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The Effect of Tuber Size and the Addition of Organic Materials on the Growth and Yield of Garlic Plants (*Allium sativum* L.) Var. Lumbu Kuning

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ABSTRACT

Efforts to increase garlic productivity can be achieved through cultivation innovations, such as selecting the appropriate tuber size and incorporating organic matter. This study aimed to determine the optimal combination of tuber size and organic matter to increase garlic yield. The research was arranged using a Split-Plot Design (SPD) within a Randomized Block Design, with three replications. The main plots involved organic matter treatments: (1) no organic matter, (2) biochar (1 kg/m²), (3) biochar + manure (0.5 kg/m²:0.5 kg/m²), and (4) manure (1 kg/m²). The subplots consisted of tuber size categories: (1) small tubers (0.3-0.6 g), (2) medium tubers (0.7-1 g), and (3) large tubers (1.1-1.4 g). Results showed an interaction between large tuber sizes and the addition of manure, which produced the highest fresh bulb weight. Additionally, the combination of large tuber sizes with the addition of biochar and manure resulted in a high dry bulb weight.

1. INTRODUCTION

Garlic (*Allium sativum* L.) is a herb plant that has a high selling value because it has many benefits. In addition to being a spice, this commodity has health benefits, so it is useful as a medicine for various diseases. The demand for garlic in Indonesia increases every year along with the increasing population, but garlic production is still low. In 2022, Indonesia's garlic production reached 30,194 tons, down 33.04% compared to the previous year's production of 45,092 tons (Sarnita, 2023). The low productivity of Indonesian garlic is partly due to technical factors.

Technical factors such as seed selection, soil preparation, fertilization, and pest and disease control play an important role. Selection of unhealthy or poor quality seeds can reduce garlic productivity. Garlic is propagated through bulbs because it does not produce seeds. Innovation in garlic cultivation involves using the right bulb size to achieve optimal garlic yields. Different bulb sizes affect the available food reserves, which in turn affect vegetative growth and garlic production. Larger bulbs have a higher germination rate but require greater capital investment compared to smaller bulbs. Selecting the right bulb size as seed is key in cultivation practices to optimize garlic yields (Efendi *et al*., 2020).

Planting media plays an important role in garlic cultivation because garlic is propagated through bulbs. Planting media functions as a place for roots to grow so that plants remain upright. One way to increase plant productivity is to enrich the soil with organic matter. Organic matter helps maintain soil fertility by increasing the availability of nutrients. Several types of organic matter can be added to the soil, including biochar and manure. Research by Fallo Angelius & Lelang Maria Afnita (2016), stated that giving 15 tons/ha of manure to single clove garlic can also increase the percentage of dry bulb weight by up to 69.59% of the total bulb weight.

Biochar is a planting medium made from previously burned rice husks. According to Syawal *et al*. (2019) biochar is a mixture of planting media that can absorb water from natural materials and functions as a soil conditioner that can restore soil quality. Biochar functions as a gathering place and habitat for microorganisms, especially bacteria that are beneficial to plants (Berek & Neonbeni, 2018). Biochar can be used in combination with manure to bind nutrients provided by fertilizers and optimize fertilization efficiency (Herhandini *et al*., 2021). When biochar is added to the planting medium, the soil will have good drainage and aeration because rice husk charcoal is porous, thus affecting plant growth and productivity.

The use of manure is beneficial for plants because it can add microorganisms to the soil and increase the soil's ability to retain water. Manure derived from animal waste acts as an agent that improves soil structure, provides a source of macro and micro nutrients, and optimizes the soil's capacity to retain water (Ardy *et al*., 2022). In addition, manure releases nutrients slowly, according to soil needs (Herhandini *et al*., 2021).

Based on the description above, this study aims to determine the effect of tuber size and the addition of organic materials on the growth and yield of garlic Lumbu Kuning variety.

