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Effect of Application Liquid Organic Fertilizer of Fruit Waste Enriched by Organic Subtances to Shallot Yield

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ABSTRACT

Liquid organic fertilizer (LOF) made from fruit waste enriched by organic substances to increase macro nutrients, which are gamal leaves (for N source), banana stem (for P source) and coconut fiber (for K source) can be applied to organic farming systems. The purpose of this study was to determine the effect and to obtain the best concentration of LOF of fruit waste with and without N, P, K nutrient enhancing organic substances on the growth and yield of shallots. The research was carried out in May-November 2021 in Lasiana Village. The experiment used a Randomized Block Design, with 10 treatments which were LOF of fruit waste with and without N, P, K nutrient enhancing organic substances using a similar concentration (30, 35, 40, 45, and 50 ml/l water for these two types of LOF). Observation variables were: plant height, number of leaves, number and wet weight of tubers per clump. The results showed LOF of fruit waste with N, P, K nutrient enhancing organic substances had a better effect on all observed variables than LOF of fruit waste without N P, K nutrient enhancing organic substances. The best concentration was 45 ml/l of water from LOF of fruit waste that was with nutrients enhancing organic substances N, P, and K which resulted in a plant height of 31.43 cm (6 weeks after planting.); number of leaves 40.25 strands (6 weeks after planting); the number of tubers per clump (11.83 bulbs); and tuber wet weight per clump (28.80 g).

Key words: *Liquid organic fertilizer of fruit waste, N, P, and K nutrient enhancing organic substances, growth and yield of shallots*

Introduction

In 1969, the Indonesian government launched the "Green Revolution" through the intensification of the use of inorganic fertilizer and pesticides. The program has succeeded in overcoming food insecurity, from a rice importer to a country that can meet its own food needs. However, another impact on the environment is damaged by the intensive use of inorganic fertilizer and pesticides for a long time. In the late 1980, soil productivity decreased, namely compacted, easily eroded, polluted, and reduced population and diversity of microorganisms, due to the use of chemical fertilizer and pesticides (Sutanto, 2002). Other impacts are pest explosions, damaged ecosystem balance, inorganic fertilizer, and pesticide residues in soil and agricultural products (Veloso, 2007).

These negative impacts encourage the application of environmentally friendly agriculture. In Indonesia, the application of environmental agriculture (Sutanto, 2002).

Organic fertilizer is an important factor in environmentally friendly agriculture, so it is important to use organic waste such as fruit waste as organic fertilizer. Organic fertilizer has a positive impact on the fertility of the growing medium. However, the nutrient content in organic fertilizers is low, therefore nutrient-enhancing materials, especially macronutrients, such as gamal leaves (a source of N

nutrients), banana stems (a source of P nutrients) and coconut husks (a source of K nutrients) are added. The research by Walunguru and Mone (2019) regarding the liquid organic fertilizer quality of fruit waste (Table 1) informed us that the nutrient content, especially macro, was increased due to the addition of gamal leaves, banana stems, and coconut husks.

Nutrient enhancing materials given are expected to have a more favorable impact on plant growth. For this reason, tests were carried out on leaf vegetables (mustard greens) and fruit vegetables (tomatoes). Tests on mustard plants with the same concentration of 35 ml/l water, liquid organic fertilizer from fruit waste with nutrient-enhancing ingredients had a better effect on average height (43 cm), the number of leaves (13.93 leaves wet weight (381.08 g), and dry weight (27.10 g) (Walunguru and Mone, 2019). Tests on tomato plants with the same concentration of 40 ml/l water, fruit waste liquid organic fertilizer with nutrient-enhancing ingredients had a better effect on average height (95.44 cm), number of fruit (31.31 fruits) and fruit weight (2535.25 g) (Walunguru and Mone, 2020).

Further research still needs to be done to get more and more varied results regarding liquid organic fertilizer from fruit waste with nutrient-enhancing ingredients, including testing on root vegetables such as shallots.

