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GROWTH AND YIELD OF ONION (Allium Cepa fa.ascolanicum) PHILIPINES VARIETY ON APPLICATIONS MYCORRHIZAL AND ORGANIC FERTILIZER IN THE LAND POST MERAPI ERUPTION

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Abstract

Research on agricultural land after the eruption of merapi aims to determine the impact of the effect of mycorrhizal and organic material to the growth and yield of onion. The experiment was conducted in greenhouse Department of Agriculture, Government of Municipality Magelang, with a factorial experiment arranged in a complete randomized block design, with two treatment factors and repeated three times. The first factor is the treatment of a mixture of organic material and mycorrhizal: cocopeat 20 t/ha+mycorrhizal (10 g/planting hole), husk charcoal 20 t/ha+mycorrhizal (10 g/planting hole) and peat 20 t/ha+mycorrhizal (10 g/planting hole). The second factor is the dose of silty soil consists of four levels: 0, 2.5, 5 and 7.5 t/ha (%). The results showed that the kind of organic material and mycorrhizal added on cocopeat, husk charcoal and peat has not been able to influence the number of leaves, number of tubers per hill, the dry weight of the top of the plant, the dry weight of the roots of plants, dried tubers per hill, and the crop growth rate, The addition of clay soil which increased 7.5% on a sand media merapi eruption is able to increase the dry weight of the top of the plant, and the crop growth rate.

Keywords*: Mycorrhizal, Merapi eruption, Silty soil, Yield, Organic fertilizer*

1. INTRODUCTION

The eruption of Mount Merapi in 2010 resulted in thousands of hectares of farmland were damaged and productivity has not returned to nor-mal. Land covered sand with different thickness turns the soil fertility decreased due to changes in the nature of the ground, both in physics, chemis-try and biology, so it needs to be specially treated to restore the fertility of the soil mixed with volcanic sand with a high sulfur (S) content (Sumiati and Gunawan 2007; Suprapto, *et al*., 2018).

The main thing that can be done by the farmer is to mix sand with the soil, followed by the addition of clay soil and organic matter, with the aim to improve the physical and chemical properties of the soil. Organic fertilizers have the advantage capable of improving the state of physics, chemistry, and biology in a soil. The use of organic fertilizer is applied independently in addition can also be applied together with myco-rrhizal. The addition of mycorrhizal in plant cultivation benefit is high. The use of mycorrhizal can improve crop production on the environment stress (Purnomo, 2008). The next issue that arises is selecting plants suitable for planting with soil conditions as mentioned above, which hopes to get results as soon as possible to support local farmers family.

Onion crop is shortlived (60 days), resistant to soil with a high S content such as sand. Element of S to the onion is very important, if the crop shortage resulting element S formed tubers smaller and less flavorful (Astiningrum, *et al*., 2017). Onion plants require soil loose, fertile with good drainage. Sandy soils have physical proper-ties that support the development of onion bulbs, so the onion can be used as an alternative to hasten activity farmers in obtaining post-disaster income. Research on agricultural land after the eruption of merapi was aimed to determine the effect of mycorrhizal and clay and organic materi-al to the yield of onion plants.

2. RESEARCH METHODS

The experiment was conducted in greenhouse Department of Agriculture, Govern-ment of Municipality Magelang, at the altitude of 370 m above sea level. Factorial experiment arranged in a complete randomized block design, with two treatment factors and repeated three times. The first factor is the

treatment of a mixture of organic material and mycorrhizal: B_1 cocopeat 20 t/ha+mycorrhizal (10 g/planting hole); B_2 husk charcoal 20 t/ha +mycorrhizal (10 g/planting hole); B_3 Peat 20 t/ ha +mycorrhizal (10 g/planting hole). The second factor is a dose of silty soil: T_0 0 t/ha (0%); T_1 2.5 t/ha (2.5%); T_2 5 t/ha (5%); and T_3 7.5 t/ha (7.5%).