2. MATERIALS AND METHODS

This research was carried out on farmers land in Sajen Village, Pacet District, Mojokerto Regency. Geographically, Pacet District is located at an altitude of about 600 meters above sea level (masl). The research took place from January to May 2024. The materials used included Lumbu Kuning variety garlic seeds, chicken manure, biochar, analytical scales, calipers, measuring tape, stationery, alfaboards, straw mulch, SP-36 fertilizer, NPK Phonska plus (15:15:15), ZA, ZK, Atonik fertilizers, Matador insecticide, and Antracol 70 WP fungicide.

This study was structured using a Split-Plot Design (SPD) with three replications. The main plot involves the addition of organic materials (M) with 4 levels, including M0 (without organic matter), M1 (biochar 1 kg/m^2), M2 (biochar 0.5 kg/m^2 + manure 0.5 kg/m^2), and M3 (manure 1 kg/m^2). Tuber size (U) was the subplot with 3 levels, namely: U1 (small tubers 0.3-0.6 g), U2 (medium tubers 0.7-1.0 g) , and U3 (larger tubers 1.1-1.4 g). There are 12 combinations repeated 3 times, so that 12 main plots are obtained with a length of 3 m and a width of 1 m, so that there are 36 sub-plots sized 1 m x 1 m, with a distance between plots of 50 cm. Each sub-plot consists of 16 plant populations with 4 sample plants located in the middle. Garlic plants are harvested at 110 Days After Planting (DAP), followed by drying for one week before generative observations are carried out.

Parameters observed included plant height, measured from the ground surface to the highest point of the plant; number of leaves; leaf width at 84 Days After Planting (DAP); wet weight, determined by weighing the fresh weight of garlic shoots per plot; dry weight, determined by weighing the dry weight of garlic shoots per plot; bulb weight, measured by weighing the dry weight of each bulb; bulb weight per plot, measured by weighing the dry weight of bulbs per plot; bulb diameter; number of cloves; and clove weight. The analysis of the observed data was conducted statistically using linear model variance analysis. If a significant effect is found, the LSD (Least Significant Difference) test at 5% is used to identify the significant differences.

3. RESULTS AND DISCUSSION

3.1. Plant Height

The single factor treatment of bulb size and the addition of organic materials significantly affected the parameters of garlic plant height. The longest plant height was found in the large tuber treatment at the age of 21 - 63 DAP, while the shortest plant height was found in the small tuber treatment at the age of 21 - 63 DAP (Table 1). According to Surya *et al*. (2020), plants originating from small seeds tend to have lower plant heights due to the limited availability of nutrients contained in the seeds. Seed size is important for the strength of plant growth during the germination process, because seed size is generally correlated with food reserves and embryo size (Wahyudi, 2019).

The single factor treatment of organic matter addition significantly affected the height of garlic plants at the age of 14-21 DAP and 42-63 DAP, but had no significant effect at the age of 28-35 DAP (Table 1). This is because at that

phase garlic plants require more nitrogen nutrients in the form of inorganic fertilizers compared to complex nutrients that are slowly released by organic matter. The treatment of adding organic matter with biochar and manure, or the treatment of adding manure alone, did not show a significant difference in plant height and had a higher value compared to the treatment without organic matter and the addition of biochar alone (Table 1). The addition of manure to the soil will increase the content of macronutrients such as N, P, and K. In the vegetative growth phase, plants need nitrogen (N) especially for tissue formation. The average height of garlic plants in this study was relatively lower when compared to the description of Lumbu Kuning variety garlic provided by Balai Pengujian Standar Instrumen Tanaman Sayuran in 2023 which was 57 - 58 cm, while the garlic in this study was only 35 - 43 cm (Table 1).