Materials and Method

The research has been carried out in Lasiana Village, Kupang city from May-November 2021. Tools and materials are machetes, knives, blenders, buckets, stirrers, decomposers, filters, digital scales, jerry cans, measuring cups, shovels, watering cans, and rulers. The ingredients are fruit waste (papaya, apple, pineapple, kapok banana), water, sugar, effective microorganisms (EM4), gamal leaves, banana stems, coconut fiber, 30 cm diameter polybag, and shallot seeds of local cultivar Sabu Raijua (shelf life ± 2 months, diameter 1.5-1.8 cm, weight ±10 g).

Study Method

The experiment used a Randomized Block Design, with 10 treatments which were liquid organic fertilizer with and without N, P, K nutrient enhancing organic substances using a similar concentration (30, 35, 40, 45, and 50 ml/l water for these two types of LOF) (Supriyanti, 2017; Walunguru and Mone, 2020). The research data were analyzed using variance (ANOVA), if the treatments were significantly different, then it was continued with the Tukey Honestly Significant Difference at 5% f trust level.

Liquid organic fertilizer was made using the method of Alamtani (2015). The LOF was then analyzed for its chemical properties. Applications of LOF based on concentration treatments and plants were given 250 ml each time. Plant height and number of leaves were measured at 2, 4, and 6 weeks after planting. The number and fresh tuber weight were measured after harvesting.

Results

Chemical Properties of LOF of Fruit Waste

Liquid organic fertilizer with and without N, P, K

Table 1. Some Chemical Properties of LOF

LOF	C-Org (%)	pH	Macro nutrient				
			N	ppm			
			(%)	P	K	Ca	Mg
Without N, P, K nutrient enhancing organic substances	16.35	3,6	1, 18	284.9	129.1	176.7	139.21
			Micro nutrient (ppm)				
			Fe	Cu	Mn		Zn
			7.38	0.14	0.18		1.21
With N, P, K nutrient enhancing organic substances	17.55	4.18	Macro nutrient				
			N	ppm			
			(%)	P	K	Ca	Mg
			1.24	321.7	139.3	294.1	139.33
			Micro nutrient (ppm)				
			Fe	Cu	Mn		Zn
			8.92	0.19	0.20		1.83

Walunguru and Mone, 2019

nutrient enhancing organic substances were analyzed for several chemical properties. Nutrient enhancing organic substances (gamal leaves, banana stems, and coconut fiber) which are added as liquid organic fertilizer ingredients will contribute to organic matter, which can be seen from the increase in C-organic content by 0.03%. Higher C-organic has a better effect on soil fertility because it contributes more food sources for organisms, contributes organic colloids which will increase the cation exchange capacity (CEC) value, and adds minerals that will break down into nutrients.

Plant Height

The results of the analysis of variance informed that the administration of several concentrations of LOF of fruit waste without and with N, P, K nutrient enhancing organic substances did not affect the average plant height of shallots at the age of 2 weeks after planting, but had a very significant effect weeks at the age of 4 and 6 weeks after planting. The average plant height due to the application of different concentrations of LOF of fruit waste without N, P, K nutrient enhancing organic substances is shown in Figure 1.

Table 2. Some Chemical Properties of LOF from Fruit Waste

LOF Without N, P, K Nutrient Enhancing Organic Substances								
Concentration	C-Org	pH	Macro nutrient					
	14.0%	3.51	N	P	K	Ca	Mg	S
			(%)			(ppm)		
			1.13	0.068	2288	177.22	139.59	602.43
			Micronutrient (ppm)					
			Fe		Cu		Mn	Zn
			43.89		14.68		9.23	2.02
LOF With N, P, K Nutrient Enhancing Organic Substances								
Concentration	C-Org	pH	Micro nutrient					
	15.6%	3.52	N	P	K	Ca	Mg	S
			(%)			(ppm)		
			1.16	0.089	2465	247.92	155.98	4490.84
			Micronutrient (ppm)					
			Fe		Cu		Mn	Zn
			16.79		0.39		11.47	2.17