Latosol soil taken from the land around the Universitas Tidar on the surface layer (0-25 cm) dried, crushed and screened with a 2 mm sieve. Cocopeat, husk charcoal, and peat dried to a moisture content of 10%. The planting medium is mixed according to treatment, inserted into a plastic tub as much as 20 kg. Mycorrhizal inoculum given at the time of planting onions by providing inoculum in the media as much as 10 g per plant, where the content of mycorrhizal as much as 10 spores/g of a mixture. Mycorrhizal used type of *Gigasfora margarita.*

Seeds (bulb) onions are ready for planting have healthy and dry. Select seeds that have two spring onions. Clean the outer skin of the tubers and roots dryness. Then, the end of the tuber is cut about one-fifth the length of tubers. Furthermore, make a hole in the media as high as tuber, then enter onion seedlings into the hole. One plastic box containing 6 bulbs.

Watering is done every day in the morning with appropriate watering volume capacity value squares. Stitching occur if there are seed plants that do not grow or grow but not normal, by moving the seed that has been prepared as a back-up, so the age of the plant remains the same. Maximum Stitching is done at 14 days after planting. Fertilization early use of SP-36 at a dose of 150 kg/ha, fertilizer aftershocks first performed at the age of 15 days after planting (DAP), in the form of NPK at a dose of 75 kg/ha and the subse-quent second was done at the plant was 30 DAP, such as NPK 75 kg/ha, Pest and disease control is done by spraying pesticides Benlate and Lannate if there are symptoms of an attack.

Harvesting is done when the plant's leaves begin to dry (over 80%), and the tubers have been hard on old plants 60 DAP. Observations included: number of leaves (leaf), number of leaves counted from perfect leaves at harvest. Number of bulbs per panicle (pieces), measure-ment of the number of tubers is done by counting the number of tubers after harvest. Tuber weight measurement is done by weighing the tubers harvested. The dry weight of the upper plant (g), the measurement of the dry weight of the plant top is done by weighing after crop oven at 70°C for 72 hours. The dry weight of the roots of plants (g), root dry weight measurements performed by weighing plant after plant roots oven at 70°C for 72 hours. Dried tubers per clump weight (g), tuber dry weight measurements performed by weighing tuber roots of the plant after the oven at 70°C for 72 hours. The crop growth rate (CGR) calculated based on total plant dry weight gain per unit area per unit time.

Data were analyzed by analysis of variance. If there is any real difference followed by least significant difference test at level 1% and 5% for organic materials and mycorrhizal species, orthogonal polynomials and test for a dose of silty soil.

3. RESULTS AND DISCUSSION

Measurement growth and yield para-meters are presented in Table 1. Treatment coco-peat + mycorrhizal provide the highest value to the number of leaves (24.33 leaf), the dry weight of the upper plant (1.27 g), root dry weight of plants (0.06 g), dried tubers per hill (1.45 g), crop growth rate (0.37 g/m^2/day) and relatively equal to the number of tubers per hill (8 pieces) compared to treatment cocopeat+mycorrhizal and peat +mycorrhizal. Soil treatment silty 7.5% gave top marks to the number of leaves (23.33 leaf), the dry weight of the upper plant (1.48 g), dry weight of plant roots (0.04 g), dried tubers per hill (1.52 g), the crop growth rate (0.41 g/m^2/day) and also a value equal to the number of tubers per hill (8 pieces) compared to treatment cocopeat +mycor-rhizal and peat+ mycorrhizal showed that the type of organic material and mycorrhizal responded relatively equal to the number of leaves, number of tubers per hill, the dry weight of the top of the plant, dried plant root, and tuber dry weight per hill. Also did not show an interaction between organic matter and soil mycorrhizal+silty soil on all parameters of observation. The formation of vegetative organs of leaves on the plant shallots faster make the plant more quickly assimilated, so as to provide food for growth which resulted in the absorption of sunlight also increase further so that assimilates resulting from the greater assimilation process. According to Gardner, *et al*. (1991) results from assimilation assimilates translocated to the plant parts both in vegetative and generative organs.

Table 1. Growth and yield parameters of onion.