Table 1. Average plant height impact of tuber size and addition of organic materials

Treatment	Plant Height (cm)							
	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP	49 DAP	56 DAP	63 DAP
Tuber Size (g)								
U1 (0.3 – 0.6 g)	8.67	11.80 a	17.68 a	21.44 a	25.06 a	30.18 a	33.38 a	35.59 a
U2 (0.7 – 1.0 g)	9.95	14.35 b	19.92 b	25.12 b	28.82 b	33.62 b	37.31 b	39.44 b
U3 (1.1 – 1.4 g)	10.08	15.54 b	22.28 c	28.21 c	32.66 c	37.48 c	40.64 c	42.55 c
LSD 5%	ns	1.75	1.64	1.80	1.91	2.29	2.70	2.05
Addition of Organic Materials								
Without organic matter	8.36 a	12.00 a	17.60	21.55	24.48 a	28.95 a	31.97 a	33.89 a
Biochar	8.50 a	12.27 a	18.44	23.40	27.04 ab	32.50 ab	36.18 ab	38.22 ab
Biochar + Manure	10.56 b	15.45 b	21.56	28.03	31.63 b	36.49 b	39.51 b	41.64 b
Manure	10.53 b	15.86 b	22.22	26.73	32.24 b	37. 10 b	40.77 b	43.03 b
LSD 5%	2.02	2.93	ns	ns	4.99	4.98	5.26	4.75

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test; ns: not significant.

3.2. Number of Leave

The single factor treatment of tuber size and the addition of organic materials significantly affected the number of leaves of garlic plants. The treatment of medium tubers with large tubers did not provide a significant variation in the number of leaves at the ages of 28 - 42 DAP and 63 DAP (Table 2). Wulandari *et al*. (2015) stated that heavy seeds tend to have superior germination power, and have more abundant food reserves than smaller seeds. The addition of organic materials significantly affected the number of leaves at the ages of 14, 28 and 35 DAP and had no significant effect at the ages of 21 and 42 - 63 DAP (Table 2).

Table 2. Average number of leaves impact of tuber size and addition of organic materials

Treatments	Number of Leave (strand)							
	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP	49 DAP	56 DAP	63 DAP
Tuber Size (g)								
0.3 – 0.6	0.46	1.60 a	2.29 a	2.77 a	3.25 a	4.04 a	3.94 a	5.40 a
0.7 – 1	0.65	1.73 ab	2.58 b	3.08 b	3.67 b	4.29 b	4.60 ab	5.83 b
1.1 – 1.4	0.58	1.83 b	2.67 b	3.23 b	3.73 b	4.52 c	4.94 b	5.96 b
LSD 5%	ns	0.16	0.28	0.25	0.17	0.17	0.76	0.21
Addition of Organic Materials								
Without Organic Matter	0.44 a	1.75	2.22 a	2.61 a	3.19	3.97	4.28	5.44
Biochar	0.28 a	1.53	2.25 a	2.86 b	3.47	4.25	4.64	5.69
Biochar + Manure	0.75 b	1.83	2.81 b	3.36 c	3.78	4.47	4.25	5.81
Manure	0.78 b	1.78	2.78 b	3.28 b	3.75	4.44	4.81	5.97
LSD 5%	0.28	ns	0.38	0.25	ns	ns	ns	ns

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test; ns: not significant.

The addition of organic materials can affect the number of leaves in the vegetative phase because all the nutrients contained in organic matter are used for chlorophyll formation, while in the generative phase, the nutrients in organic matter are allocated for tuber formation. Manure can increase soil fertility because it adds organic matter, nitrogen,

phosphorus, potassium, and micronutrients. Akerina *et al*. (2021) argue that one of the factors that can increase the number of leaves is the adequacy of nutrients in plants. The garlic plants in this study had fewer leaves, with only 4 to 5 strands (Table 2), compared to the 7 to 8 strands described for the Lumbu Kuning variety by the Balai Pengujian Standar Instrumen Tanaman Sayuran (2023).