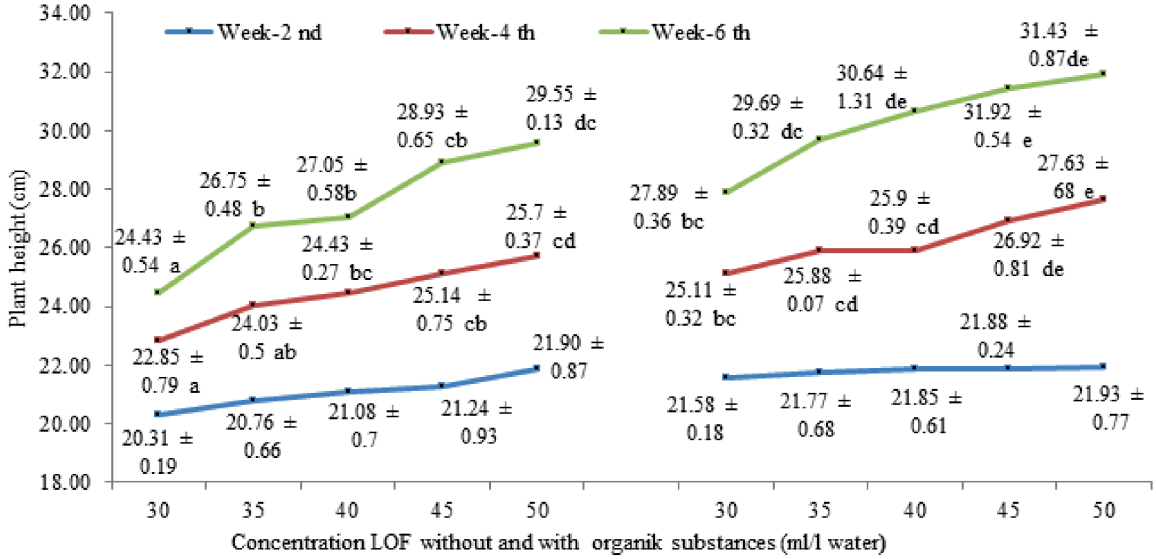

Fig. 1. The Average Plant Height of Shallots at 2, 4, and 6 Weeks After Planting Due to The Administration of LOF Without and With N P, K Nutrient Enhancing Organic Substance

Liquid organic fertilizer is that of fruit waste with N, P, K nutrient enhancing organic substances at a concentration of 50 ml/l of water addedto the growing media at 4 weeks after planting observations resulted in the highest plant average of 27.63 cm, which was not significantly different from the concentration of 45 ml/l water (26.92 cm), but significantly higher than the other concentrations of LOF of fruit waste without and with N, P, K nutrient enhancing organic substances. Likewise, at the age of 6 weeks after planting, the concentration of 50 ml/l water given to the growing medium produced the highest plant average of 31.92 cm, which was not significantly different from the concentration of 45 ml/l of water, namely 31.43 cm, and 40 ml/l (30.64 cm), but significantly higher than the other concentrations of LOF of fruit waste with and without N, P, K nutrient enhancing organic substances.

Number of leaves

Liquid organic fertilizer of fruit waste with and without N, P, K nutrient enhancing organic substances did not affect the average number of shallot leaves at the age of 2 weeks after planting, but had a very significant effect at the age of 4 and 6 given organic materials that increase nutrients N, P, and K (Figure 2).

Figure 2 shows that at all the same concentrations, the administration of LOF of fruit waste was not given a boosting agent. Nutrients N, P, and K in the growing medium produced a smaller average number of leaves, which ranged from 22.25-37.25 strands, compared to LOF of fruit waste with N, P, K nutrient enhancing organic substances, which ranged from 23.33 -42.00 pieces. The addition of organic materials that increase nutrients N, P, and K affects the chemical properties of liquid organic fertilizers where C-organic, cation exchange capacity (CEC), and especially macronutrients (N, P, K, Ca, Mg, and S) to be higher (Table 2), causing more energy is available for metabolic processes so that leaves that are more new are formed.

Planting media that was given LOF of fruit waste without and with N, P, K nutrient enhancing organic substances at all concentrations did not affect the number of leaves of shallot plants at the age of 2 weeks after planting. This is because the plant roots just starting to develop limit the absorption of nutrients and the plant growth phase is not yet active weeks, although there are more nutrients available in the planting medium, the LOF of fruit waste with N, P, K nutrient enhancing organic substances has not had an impact on the number of leaves 2 weeks after planting.