Treatment	The number of leaves (leaf)	Tuber number per panicle (pieces)	The dry weight of the upper plant (g)	The dry weight of the roots of plants (g)	Dried tubers per clump weight (g)	The crop growth rate ($g/m^2/day$)
Organic material type:						
Cocopeat + mycorrhizal	20.75 a	8 a	1.08 a	0.03 a	1.42 a	0.34 a
Husk charcoal + mycorrhizal	24.33 a	8 a	1.27 a	0.06 a	1.45 a	0.37 a
Peat + mycorrhizal	20.66 a	8 a	1.20 a	0.04 a	1.42 a	0.36 a
Silty soil:						
Silty 0%	20.55 a	8 a	0.80 a	0.04 a	1.26 a	0.28 a
Silty 2.5%	23.24 a	8 a	1.16 b	0.04 a	1.51 a	0.36 b
Silty 5.0%	20.33 a	8 a	1.31 b	0.03 a	1.42 a	0.37 b
Silty 7.5%	23.33 a	8 a	1.48 b	0.04 a	1.52 a	0.41 b

Note: The figure followed by the same letter in the column are not significantly different at test level 5%.

Organic fertilizer as a provider of nutrients affect seedling growth, but it also mycorrhizal as an organic fertilizer solvent media. Nutrients contained in the fertilizer role in the development of root and stem meristem that cause growth to support the formation and growth of leaves. According to Jones (1979), elements which a role in stimulating the formation and development of plant parts (leaves, stems and roots) are elements of N, P, K and Ca. Furthermore, according to Smith and Read (1997) mycorrhizal symbiosis with plant roots and form hyphae so as to expand contact roots with soil and liberate nutrients bound to soil particles.

The addition of organic matter in the form of cocopeat, husk charcoal and peat duly responded mycorrhizal on the sand at the onion crop. It was also reported by Suprapto, *et al.* (2017) award kinds of organic matter both of cocopeat, husk charcoal and peat give the same value to the dry weight of onion. The physical properties of sand the important thing is structured loose, rough, loose, good drainage and aeration, easily process-sed and do not show pliancy and sticky and porous. Besides, water holding capacity and low aggregate stability because the organic matter and clay content is low, making it less profitable due to dry quickly.

Three types of organic materials that are added have the ability to withstand high water. Cocopeat to withstand water at up to 73%, thereby increasing the availability of water for crops. Husk charcoal is also easy to bind water and peat has a high water holding capacity. The three types of organic materials are perfectly suited added to the sandy soil after the eruption of merapi to the poor water holding capacity, so that the crop needs for water can be met. Another property remains good aeration and drainage. The condi-tion is very supportive of the roots to absorb water and nutrients dissolved in it, so it will be a good plant metabolic processes including plant growth and development. That which causes no effect on the growth and yield parameters of onion.

The addition of organic matter in addition aimed to improve the physical properties also to improve soil chemical properties of sand, among others, to increase the cation exchange capacity (CEC) and the supply of nutrients will increase the amount and type of nutrients are available and can be absorbed by plant roots. Cocopeat, husk charcoal and peat used in this study is a kind of organic matter derived from the remains of plants that require decomposition, so that when used yet completely decomposed. The result has not been able to increase the CEC and the supply of nutrients that can be used for plant growth in order to obtain growth and yield of onion samiliar.

Results of measurement parameters such as root dry weight and dry weight of the top of the plant showed that the addition of organic matter such as peat the highest weight (Table1). The research result Husin (1995), which inoculation onion plants with mycorrhizal shows dry weight heavier when without mycorrhizal. Murniati (2006) reported that onion is grown by mycorrhizal increases the weight of dried tubers. It has also supported research Historiawati, *et al*. (2015) stated peat generate the highest weight of

onion. Peat has the advantage of high water holding capacity in addition to a lot of containing lignin if obsolete in aerobic conditions will pro-duce phenolic acids. Phenolic acids are biological alemiorant against toxic elements in the soil and in the form of soil aggregates are also binding of cations in the soil, thereby improving plant root growth environment and the impact on growth and yield of onion.