3.3. Leaf width

The single factor treatments of tuber size and the addition of organic materials had a significant effect on the leaf width of garlic plants. The treatment of large tubers had the highest leaf width of 1.48 cm, while small tubers showed no significant difference compared to medium tubers (Table 3). Treatment with the addition of organic materials in the form of manure produced the longest leaf width of 1.49 cm, not significantly dissimilar from the biochar + manure treatment of 1.48 cm. On the other hand, the lowest leaf width was found in the treatment without organic matter, namely 1.22 cm (Table 3). According to Santika *et al*. (2022), the addition of manure to the planting medium can function as a source of nutrients, namely: Nutrients are one of the important factors that can support optimal growth and development of potato plants. The combination of biochar and manure will increase nutrient availability and improve soil structure, thus affecting the width of plant leaves. The width of the garlic plant leaves in this study was lower when compared to the description of the Lumbu Kuning variety of garlic provided by Balai Pengujian Standar Instrumen Tanaman Sayuran in 2023, which showed a leaf width of 1.8 cm, while the highest leaf width in this study was 1.49 cm (Table 3).

Table 3. Average leaf width impact of tuber size and addition of organic materials

Treatments	Leaf Width (cm)
Tuber Size (g)	
0.3 – 0.6	1.30 a
0.7 – 1	1.37 a
1.1 – 1.4	1.48 b
LSD 5%	0.08
Addition of Organic Materials	
Without Organic Matter	1.22 a
Biochar	1.33 ab
Biochar + Manure	1.48 b
Manure	1.49 b
LSD 5%	0.16

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test

3.4. Wet Weight

The combination of tuber size and the addition of organic materials had a significant effect on the wet weight parameter of garlic plants. The combination of tuber size and the addition of organic materials significantly affected the wet weight parameters of garlic plants. The highest wet weight was obtained in the combination treatment of large tubers and the addition of organic matter in the form of manure, which was 200.33 g and was not significantly dissimilar from the combination of large tubers and the addition of biochar + manure (Table 4). This is because larger and heavier seeds have larger food reserves and embryos compared to smaller seeds. When food reserves are limited,

Table 4. Average wet weight impact (g) of tuber size and addition of organic materials

Addition of Organic Materials	Tuber Size (g)		
	0.3 – 0.6	0.7 - 1	1.1 – 1.4
Without Organic Matter	112.00 a	106.33 a	150.33 b
Biochar	121.00 a	157.33 bc	169.33 c
Biochar + Manure	150.00 b	150.00 b	193.00 d
Manure	159.00 bc	143.00 b	200.33 d
LSD 5%		16.91	

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test

plant growth tends to be weaker. According to Surya *et al.* (2020), fresh plant weight is an indicator of plant growth biomass that reflects the results of plant growth involving biochemical processes ranging from cell formation to the development of plant tissues, organs, and body structures. Research by Hermanto *et al.* (2021), stated that the characteristics of fresh plant weight originating from large seeds showed the best results.

Manure also increases the number of soil microorganisms, helps plant roots absorb nutrients from the soil and use them for bulb growth. According to Astuti *et al.* (2022), the addition of manure increases the organic carbon content in the soil through the decomposition of animal waste, thus producing carbon compounds as the main component of organic matter.

3.5. Dry Weight

The combination treatment of tuber size and addition of organic materials has a significant effect on the dry weight parameters of garlic plants. The combination of tuber size treatment and the addition of organic materials significantly affected the dry weight parameters of garlic plants. The highest average dry weight was obtained in the combination treatment of large tubers with the addition of biochar + manure, which was 111.67 g, not significantly dissimilar from the combination of large tubers with the addition of manure, which was 110.33 g (Table 5) compared to medium and small tubers, large tubers generally have more abundant food reserves. The addition of organic materials such as biochar and manure can improve soil structure and function as soil conditioners (Iswidayani & Sulhaswardi, 2022). Biochar or rice husk charcoal plays a role in increasing soil porosity, while when combined with manure it can add nutrients and microorganisms to the soil. According to Kurniasih *et al.* (2022), the use of soil composition with rice husk charcoal and manure can increase the total dry weight of shallot plants by 3 grams. The increase in soil porosity due to the addition of biochar and manure can increase the total dry weight of shallot plants by 3 grams. The use of rice husk charcoal helps reduce root respiration and increases water availability in the soil.