Liquid organic fertilizer of fruit waste with N, P, K nutrient enhancing organic substances at a concentration of 50 ml/l of water added to the planting medium 4 week after planting. Observations produced an average number of leaves, namely 33.42 strands, which was not significantly different with a concentration of 45 ml/l water (32.58 strands) and 40 ml/l water (31.42 strands), but significantly

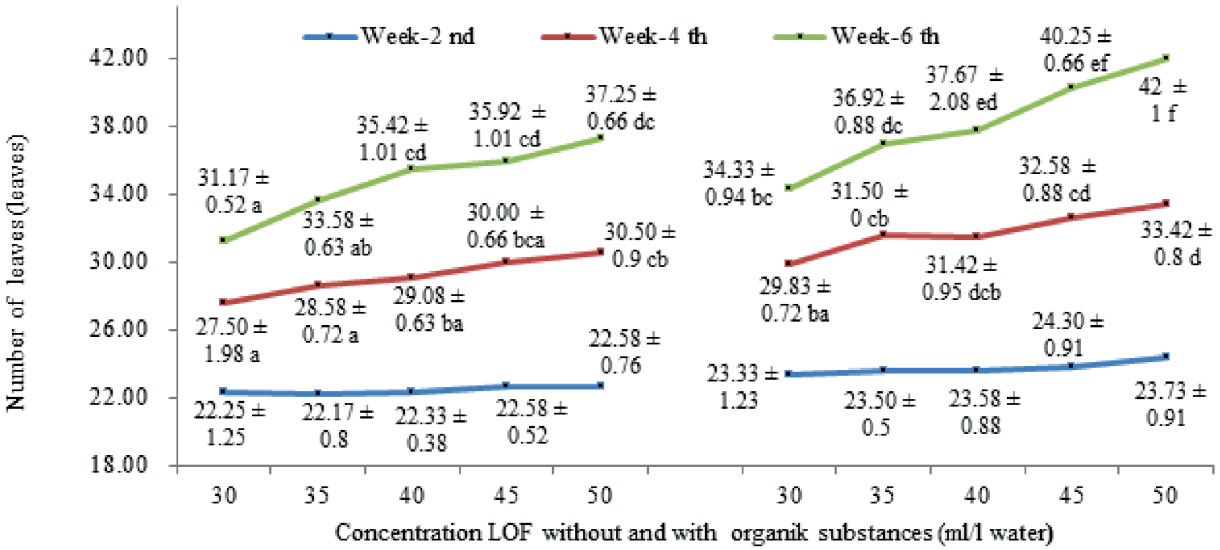

Fig. 2. Average Number of Leaves of Shallots at 2, 4, and 6 Weeks after Planting Due to the Administration of LOF Without and with N P, K Nutrient Enhancing

higher than the other concentrations of LOF of fruit waste without and with N, P, K nutrient enhancing organic substances. Observations 6 weeks after planting, a concentration of 50 ml/l of water given to the growing medium resulted in the highest average number of leaves, namely 42 strands, which were not significantly different from a concentration of 45 ml/l of water (40.25 strands), but significantly more than other concentrations from LOF of fruit waste without and with N, P, K nutrient enhancing organic substances.

Number of Tubers

The results of the analysis of variance inform that the administration of several concentrations of LOF of fruit waste without and with N, P, K nutrient enhancing organic substances. Organic nutrients increasing N, P, and K had a very significant effect on the average number of tubers per clump. The average number of tubers per clump was due to the application of several concentrations of LOF of fruit waste without N, P, K nutrient enhancing organic substances is shown in Figure 3.

