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Study on the Suspension Extract of Agro-industrial Plant Waste and the Compost Type on the Change of Soil Chemical Properties and the Yields of Shallot (*Allium ascalonicum* L.)

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ABSTRACT
Shallot cultivation has constraints in regarding less fertile soil and lacking of soil nutrients. This study aimed to determine the effect of suspension extracts of the agro-industrial plant wastes (banana weevil, pineapple rhizome, and oil palm empty fruit bunches) and the type of compost (solid and liquid compost) on the soil chemical properties and the yields of shallot. The study used a Completely Randomized Block Design arranged in a factorial treatment. The first factor was the type of suspension extract of agro-industrial plant wastes, namely banana weevil (P1), pineapple rhizome (P2), and oil palm empty fruit bunches (P3). The second factor was the type of compost, namely without compost (K0), solid compost (K1), and liquid compost (K2). Data were analyzed by analysis of variance and followed by a Duncan Multiple Range Test at 5% level. The results showed that the suspension extract type of agro-industrial plant wastes and the compost type increased the pH, available-P, and organic-C of soil, but they did not affect the total-N and exchangeable-K of soil. The application suspension extract of oil palm empty fruit bunch significantly increased the volume of the bulb of shallot compared to the suspension extract of pineapple rhizome and banana weevil. Moreover, the application of compost (either solid or liquid) significantly increased the volume of the bulb of shallot compared to without compost. The application of suspension extract of oil palm empty fruit bunch with solid compost significantly increased the weight of the wet and dried bulbs compared to the suspension extracts of banana weevil and pineapple rhizomes. Also, the application of solid compost with suspension extract of oil palm empty fruit bunch significantly increased the weight of wet bulbs and dried bulbs of shallot compared to without compost and liquid compost. Therefore, the suspension extract of agro-industrial plant wastes has a potential to be used as liquid organic fertilizers.

Keywords: *Banana Weevil, Compost, Palm Oil Empty Fruit Bunch, Pineapple Rhizome, Plant suspension extract*

1. INTRODUCTION

The demand and need for shallots continue to increase every year, however, it is not followed by the increase in production. The national consumption of shallots in 2015 was 2.71 kg capita^{-1} yr^{-1}[1]. Efforts to increase production are usually carried out by using agrochemicals (fertilizers and pesticides) because generally in Indonesia shallots are planted on ultisols soils that are less fertile. The continuous use of chemical fertilizers can be harmful to the soil and the environment. This will cause a decrease in soil quality and a decrease in soil fertility as a result of soil degradation, loss of soil biodiversity, groundwater contamination, and environmental pollution [2]. Improvement of soil fertility can be done through balanced fertilization between chemical fertilizers and biological fertilizers [3]. According to [3] that the application of NPK (50% recommended level) and Biofertilizer indicates in the highest biomass dry weight, yield of corn, and RAE (Relative Agronomic Effectiveness) value. The optimum doses of NPK fertilizers were 200 kg Urea ha^{-1}, 60 kg SP-36 ha^{-1}, and 45 kg KCl ha^{-1} combined with 4 L ha^{-1}of biofertilizer.

Moreover, the use of organic fertilizers is needed in shallot cultivation, namely compost and liquid organic fertilizer. Organic matters play a role in increasing soil fertility and will determine soil productivity [4]. In Indonesia, various sources of organic material can be used as raw materials for compost, including rice straw, chicken manure, and cow dung, oil palm empty fruit bunches, etc.

This study used compost made from various sources of organic matter in the form of chicken manure, cow dung, and rice straw, both in the form of solid compost and liquid compost. Nuraini [5] stated that rice straw has a nutrient content of 22.06% organic-C, 1.64% N, 0.53% P_2O_5, 2.23% K_2O. Lingga [6] stated that cow dung contains 20-25 C/N ratio, 16% organic- C, 0.3% N, 0.2% P_2O_5, 0.15% K_2O. Moreover, chicken manure has a higher nutrient content compared to other organic materials containing 9–11 C/N ratio, 29% organic- C, 1.5% N, 1.3% P_2O_5, 0.8% K_2O.

Lampung Province has many agro-industrial companies at national and international levels that produce fresh and canned pineapples, sugar, Cavendish bananas, guava, palm oil, and others. The resulting waste, for example, empty oil palm bunches, banana weevils, and pineapple rhizomes has the potential to be used as a source of organic material to improve the quality of agricultural land. Plant extracts contain nutrients and microorganisms which can act as a source of local microorganisms that can improve soil fertility and increase plant production. Dermiyati et al. [7] obtained bacterial isolates that can dissolve phosphate from a suspension extract derived from oil palm empty bunches and pineapple rhizomes. Furthermore, Dermiyati et al. [8] found that suspension extract of the oil palm empty bunch contains bacteria that have the potential to decompose organic matter, to solubilize soil phosphate, to stimulate plant growth, and to control pests and plant diseases. Besides, Hadi [9] stated that the suspension extract from organic material contains *Azotobacter* sp., *Lactobacillus* sp., yeast, photosynthetic bacteria, and cellulose-decomposing fungi that function in the breakdown of organic compounds.