Based on the results of weight measurement dried tubers obtained the highest value addition of organic material such as rice husk charcoal (Table 1). Husk charcoal is easy to bind water and a source of potassium for plants (Agoes, 1994; Historiawati, *et al*., 2015). Husk charcoal is a growing media that are easy to keep crumbs and structure of oxygen so that the plant roots will grow perfectly adequate if water and oxygen in the soil available (Suradal, 2014). Porous media mix is very good for the enlargement of the tubers. Husk charcoal also contains SiO_2 (52%), C (31%), K (0.3%), N (0.18%), F (0.08%), and Ca (0.14%). It also contains other elements such as Fe_2O_3, K_2O, MgO, CaO, MnO and Cu in small quantities as well as some types of organic matter. A high content of silicate advantageous for the plant as it becomes more resistant to pests and diseases (Anonim, 2008) so that the onion crop growth will be good, and the result is a tuber is also high. This decreases the weight of the dry bulb high shelf.

Dry weight is an indicator of accumulated product of photosynthesis plants nearly all the events experienced by these crops, which describes the growth of plants (Sitompul and Guritno, 1995). The high weight in the dry in the media mix husk showed that the absorption of water and nutrients as raw material for photo-synthesis and metabolism running smoothly so fotosintat generated is also high and stored in the generative organs in this case the bulb too much, it can be seen from the weight of tuber dry the tallest.

The organic material is added serve as a source and a sink as well as the substrate nutrient soil microorganism which in turn helps the soil aggregation, thus increasing the availability of water in the soil. If organic matter is added has the absorptive capacity and power savings against high water, will cause the media to be very humid. Cocopeat and peat power savings are so high that the water is very humid media. The condition is not good for the growth of roots and bulbs of onion, because onion is a plant that does not like moist soil.

Interest, organic matter is to improve soil chemical properties, which add nutrients, also improve soil physical properties such as soil retain moisture. Consideration of selection of the type of organic material based on the speed of deco-mposition and mineralization, so that the degree of synchronization of the tall plants. Then only a few nutrients that can be used to grow crops for nutrient availability does not coincide with the plants need (Hairiah, *et al*., 2002).

In Table 1, also indicated that the organic fertilizers+mycorrhizal showed no significant difference to crop growth rate (CGR). Showed Treatment B_1, B_2 and B_3 the same relative CGR 0.3 g/m^2/day, whether it cocopeat, husk charcoal and peat. The growth rate of plants is the accumulation of plant dry matter per unit time. Dried plant material is a picture of translocation of photosynthesis to all parts of the plant. According to Gardner *et al.* (1991) the rate of growth of plants during growth is never constant in a relatively short period of time, but always changing continuously with time due to the fluctuation of environmental change.

Crop growth rate different value due to the different organic fertilizer. Organic fertilizer because it can improve soil physical properties through increasing the buffering capacity of the water, the water content, aggregation, and aeration. Organic fertilizers can improve soil chemical properties, including increasing the availability of nutrients in the soil as nutrients N, P and K, as well as other elements, so that the nutrients needed by plants more available and photosynthesis will increase. Therefore, an increase in plant dry matter (Table 1).

This was in line with that proposed by Reynders and Vlassak (1979) that the vegetative growth of crops affected element N. element is required by plants for growth and development of plant cells and organs of plants. All these organs will grow and develop faster, especially the leaves. The leaves will grow wider so as to intercept the maximum sunlight for photosynthesis and further increase the rate of photosynthesis of plants. It was all very dependent on the supply of N and water in the soil.

Growth and yield observation are presented Table 1, indicate that the clay soil is relatively the same response to the number of leaves, number of tubers per hill, plant root dry weight, dry root weight per clump on onion crop. As for the top of the dry weight of plants, and plant growth rate showed no difference in the onion.

The addition of clay soil in the form of land latosol up to doses of 7.5% of the weight of the sand one hectare of land, affect the dry weight of the top of the plant (see Figure 1). More and more land added silty or clay soil the higher the percent dry weight were added to the top of the plants is increasing. A clay soil texture constituent particles are smaller in size, when added to the soil sand, will be among the sand fraction.

As a result, most of the macro pores will shrink into micro pores or number of micro pores that can hold water will be many more. So that the water resistance of the soil will increase.

