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THE EFFECT OF VARIOUS RATES OF COW MANURE APPLICATION ON GROWTH AND YIELD OF MUSTARD (*BRASSICA JUNCEA* L.)

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ABSTRACT

The research was conducted in the village of Sidera, Subdistrict of Sigi Biromaru, District of Sigi, in May to June 2016. The research aims to find out the effect of various rates of cow manure on growth and yield of mustard.this research was arranged in a randomized block design (RBD) which consist of 5 rates ofcow manure are: 10 t ha^{-1}, 15 t ha^{-1}, 20 t ha^{-1}, 25 tha^{-1} and 30 t ha^{-1} , each treatment was repeated three times to obtain 15 units experiment. The results of this research showed that the application of cow manure significantly affected on growth and yield of mustard plants (plant height, number of leaves, fresh weight and dry weight of plant) and best rate of manure to mustard (Brassica juncea L.) can be achieved at the dose of 25 t ha^{-1}.

Keywords : Cow manure, Dose, Mustard.

INTRODUCTION

Mustard plant is a vegetable commodity that has potential value and has a prospect to be developed. In terms of climatological and economic social support, so it has the feasibility to be cultivated in Indonesia and this vegetable is a type of vegetables that are favored by all community groups. Demand for mustard plants always increases with increasing population and awareness of nutritional needs (Haryanto, et al., 2006).

Part of the mustard plant that has economic value is the leaf, hence efforts to increase production is performed on the increasing vegetative product, so to support the effort is performed a fertilization. The mustard plant requires sufficient nutrients and is available for growth and development to produce maximum production. One of the nutrients that plays a role in leaf growth is nitrogen. This nitrogen works to increase vegetative growth, so the plant leaves become wider, greener and more qualified (Wahyudi, 2010).

According to Sutanto (2002), inorganic fertilizer can increase the productivity of the soil in a short time, but will cause damage to the soil structure (soil becomes hard) and reduce the productivity of plants produced, while the soil is fixed with organic fertilizer has a good structure and soil with adequate organic materials that has greater water binding ability.

This organic fertilizer can come from manure or from industrial waste. Hendri (2014) stated, there is a close relationship between the provision of nutrients, in this case, manure or animal waste with water that also serves as a solvent of nutrients to be more easily absorbed by plants. Syekhfani (2000), explained that manure has natural and non-destructive property, provides macro and micronutrients, and the manure function is to increase water holding capacity, soil microbiology activities, cation exchange rate, and soil structure. Organic fertilizers that can be used in mustard plants are manure derived from cow manure, horse

manure, goat manure, chicken manure, compost, worm castings, and others.

Cow manure is also one of the organic fertilizers that can be used as a trigger to environmentally friendly plant growth, improve and maintain the productivity of agricultural land in the long term and the production of safe products for consumption.

The purpose of this study was to determine the effect of giving various doses of cow manure on the growth and yield of mustard plants. While the benefit of this study is to provide information to the public about the cultivation of mustard plants, especially about the use of cow manure so as to produce growth and maximum results.

RESEARCH METHODS

This research was conducted in Dusun Bolupontu, Jaya Sidera Village, Sigi Biromaru Sub-district, Sigi Regency. The crop analysis was conducted at the Seed Technology Laboratory of Agricultural Faculty of Tadulako University of Palu. The study took place from May 2016 to July 2016.

The tools used in this research were a shovel, bucket, tarpaulin, hoe, meter, water can, sprinkle, sickle, ruler, stationery, label paper, envelope, digital camera, analytical scale, leaf area meter and oven. The materials used were varieties of dakota and cow manure.

This study used Randomized Block Design with treatment that consisted of 10 ton/ha of cow manure, 15 ton/ha of cow manure, 20 ton/ha of cow manure, 25 ton/ha of cow manure and 30 ton/ha of cow manure.

Each treatment was replicated 3 (three) times and obtained 15 experimental units, so that there were 84 plant per plot, a total of 1,260 plants.

Research Implementation

Land Cultivation. First of all, the land was cleared of grass, wood and stone by using machete, sickle and bucket. Then the land was plowed by using tractor and hoe with the aim to return the land so that the land to be planted more loose, after that the land left for 7 days. After being left, the soil was plowed back until the soil became smooth and loose. The manufacture of plots with a hoe of 210 cm x 300 cm, height of 30 cm. The distance between fellow plots of 50cm which serves as a disposal or drain water channel when it rains.