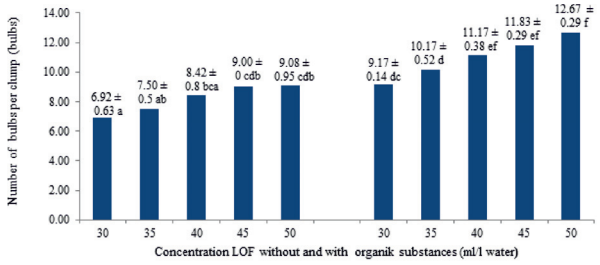

Fig. 3. Average Number of Bulbs per Clump of Shallots Due to the Administration of LOF of Fruit Waste Without and with N, P, K Nutrient Enhancing Organic Substances

Liquid organic fertilizer from fruit waste of fruit waste with N, P, K nutrient enhancing organic substances at all concentrations produced an average number of tubers per clump (9.17-12.67 bulbs) than the LOF of fruit waste without N, P, K nutrient enhancing organic substances (6.92-9.08 tubers). Crop yields are closely related to plant growth, if plant growth is better, better results can be obtained and vice versa. Planting media that was given LOF of fruit waste with N, P, K nutrient enhancing organic substances at the age of 4 and 6 weeks after planting.

Bulb Weight

The results of the analysis of variance inform that the administration of several concentrations of liquid organic fertilizer in fruit waste that is not and given organic materials Nutrient enhancers N, P, and K had a very significant effect on the average wet weight of tubers per clump. The average wet weight per clump due to the application of several concentrations of liquid organic fertilizer in fruit waste that was not treated with organic matter enhancing nutrients N, P, and K is shown in Figure 4. The wet weight of bulbs per clump produced by growing media in liquid organic fertilizer of fruit waste treated with Nutrient-enhancing organic matter N, P, and K at all concentrations resulted in an average wet weight of tubers per clump that was heavier (24.37-31.94 g) than the liquid organic fertilizer of fruit waste that was not given nutrient-enhancing materials (20.72-26.31).

Liquid organic fertilizer from fruit waste of fruit waste with N, P, K nutrient enhancing organic substances at all concentrations produced an average number of tubers per clump (9.17-12.67 bulbs) than the LOF of fruit waste without N, P, K nutrient enhancing organic substances (6.92-9.08 tubers). Crop yields are closely related to plant growth. If plant growth is better, better results can be obtained and vice versa. Planting media that was given LOF of fruit waste with N, P, K nutrient enhancing organic substances at the age of 4 and 6 weeks after planting.

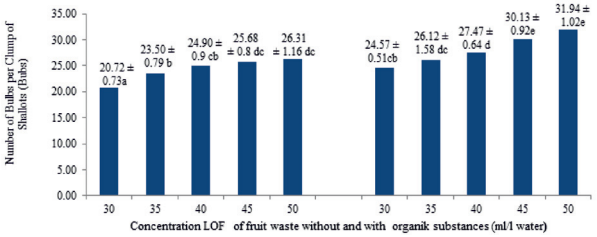

Fig. 4. Average Wet Weight of Bulbs per Clump of Shallots Due to the Administration of LOF of Fruit Waste without and with N, P, K Nutrient Enhancing Organic Substances

Discussion

Chemical Properties of LOF

The pH value of LOF without N, P, K nutrient enhancing organic substances was 3.51, smaller than 0.01 compared to LOF with N, P, K nutrient enhancing organic substances. Nutrients influence increasing pH Ca and Mg because they will donate OH-. The addition of nutrient-enhancing materials was able to increase the levels of Ca by 39.89% (70 ppm) and Mg by 11.74% (16.39 ppm) from LOF.

Macronutrients are nutrients that plants need in large quantities, usually > 500 ppm. Macro nutrients are carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphate (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S). Liquid organic fertilizer of fruit waste that was given nutrient enhancing ingredients N, P, and K had a total N content of 1.16% higher than 0.03%, total P 0.089% higher than 0.021%, total K was 2.465 me/100 g higher 177 me/100 g, the total Ca was 247.92 me/100 g higher at 70.7 me/100 g, and the total Mg was 155.98 me/100 g higher 16.39 me/100 g, and the total S was 4,490.84 me/100 g higher 3,888.41 me/100 g compared to LOF of fruit waste without N, P, K nutrient enhancing organic substances. The addition of organic materials (gamal, banana stems, and coconut) was able to improve the chemical quality by increasing the content of all macronutrients.

Micronutrients are nutrients that plants need in small amounts, usually <50 ppm. The micronutrients are iron (Fe), manganese (Mn), boron (B), molybdenum (Mo), zinc (Zn), chlorine (Cl), and copper (Cu). Table 3.1 shows that the addition of nutrient-enhancing ingredients N, P, and K had an effect on reducing the content of Fe and Cu and almost no effect on the levels of Zn and Mn.