The lower clay content then the media will be more dry, so the plant metabolic activity is concentrated to lengthen the roots to absorb water and nutrients dissolved. So long and large roots physically, so that high dry weight. Plant growth will be disturbed if the respiration of roots because aeration not smooth and most of the soil pores filled with water. The addition of clay will result in an increase in micro pores filled with water so that the media will be moist and oxygen content is reduced. This resulted in impaired root respiration that have an impact on the absorption of water and nutrients to be not optimal.

The addition of clay soil treatment dosages up to 7.5 t/ha (7.5%) affects the upper part of plant dry weight (Table 1), meaning that the provision of such clay is able to optimize the growth of the onion. Clay is added to contribute affect the physical properties of sandy soil. Clay fraction has a large surface area so that a relatively high water holding capacity (Hakim, *et al*., 1986).

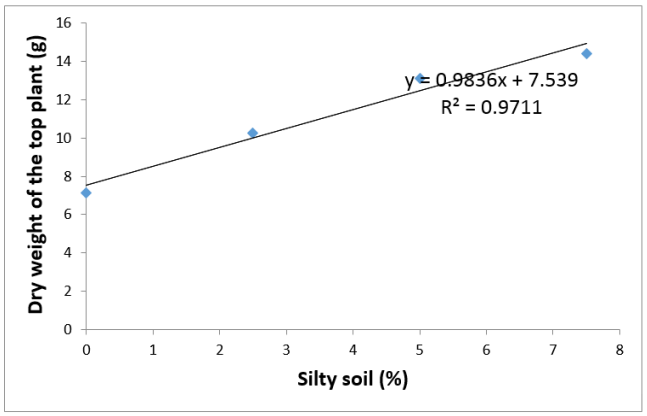

Figure 2. Effect of silty soil to dry weight of the top of the plant.

Silty soil were added to the dose of 7.5 t/ha in this study latosol land, this land which give rise to the top of the dry weight of the plant. Onion plants are best planted crops in dry areas with temperature rather hot and the soil that is easily percolation water, well aeration and does not tarnish. According to the structured nature sand soil loose, porous, coarse, crumbly, drainage and good aeration (Agoes, 1994). Further explained that the media porous sand very suitable for development of the tuber so that the weight of dried tubers should have obtained a high shelf. Because the nutrient content of sand and clay is low, yet able to meet the growth of onion bulbs that have not been able to increase crop yields both the number of tubers and tuber dry weight (Historiawati, *et al*., 2015).

These results are consistent with research Partoyo (2005) that the use of land in the form of clay on Samas beach sand has increased the quality of the soil. The use of clay and manure to the land of sand beach for 19, 11, 3 and control (0 years) yields varying soil quality index that is equal to 0.3533, 0.3234, 0.2868 and 0.1750. Granting that the longer soil ameliorant can improve soil quality. This was confirmed by Sukirno (2006) suggests the addition of clay soil can increase water holding capacity. The use of clay in the soil of sand can improve the number of micro pores, aggregation and soil structure (Kastono, 2007). Changes in soil structure affect the permeability and the ability to store and provide water. Application of soil ameliorant has increased the content of C-organic, pH, N, P, and K on beach sand (Kertonegoro, 2000).

The results showed that treatment to 7.5% silty soil significantly affected the crop growth rate (Table 1). The addition of higher silty soil will increase the rate of plant growth. Translo-cation to the tubers can be determined by the weight ratio of stover with weights, which is a measure of the proportion of the weight of biological translocated into crops. Onion harvest index, the higher the increase in silty soil until 0.41.

4. CONCLUSION

Based on the data that has been done can be concluded as follows: Kinds of organic material and mycorrhizal added on cocopeat, husk charcoal and peat has not been able to influence the number of leaves, number of tubers per hill, the top of the plant dry weight, dry weight of plant root, tuber dry weight per hill, and the crop growth rate. Thus, addition of clay soil which increased to 7.5% in sand media merapi eruption is able to increase the dry weight of the top of the plant, and the crop growth rate.

5. ACKNOWLEDGEMENT

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