Also, plant extracts from agro-industrial waste in the form of oil palm empty bunches, pineapple rhizomes, and banana weevils can be potential as liquid organic fertilizer. Oil palm empty bunches contain total N (1.91%), K (1.51%), Ca (0.83%), P (0.54%), Mg (0.09%), C- organic (51.23%), C / N ratio (26.82), and pH 7.13 [10]. While banana weevils contain 76.57% carbohydrates, 18.97% water, 2.11 fat. %, Protein 0.32%, Calcium 717 mg $100g^{-1}$, Phosphorus 114 mg $100g^{-1}$, and Iron 0.13 mg $100g^{-1}$. Therefore, banana weevils can be used as liquid organic fertilizer [11]. Pineapple rhizomes have not been much studied yet.

This research was aimed to study the effect of suspension extracts from various agro-industrial plant wastes (banana weevil, pineapple rhizome, and oil palm fruit bunches) and types of compost on the growth and yields of shallot plants (*Allium ascalonicum* L.).

2. RESEARCH METHODS

2.1. *Experimental Design*

This was a field research using a completely randomized block design method which was arranged in a factorial with three replications. The first factor was suspension extracts of industrial plant wastes, namely banana weevil (P1), pineapple rhizome (P2), and oil palm empty bunches (P3). The second factor was the type of compost, namely without compost (K0), solid compost (K1), and liquid compost (K2). The data were analyzed using the F test with a 95% confidence level, followed by Duncan's Multiple Range Test (DMRT) at 5% level.

2.2. *Preparation of Composts*

A solid compost was made using a layered method consisting of 5 layers. Each layer was composed of rice straw (150 kg), hens manure (25 kg), broiler manure (25 kg), and cow dung (300 kg). Among the layers were given urea (200 g), dolomite (800 g), bio-activator containing Nitrogen-fixing microbes (*Azospirilum* sp. and *Azotobacter* sp.), and Phosphate-solubilizing microbes (*Aspergillus niger* and *Pseudomonas* sp.) as much as 10^8 CFU mL^{-1} respectively. Then, all compost mold wascovered with plastic aftersome pipe was given for air circulation. The composting processes have lasted for 60 days, then the compost was harvested. The results of solid compost can be seen in Figure 1.

Figure 1 Solid compost made from rice straw, hens manure, broiler manure, and cow dung

A liquid compost was made by extracting the above solid compost into a solution. Liquid compost was made with 3 compositions, firstly 1: 5 (1kg solid compost extracted with 5 liters of water), secondly 1: 10 (1kg solid compost extracted with 10 liters of water), and thirdly 1: 15 (1kg solid compost extracted with 15 liters of water). Each composition was added 50 g of sugar along with water and compost to be extracted. The materials were extracted for 48 hours using an air pump aerator (Brand New Design Armada AR-2800), then the solution was filtered. After that, the results of the liquid compost were tested on the corn plants, and the composition of 1:10 was obtained as the best composition for the plants so that the 1:10 composition was used for this study.

2.3. *Preparation of Suspension Extract from Agro-Industrial Plant Wastes*

The suspension extractof agro-industrial plant wasteswas derived from banana weevil, pineapple rhizome, and oil palm empty bunches, respectively, which was made separately following the method developed by Hadi [9]. As much as a 1.5 kg of each raw material (banana weevil/pineapple rhizome/oil palm empty bunches) which had been cut into small pieces about ± 3 cm were put in a drum with a capacity of 16 liters given by 3 liters ofrice washing water, 3 liters of coconut water and 0.25 kg of brown sugar. After that, the drum was closed tightly and a little air hole insert the hose into the drum, and the hose was also connected to a bottle that was filled with water. Fermentation was carried out for 21 days, then the fermented solution was filtered and stored in a container before being used.

The contents of the solid compost, the liquid compost, and the suspension extract of agro-industrial plant wastes (banana weevil, pineapple rhizome, and oil palm empty bunches) are presented in Table 1.