Plant Height

Figure 1 shows that at all the same concentrations, the administration of LOF of fruit waste without N, P, K nutrient enhancing organic substances in the growing medium resulted in shorter plant heights ranging from 20.31-29.55 cm, compared to LOF of fruit waste with N, P, K nutrient enhancing organic substances ranged from 21.58 to 31.92 cm. The addition of organic materials that increase nutrients N, P, and K affects the chemical properties of LOF where C-organic, CEC, and especially macro-nutrients (N, P, K, Ca, Mg, and S) are higher (Table 2). This will affect the fertility of the growing medium better, including more available nutrients. This condition allows plant roots to absorb more nutrients, which affect better plant growth and development. LOF of fruit waste without N, P, K nutrient enhancing organic substances at all concentrations had no effect on plant height 2 weeks after planting. Plant roots have not developed at the age of 2 weeks after planting, where the root area is still limited, which will affect the number of nutrients, as well as water and oxygen absorbed. Although there were more nutrients available in the growing medium that were given LOF of fruit waste with N, P, K nutrient enhancing organic substances, it did not have an impact on the average plant height 2 weeks after planting.

Liquid organic fertilizer is that of fruit waste with N, P, K nutrient enhancing organic substances had some better chemical properties (Table 2). Based on the observation of plant height 4 weeks after planting, the concentrations of 50, 45 and 40 ml/l water were concentrations that were able to provide more nutrients and could be absorbed by more plant roots so as to better support plant growth and development. Nutrients are one of the factors that play a role in plant metabolic processes such as the process of photosynthesis. Nutrients N, Mg, S, and Fe are elements that form chlorophyll (Suharjo and Sutarno (2009) *in* Khoiriyah and Nugroho (2018). If the availability of nutrients including these elements is sufficient and can be absorbed by plants, it can increase the content of leaf chlorophyll. This will further support the photosynthesis process so that more photosynthate is produced, which has an impact on better plant growth and development, including plant height.

Number of Leaves

Liquid organic fertilizer of fruit waste with N, P, K nutrient enhancing organic substances had some better chemical properties (Table 2). Based on the observation of plant height 4 weeks after planting, the concentrations of 50 and 45 ml/l of water were concentrations that were able to provide more nutrients and could be absorbed by more plant roots so as to better support plant growth and development. Nutrients are one of the factors that play a role in plant metabolic processes such as the process of photosynthesis. Nutrients N, Mg, S, and Fe are elements that form chlorophyll (Suharjo and Sutarno (2009) *in* Khoiriyah and Nugroho (2018). If the availability of nutrients including these elements is sufficient and can be absorbed by plants, it can increase the content of leaf chlorophyll. This will further support the photosynthesis process so that more photosynthate is produced, which has an impact on better plant growth and development, including plant height.

Number of tubers

It produces a higher plant average (Figure 1) and more leaves (Figure 2) so that it further supports plant metabolic processes that can produce more

energy for the formation of plant tubers. Figure 5 and Figure 6 showed that the average number of tubers per clump was influenced by the average plant height at the age of 6 weeks after planting with an R-value $R^2 = 0.901$, and the average number of leaves at the age of 6 weeks after planting with an R-value $R^2 = 0.897$. The regression value y = 1.189x + 17.42 for the average plant height at the age of 6 weeks after planting (Figure 5) and y = 1.610x + 21.00 for the average number of leaves at the age of 6 weeks after planting (Figure 5), which means if the average The increase in the average height and number of leaves of shallot plants will increase the average number of bulbs per clump.