Seeding. Seeding was performed two weeks before planting. The manufacture of plot with size of 2 m x 2 m. Seeding plot was watered until quite wet or damp then seed sown on the plot and closed using banana leaves. After 6 days, old seedlings were replaced with shade with paranet with of 40 cm shade height. Maintenance of seedlings during the seeding is the watering in the morning and afternoon which depends on the weather conditions. Weeding was performed by removing any weeds that grow. After the seeds were two weeks old, the seedlings were ready to be transferred to the planting area.

Manure Application. Fertilization was conducted one week before planting with the aim that the organic cow manure has been mixed with the soil by mixing the fertilizer with soil after processing the land before the mustard plant was removed. Fertilizer was given according to treatment, Fertilization on mustard plants was done once.

Planting. Planting was performed after the seeds were 2 weeks old or after the seedlings had 3 to 4 leaves and the depth of the hole 5 cm. Before the seedlings were planted, first the soil in each of the hollowing plots was perforated with the spacing of 30 cm x 25 cm. Then the seedlings were planted on the prepared hole of each seeds.

Maintenance. Maintenance was performed by keeping the soil moist by sprinkling for one hour per plot every day. Next weeding was performed when there were weeds that grow by pulling out. Planting was performed

at the age of three days after planting by replacing new plants if there were dead plants.

Harvesting. Harvesting was performed after the plant is 30 days after planting (DAP). Harvesting was performed in the morning by removing all parts of the plant.

Research Variable

Plant Height. Plant height was measured from the base of the plant to the highest end of the leaf. Measurement as performed on 5 plant samples in each treatment at the age of 15 days after planting (DAP) and in plants aged 25 days after planting.

Number of Leaves. The observation of the number of leaves was performed by counting the number of leaves that have been perfectly shaped from the 5 samples of the same plant with the measurement of plant height. Fertilization was performed when the plants were 15 and 25 days after planting.

Total Area of Leaf Per plant. Observation of total leaf area (cm^2) was performed on 2 samples of the same plant with the observation of dry weight with leaf area meter tool. Leaf area measurement was performed when the plants were 15 and 25 days after planting.

Dry Weight Total. Observation of dry weight of plants was performed on two plant samples per treatment by removing the two plants and then baked in the oven with temperature 80^0C for 2 x 24 hours or until the water state in a constant state, then weighed. Observation was made when the plants were 15 and 25 DAP.

Fresh Weight of Plants. The observation of the fresh weight of the plant ($ton.ha^{-1}$) was performed on a tile with an area of 100 cm x 80 cm so that there were 12 samples of mustard plants in each plot, by weighing mustard plant on each tile that had been cleaned by using scales then convert it into acres.

Data Analysis. The data results of this study were analyzed by using analysis of variance (anova) to know the effect of treatment on observation variable. If the treatment was significant or very real there would be done a further test with the honestly significant different test (HSD) at 5% level.

RESULTS AND DISCUSSIONS

Plant Height. The result of analysis of variance showed that the application of cow manure on 15 days after planting had a significant effect on the average of plant height, but on observation on 25 DAP had no significant effect. Average plant height is presented in Table 1.

Based on the result of 5% HSD test in Table 1 showed that the average height of 15 DAP plant on cow manure treatment with dose of 30 tons/ha was obtained the highest plant height of 21.80 cm, but not different with treatment 10, 20 and 25 ton /Ha. But different with the dose of 15 tons/ha.

The result of observation and variance analysis of cow manure dosage had significant effect on the height of mustard plant on 15 DAP although not significantly different on 25 DAP plant. Where the highest average plant height was obtained on the treatment of 30 tons/ha. This showed that the dose of 30 tons/ha fertilizer was able to supply nutrient needs especially N, P and K.

Table 1. Average plant height (cm) 15 DAP.

Manure dose	Dosis 15 DAP (Days after planting)
10 ton/ha	19.17^{ab}
15 ton/ha	17.37^{a}
20 ton/ha	19.80^{ab}
25 ton/ha	20.27^{ab}
30 ton/ha	21.80^{b}
HSD 5%	3.57

Information : The number followed by the same alphabet has no significant difference at the HSD level of 5%.

In accordance with Sompotan (2000) statement, the higher the dosage of organic material, the higher the concentration of N, P and K in the plant. All of these elements play a very important role in plant metabolism. The value of manure is not only determined by the content of nitrogen, phosphoric acid, and potassium but because it contains almost all macro and micro nutrients that plants need and play a role in maintaining the balance of nutrients in the soil.