Table 5. Average dry weight (g) impact of tuber size treatment and addition of organic materials

Addition of Organic Materials	Tuber Size (g)		
	0.3 – 0.6	**0.7 – 1**	**1.1 – 1.4**
Without Organic Matter	66.33 a	66.67 a	74.33 ab
Biochar	75.33 ab	84.67 b	87.67 b
Biochar + Manure	80.00 ab	85.33 b	111.67 c
Manure	87.33 b	83.33 b	110.33 c
LSD 5%		14.83	

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test

3.6. Bulb Weight

The single factor treatment of addition organic material has a significant effect on the bulb weight parameters of garlic plants. The single factors of tuber size and the addition of organic matter showed a significant effect on the weight of

Table 6. Average bulb weight/plot impact of tuber size treatment and addition of organic materials

Treatment	**Bulb Weight (g)**
Tuber Size (g)	
0.3 – 0.6	3.24 a
0.7 – 1	3.49 b
1.1 – 1.4	3.68 b
LSD 5%	0.22
Addition of Organic Materials	
Without Organic Matter	2.79 a
Biochar	3.42 b
Biochar + Manure	3.74 c
Manure	3.92 c
LSD 5%	0.30

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test.

garlic bulbs. The treatment of large tubers had the heaviest weight, namely 3.68 g, although it was not significantly dissimilar from medium tubers which weighed 3.49 g (Table 6). The highest average bulb weight occurred with the addition of manure, reaching 3.92 g, although it was not significantly dissimilar from the addition of biochar + manure, which was 2.74 g, while the lowest bulb weight was in the treatment without the addition of organic matter, which was 3.44 g (Table 6). This is in line with research Arifin *et al*. (2020), which found that the use of large tubers had a significant effect on the diameter and weight of garlic bulbs.

The application of manure to garlic plants can increase soil productivity because manure contains organic matter that plays a role in improving soil structure and increasing nutrient availability. According to Danial *et al*. (2020), the growth and development of plant roots, as well as the ability of roots to absorb nutrients are influenced by good soil structure and optimal soil aeration. High levels of nutrient absorption by plants can increase the photosynthesis process, which will ultimately increase bulb formation.

3.7. Bulb Weight/Plot

The single factors of tuber size and addition of organic material have a significant effect on the bulb weight/plot parameters of garlic plants. The highest average bulb weight/plot was obtained in large tubers, reaching 58.83 g, which was not significantly dissimilar from medium tubers, reaching 55.83 g, while the lowest average bulb weight/plot was obtained in small tubers, reaching 51.83 g (Table 7). According to Bumbungan *et al*. (2021), the larger the tubers used, the more leaves will grow, thereby increasing the total plant yield and the number of tubers per plant.

Table 7. Average bulb weight/plot impact of tuber size treatment and addition of organic material.

Treatment	Bulb Weight (g/plot)
Tuber Size (g)	
0.3 – 0.6	51.83 a
0.7 – 1	55.83 b
1.1 – 1.4	58.83 b
LSD 5%	3.54
Addition of Organic Materials	
Without Organic Matter	44.67 a
Biochar	54.78 b
Biochar + Manure	59.78 c
Manure	62.78 c
LSD 5%	4.78

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test

The single factor treatment of organic matter addition showed a significant effect on bulb weight/plot. The provision of manure functions to improve the physical, chemical, and biological properties of the soil and is more environmentally friendly (Jali *et al*., 2022). The highest average bulb weight/plot was obtained with the addition of manure, reaching 62.78 g, although it was not significantly dissimilar from the addition of biochar + manure, reaching 59.78 g, while the lowest average bulb weight/plot was in the treatment without organic matter, reaching 44.67 g (Table 7). The garlic harvest in this study was lower than the description of the Lumbu Kuning garlic variety released by Balai Pengujian Standar Instrumen Tanaman Sayuran in 2023, which was 6-8 tons/ hectare, while the garlic harvest in this study if converted was less than 1 ton/ha. This is because garlic planting is carried out during the rainy season, namely from January to May, which results in less than optimal plant growth and development.