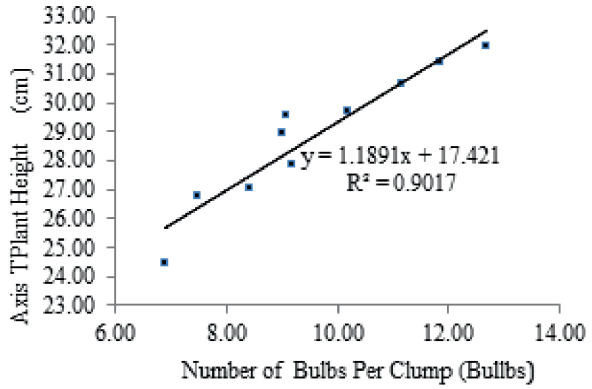

Fig. 5. Relationship of Plant Height (6 Weeks After Planting) and Number of Bulbs Per Clump

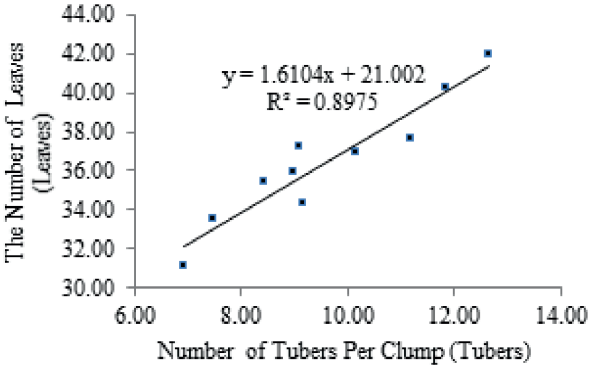

Fig. 6. The Relationship of The Number of Leaves (at 6 Weeks After Planting) and The Number of Tubers Per Clump

Liquid organic fertilizer of fruit waste with N, P, K nutrient enhancing organic substances at a concentration of 50 ml/l of water added to the growing medium produced the highest average number of tubers per clump, which was 12.67 tubers that were not significantly different with a concentration of 45 ml/l water (11.83 bulbs) and a concentration of 40 m/l water (11.17 bulbs), but significantly more than other concentrations of LOF of fruit waste without and with organic substances. Planting media that was given liquid organic fertilizer with nutrient-enhancing ingredients N, P, and K concentrations of 50, 45, and 40 ml/l water resulted in the growth of shallot plants, namely the average plant height (Figure 1) and the average number of leaves (Figure 2) which is better than other concentrations of LOF of fruit waste without and with organic substances that increase nutrients N, P, and K.

Bulb weight

One of the factors that affect the wet weight of tubers is the number of tubers. Planting media that were given LOF of fruit waste without N, P, K nutrient enhancing organic substances produced an average number of tubers that were less (Figure 6) than those given LOF of fruit waste with N, P, K nutrient enhancing organic substances. Figure 7 shows that the average wet weight of tubers per clump is influenced by the average number of tubers per clump by $R^2 = 0.919$. The regression value y = 1.651x + 10.29 means that if the average number of bulbs per clump of shallots increases, the average wet weight of bulbs per clump will be heavier.

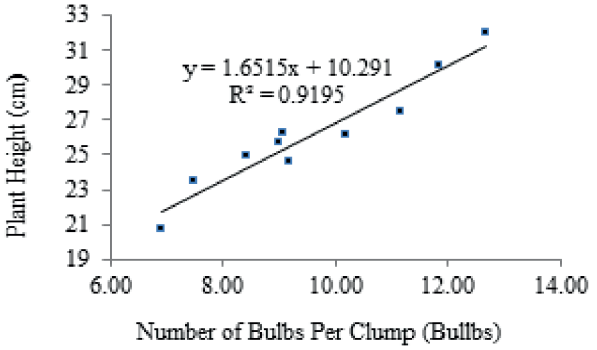

Fig. 7. Relationship of Number of Bulbs per Clump and Wet Weight of Bulbs per Clump

Planting media that was given liquid organic fertilizer of fruit waste added with organic matter increasing nutrients N, P, and K at a concentration of 50 ml/l of water resulted in the average wet weight of the heaviest tubers, which was 31.94 g, which was not significantly different with a concentration of 45 ml/l water (30.13 g) but was significantly heavier than the other concentrations of LOF of fruit waste without and with organic substances. Concentrations of 50 and 45 ml/l of water from LOF of fruit

waste with N, P, K nutrient enhancing organic substances resulted in a higher average number of tubers per clump (Figure 3) which affected the wet weight of tubers per clump, which was heavier.

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