Number of Leaves. The result of analysis of variance showed that the application of cow manure on 15 DAP had significant effect on the average number of leaves but on observation on 25 DAP had no significant effect. The average number of leaves is presented in Table 2.

Based on the result of 5% HSD test in Table 2 showed that the average number of leaves at the age of 15 DAP in the treatment of cow manure with the dose of 25 tons/ ha was obtained the highest number of leaves, that was 9.13 leaves and not different with the dose 20 and 30 tons/ha, but different from other doses.

Based on the analysis of variance showed that the treatment of cow manure dose gave a significant effect on the number of leaves at the age of 15 DAP. In manure dose of 25 tons/ha gave the highest growth of leaves number compared to other doses. This showed that manure dose of 25 tons/ha could supply nitrogen as the amount needed for growth and development of leaves number in the mustard plant because nitrogen nutrient is very important in plant vegetative growth such as plant height and the number of leaves of the mustard plant. This is in accordance with Mahrita (2003) statement that the higher the dose of fertilizer given, the nitrogen requirement by the plant is more fulfilled, where nitrogen is very important for the growth of plants that is for the formation and division of cells both in leaves, stems, and roots. Furthermore, Lingga and Marsono (2008) suggested that main role of N for plants is to stimulate overall growth, especially stems, branches, and leaves. In addition, N plays an important role in the formation of forage leaves that are very useful in the process of photosynthesis.

Total Area of Leaf Per plant. The results of analysis of variance showed that the application of cow manure on 15 DAP and 25 DAP significantly affected the average leaf area. The average leaf area is presented in Table 3.

Based on the result of 5% HSD test in Table 3 showed that the average leaf area on 15 DAP in the treatment of cow manure with dose of 25 tons/ha was obtained the largest leaf that was 528.47 cm^2, but not significantly different with treatment 10 and 20 tons/ha, while the average leaf area on 25 DAP in the treatment of cow manure with the dose of 15 tons/ha was obtained the largest lead of 1895.19 cm2 but not different with the dose of 25 tons/ha.

Table 2. Average number of leaves 15 DAP

Manure dose	Dosis 15 DAP (Days after planting)
10 ton/ha	7.73[a]
15 ton/ha	7.80[a]
20 ton/ha	7.87[ab]
25 ton/ha	9.13[b]
30 ton/ha	8.40[ab]
HSD 5%	1.26

Information : The number followed by the same alphabet has no significant difference at the HSD level of 5%.

Table 3. Average leaf area (cm^2) on 15 and 25 DAP

Manure dose	Age (days after planting)	
	15	25
10 ton/ha	513.17[b]	1297.45[a]
15 ton/ha	325.38[a]	1895.19[b]
20 ton/ha	463.75[b]	1214.23[a]
25 ton/ha	528.47[b]	1428.81[ab]
30 ton/ha	256.66[a]	1001.94[a]
HSD 5%	111.23	494.06

Information : The number followed by the same alphabet and column has no significant difference at the HSD level of 5%

Based on the analysis of variance showed that the treatment of cow manure dose gave very significant effect to leaf area at age 15 and 25 DAP. In manure dose of 25 tons/ha gave the highest growth of leaf area compared with other doses. This showed that manure dose of 25 tons/ha could supply nitrogen nutrient requirement in the process of growth and development of the mustard plant. Where the mustard plants response to the application of cow manure, this is because the mustard plant is one type of vegetable crops that the main crop is the leaves so that the growth of mustard plants must be met the supply of nutrients until the vegetative phase only. Nitrogen is the most important element in the growth of mustard plants because nitrogen is one of the essential nutrients. This is in line with the opinion of Lakitan (2008) that in the plant tissue, nitrogen is an essential nutrient element and the constituent elements of amino acids, proteins, and enzymes. In addition, nitrogen is also contained in chlorophyll, cytokinin and auxin hormones. Furthermore, Wijaya (2008) opinion that the nitrogen in plants will encourage the growth of organs related to photosynthesis, namely leaves. Sufficient plants which get nitrogen supply will form leaves that have wider leaves with higher chlorophyll content, so plants are able to produce enough carbohydrates to sustain their vegetative growth.

Furthermore, Sutedjo and Kartasapoetra, 1988, stated that if the need of nitrogen element is fulfilled, it can increase the plant growth. As it is known the nitrogen element in the plant serves to increase the growth of the leaves so that the leaves will be many in number and will be wide with a greener color that will increase protein levels in the plant body. With the increase in total leaf area will boost the process of photosynthesis which can eventually increase the production of plants.