3.8. Bulb Diameter

The single factor treatment of organic material addition has a significant effect on the bulb diameter parameters of garlic plants. The single factor of tuber size did not significantly affect the bulb diameter parameter, while the single factor of organic matter addition treatment showed a significant difference in bulb diameter (Table 8). The highest average bulb diameter was obtained in the manure treatment, reaching 26.17 mm, although it was not significantly

dissimilar from other treatments. The lowest average bulb diameter was found in the treatment without organic matter, which was 22.28 mm. Manure has the advantage of good water retention capacity, so that the higher proportion of manure compared to mineral materials allows more water to be stored in the soil (Sugianto & Jayanti, 2021). The diameter of the garlic bulbs in this study was lower than the description of the Lumbu Kuning garlic variety released by Balai Pengujian Standar Instrumen Tanaman Sayuran in 2023, which was 3 - 3.8 cm or 30 - 38 mm, while the diameter of the garlic in this study was only 22 - 26 mm (Table 8).

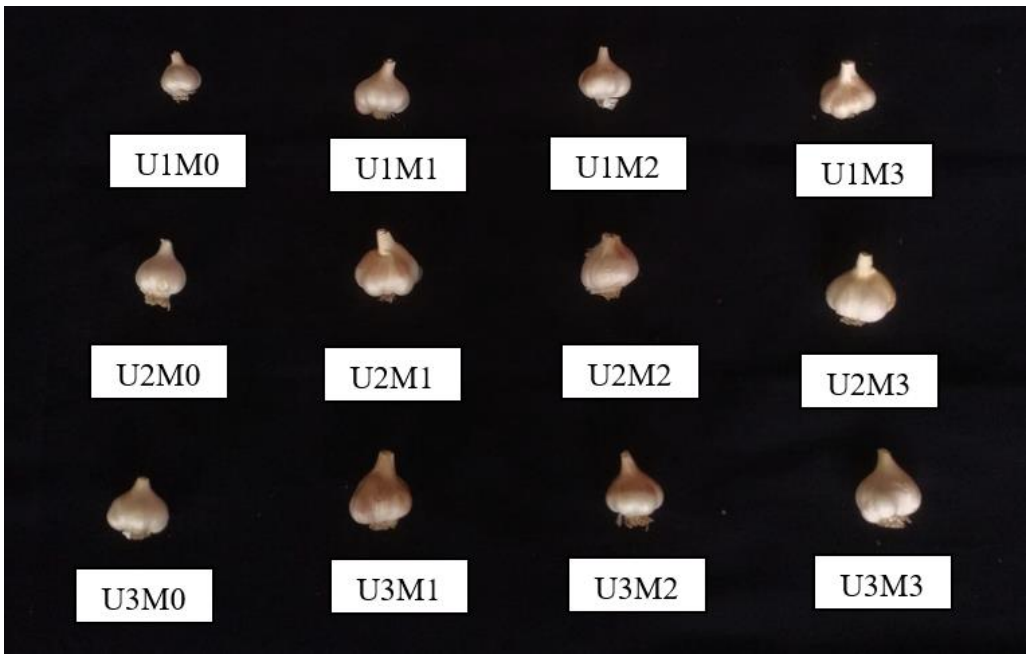

Figure 1. Garlic bulbs resulted from different treatments. [Tuber size: U1 (0.3–0.6 g); U2 (0.7–1 g); U3 (1.1–1.4 g). Organic Materials: M0 (Without OM); M1 (Biochar 1 kg/m^2); M2 (Biochar 0.5 kg/m^2; + Manure 0.5 kg/m^2); M3 (Manure (1 kg/m^2)]

Table 8. Average bulb diameter impact of tuber size treatment and addition of organic materials

Treatment	Bulb Diameter (mm)
Tuber Size (g)	
0.3 – 0.6	25.13
0.7 – 1	24.35
1.1 – 1.4	24.47
LSD 5%	ns
Addition of Organic Materials	
Without Organic Matter	22.82 a
Biochar	24.86 b
Biochar + Manure	24.75 b
Manure	26.17 b
LSD 5%	1.69

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test; ns: not significant.

