still actively splitting. This is following research Ganefianti (2000) which states the higher the chili plants will produce the number of branches of the dichotomous lot, and this relationship is positive because the increase of one variable will increase the growth of the other parts of the plant.

Figure 7 showed the increase of plant canopy area from treatment of 0 tons ha^{-1}, 10 tons, 20 tons ha^{-1} and 30 tons ha^{-1}. The highest increase in the canopy area was found in the treatment of dosage of organic material of 30 tons ha^{-1} with the crown area of 1756.54 cm^2. The extent of plant canopy is closely related to the number of branches and plant height where in this study the 3 variables observation gives the best growth response at dosage of organic material dose 30 ton ha^{-1}. The higher the plant will produce more branches of dichotomy that formed so influence broad plant canopy. The process of increasing the growth variable is related to the amount of organic material given, where the more organic materials are given the population of organisms will also increase. Microorganisms in the soil play a role in overhauling organic materials to form soil structures rich in organic matter, so that the nutritional needs for plant growth can be met. Organic fertilizers provide better availability of

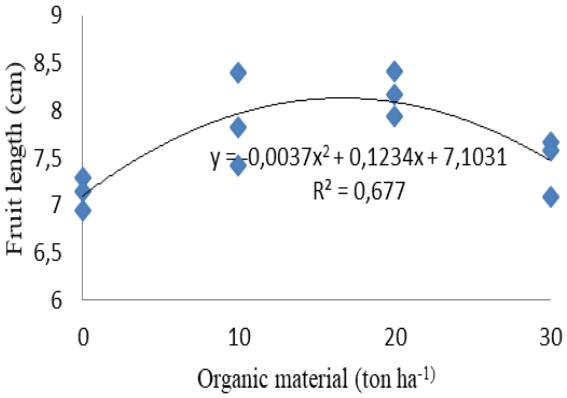

Figure 8. Fruit length at different rate of compost

nutrients compared to treatment with no fertilizer.

In Fig. 8, it can be seen that the highest fruit length found in the provision of compost at optimum dose of 16.68 tons ha^{-1} with an average fruit length of 8.90 cm. Treatment of dose 30 ton ha^{-1} did not give effect to the increase of chili fruit length, it is assumed that the amount of fruits produced at treatment of 30 ton ha^{-1} more than the treatment of 20 ton ha^{-1} with the average yield of 21.77 fruits and 10 tons/ha, number of fruit 18.72. Compost treatment 30 tons ha^{-1} yielded 22.88 fruits.

Plant Response to Different Source of Compost

This experiment proved that different source of materials of compost effect plant height. The treatment did not influence other growth and yield variables. Cow dung as raw material of compost resulted higher plant compared of the other two material sources (Table 1).

The slow growth of plant in this study is due to environmental conditions that are less supportive of the growth process. Environmental factors that affect the growth and the results of chili are rainfall, temperature, humidity, and duration of irradiation.

The greenness of leaf is closely related to the amount of chlorophyll. The higher the chlorophyll content contained in the leaves of the plant, then the process of photosynthesis in plants will be better. Edmond *et al*. (1964) state that the rapid rate of flowering is influenced by the intensity of daylight, daily temperature, and plant genotype. Number of fruits will affect plant production. Situmorang *et al*. (2013) state that the higher the number of fruits per plant, the higher the total fruit weight per plant will be. Fruit weight per plant is influenced by the number of fruits per plant, the weight of the fruit per plant and the fruit diameter. According to Leopold and Kriedemann (1973) that fruit size correlates with cell size in fruit, and it is in accordance with what Atherton and Harris (1986) say that the variables are also influenced by the photosynthetic supply of the source organs, The ongoing process of photosynthesis that produces fotosintat useful in the enlargement of the fruit.

CONCLUSIONS

Compost application at 30 tons ha^{-1} was able to increase plant growth, number of dichotomous branches, plant canopy and fruit length. The fruit length was the highest (8.90 cm) at 16,68 ton ha^{-1} of compost. Compost derived from cow manure can accelerate plant growth at week 5 and week 6 after transplanting, but gave no effect on plant yield.

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