The area of the leaf is closely related to the size of the photosynthate produced by plants from photosynthesis. The larger the photosynthate produced by plants the greater the photosynthate is transferred to the plant part. Mayadewi (2007) stated that plant leaf area is a factor that determines the amount of solar energy that can be absorbed by the leaves and will determine the amount of photosynthate result. With the provision of manure as an organic material, light can be utilized as efficiently as possible for the process of photosynthesis.

Dry Weight Total Per Plant. The result of analysis of variance showed that the application of cow manure on 15 DAP had a significant effect on the average total dry weight, while 25 DAP had a very significant effect on the average leaf area. Average total dry weight is presented in Table 4.

Based on the result of the 5% HSD test in Table 4 showed that the average total dry weight on 15 DAP in the treatment of cow manure at a dose of 25 tons/ha was obtained the highest total dry weight of 5.90 g/plant but it was not different from other treatments except the treatment with dose of 30 tons/ha, meanwhile total dry weight on 25 DAP in cow manure treatment with dose of 15 tons/ha got highest total dry weight of 27.57 g/plant but it was not different from other treatments except the treatment with dose of 10 tons/ha.

Table 4. Average total dry weight (g) on 15 and 25 DAP.

Manure dose	Age (days after planting)	
	15	25
10 ton/ha	4.69^{ab}	20.03^{a}
15 ton/ha	5.61^{b}	27.57^{b}
20 ton/ha	4.59^{ab}	26.06^{b}
25 ton/ha	5.90^{b}	25.66^{b}
30 ton/ha	3.38^{a}	22.67^{ab}
HSD 5%	1.89	5.26

Information : The number followed by the same alphabet and column has no significant difference at the HSD level of 5%

Based on the analysis of variance showed that the treatment of cow manure dose gave a very real effect on the average total dry weight. In manure dose of 25 tons/ha on 15 DAP was not different from 15 tons/ha on 25 DAP that gave the highest average total dry weight compared to other doses. This suggested that the process of photosynthesis was performed better /efficient due to the increased dry weight of plants, associated with the existence of better plant growth conditions for the ongoing activities of plant metabolism such as photosynthesis. This is in line with the opinion of Prayudyaningsih and Tikupadang (2008), dry weight is an indication of the success of plant growth, because dry weight is an indication of net photosynthetic results that can be precipitated after the water content is dried. Dry weight indicates the ability of plants to take nutrients from planting media to support its growth. Increased dry weight of plants associated with plant metabolism or the existence of better plant growth conditions for the ongoing activities of plant metabolism such as photosynthesis. Thus, the greater the dry weight indicates the process of photosynthesis is more efficient. The greater the dry weight, the more efficient process of photosynthesis that occurs and the productivity and development of tissue cells becomes higher and faster, so that the growth of plants to be better.

Table 5. Average fresh weight of plants (ton ha^{-1})

Manure dose	Average
10 ton/ha	47.99[a]
15 ton/ha	52.44[a]
20 ton/ha	51.25[a]
25 ton/ha	60.14[b]
30 ton/ha	51.55[a]
HSD 5%	7.53

Information : The number followed by the same alphabet has no significant difference at the HSD level of 5%.

Fresh Weight of Plants. The results of analysis of variance showed that the application of cow manure at various doses significantly affected the average of plant weight (ton ha^{-1}). The average plant weight (ton ha^{-1}) is presented in Table 5.

Based on the result of 5% HSD test in Table 5 showed that the average fresh weight in cow manure treatment with dose of 25 tons/ha was obtained the highest amount of fresh weight of plant was 60.14 ton ha^{-1} but it was not different from other treatments except the treatment with dose of 10 tons/ha.

Based on the analysis of variance showed that the treatment of cow manure dose gave a real effect on the average fresh weight of mustard plants. At manure dose of 25 tons/ha gave the highest average fresh weight yield. This indicated that the application of 25 tons/ha of manure was capable to fulfill nutrients for root crops to increase crop production and growth supporting elements so that it can produce well such as climate, soil, and biology. Simatupang (1997) stated that the high production of a variety caused by the variety is able to adapt to the environment.

CONCLUSION AND SUGGESTION

Conclusion

Based on the above description it can be concluded that the application of cow manure had a significant effect on the observation of plant height, the number of leaves, the fresh weight of the plant, the total leaf area and total dry weight of the plant and the dosage of 25 tons/ha of cow manure was the best for mustard plant result.

Suggestion

Based on the result of research, it is necessary to do further research on different place and planting season.

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