3.9. Number of Clove

The single factor of tiber size had a significant effect on the number of cloves parameter in garlic plants. The highest average number of cloves was obtained in small tubers which was 7.17 cloves, while the lowest average number of cloves was found in large tubers which was 5.81 cloves, although it was not significantly dissimilar from medium tubers which was 6.21 cloves (Table 9). The difference in the number of clove produced by shallot plants is influenced by genetic diversity, even though the plants come from the same species (Azmi *et al*., 2011). The single factor

treatment of organic matter addition did not show a significant effect on the number of cloves of garlic plants. The number of garlic cloves in this study was lower than the description of the Lumbu Kuning garlic variety released by Balai Pengujian Standar Instrumen Tanaman Sayuran in 2023, which was 14 - 17 cloves, while the garlic yield in this study was only 5 - 7 cloves (Table 9).

Table 9. Average number of cloves impact of tuber size treatment and addition organic materials

Treatment	Number of Cloves
Tuber Size (g)	
0.3 – 0.6	7.17 b
0.7 – 1	6.21 a
1.1 – 1.4	5.50 a
LSD 5%	0.88
Addition of Organic Materials	
Without Organic Matter	5.81
Biochar	6.47
Biochar + Manure	6.28
Manure	6.61
LSD 5%	ns

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test; ns: not significant.

Table 10. Average Clove Weight Impact of Tuber Size Treatment and Addition of Organic Materials

Treatment	Clove Weight (g)
Tuber Size (g)	
0.3 – 0.6	0.62 a
0.7 – 1	0.80 b
1.1 – 1.4	0.89 b
LSD 5%	0.08
Addition of Organic Materials	
Without Organic Matter	0.67
Biochar	0.78
Biochar + Manure	0.76
Manure	0.86
LSD 5%	ns

Note: Numbers with the same letter in the same row and column represent no significant variation based on the 5% LSD test; ns: not significant.

3.10. Clove Weight

The single factor of tuber size had a significant effect on the weight of cloves parameter in garlic plants. Garlic plant bulbs consist of cloves which are the smallest part of the garlic bulb. The single factor treatment of tuber size showed a significant effect on the weight of cloves in garlic plants. The highest average clove weight was obtained in large tubers which was 0.89 g, although it was not significantly dissimilar from the medium tuber treatment which was 0.8 g. The lowest average clove weight was found in the small tuber treatment which was 0.62 g (Table 10). According to Yulianingtyas *et al*. (2015), larger seeds have more main chemical components stored as reserves compared to smaller seeds, so that larger seed sizes will achieve optimal growth conditions to obtain nutrients from the soil and absorb light for the photosynthesis process. The single factor treatment of organic matter addition did not show a significant effect on the weight of cloves in garlic plants.

4. CONCLUSION

The treatment of large tubers gave the best effect on the parameters of plant height aged 21 to 63 days after planting (DAP), number of leaves aged 21 to 63 DAP, leaf width, wet weight, dry weight, bulb weight/plot, and clove weight. The addition of organic matter in the form of manure showed a significant effect on plant height aged 14 to 21 DAP and 42 to 63 DAP, number of leaves aged 14 DAP, leaf width, wet weight, bulb weight, bulb weight/plot and bulb

diameter. The use of a combination of large tuber treatment with the addition of organic matter (manure) showed a significant effect on the wet weight parameter of garlic, while the treatment of large tubers (1.1 - 1.4 g) and the addition of biochar + manure gave a significant effect on the dry weight parameter.

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