Table 1 The nutrient contents of the suspension extract of the agro-industrial plant wastesand the compost

Properties	EFB	Pineapple Rhizome	Banana Weevil	Liquid Compost	Solid Compost
pH	4.91	3.91	3.87	5.47	8,06
Total-N (%)	0.02	0.06	0.02	0.02	1.25
Available- P (%)	0.0058	0.0006	0.0041	0.001	0.10
Exch.-K (%)	0.21	0.045	0.15	0.086	0.76
Organic-C (%)	0.36	2.14	2.28	0.12	15.39
Ca (mg kg^{-1})	905.81	241.86	97.76	340.89	0.76
Mg (mg kg^{-1})	498.49	181.92	364.87	251.57	0.3
Fe (mg kg^{-1})	94.01	67.98	4.50	3.51	na
Mn (mg kg^{-1})	21.48	3.47	2.01	4.46	na

Note: EFB = oil palm empty fruit bunches suspension extract; na = data is not available.

2.4. *Soil Preparation and Research Implementation*

The shallot seeds used were Bima Brebes variety with a seed bulb size of about 5-6g per bulbs. The soil was 4 mx 12 m in size consisting of 27 experimental plots and each experimental plot measuring 1m x 1m. The distance between the experimental plots was 30 cm and between the replication was 50 cm. Before planting, the tips of the shallot seeds were cut by 1/3 parts. The shallot seeds were inserted into the planting hole with a depth of 3 cm with a spacing of 20 cm x 20 cm so that the total plants in one plot were 25 plants.

Harvesting of onions was carried out at 10 weeks after planting (WAP) Each treatment was applied at a different time. The application of solid compost treatment was carried out 1 day before planting at a dose of 20 t ha^{-1}. Each of the treatments of a 5 mL suspension extract of agro-industrial plant wastes (banana weevil, pineapple rhizome, oil palm empty bunches) and a 50 mL of liquid compost were dissolved in 1 L of water then applied 3 times, namely at 1, 3, and 5 WAP. Each treatment of plant suspension extract and liquid compost was applied as much as 200 mL per plant. Urea fertilizer (200 kg ha^{-1}) was given 3 times, namely at 1, 3, and 5 WAP, while SP-36 (150 kg ha^{-1}) and KCl (100 kg ha^{-1}) were given at 1 WAP given to all treatments to give adequate plant nutrients.

Soil samples were taken for each experimental plot after harvesting. Initial soil samples were taken at 5 points in each treatment field. Then the soil samples were mixed evenly, dried, and sieved until it passed a 0.2 mm sieve and then composited. Soil samples were weighed for analysis. The results of the initial soil analysis are presented in Table 2.

Table 2 Initial Soil Properties of Ultisol soil used in the experiment

Soil Properties	Method	Value	Criteria
pH (H_20)	Electrometer	6.16	Slightly acid
Total-N (%)	Kjeldahl	0.16	Low
Available-P (mg kg^{-1})	Bray-1	12.08	Moderate
Organic-C (%)	Walkey & Black	0.58	Very low
Exch.-K (me $100g^{-1}$)	Flame photometer	1.98	Low

Observation of wet bulbs weight wascarried out shortly after harvest, while, dry bulbs weight was carried out after the bulbs were air-dried for one week. Observation of bulbs weight loss percentage was obtained by calculating the difference between fresh bulbs weight and dry bulbs weight. While the observation of bulbs volume was carried out by placing the bulbs in the water that had been put into a measuring cup. Thevolume of onion bulbs was obtained from the addition of volume after adding the bulbs to reduce the initial volume.

3. RESULTS AND DISCUSSION

3.1. Changes in Soil Chemical Properties Before Planting and After Harvesting

The results of soil analysis before planting are presented in Table 1 and after harvesting in Table 3. The total-N of soil after harvest is in the range of 0.19% - 0.23% and is not much different from the initial total-N of 0.16%. N is likely used as a source of energy for soil microorganisms and a source of nutrition for the growth of shallot plants so that the total N content of the soil does not change. Meanwhile, exchangeable-K decreased from 1.98 (me $100g^{-1}$) to 1.14-1.78 (me $100g^{-1}$). This is because K has the nature of "luxury consumption" where the plant will absorb as much K as possible but to a certain extent no longer increases crop production.

In contrast, soil organic-C after harvestingwas in the range of 1.26% - 2.55%, there isan increase compared to the initial soil organic-C of 0.58%. Likewise, soil available-P increased significantly with the provision of the suspension extract treatments of agro-industrial plant waste and composts. The plant suspension extracts treatment of banana weevil, pineapple rhizome, and oil palm empty bunches, and compost is thought to increase the activity and biomass of soil microorganisms so that they can contribute to soil organic-C and soil available-P. This is presumably because of the plant suspension extracts and the compost containing organic matter and P-solubilizer microbes that can increase soil organic-C and soil available-P. Dermiyati [7] stated that pineapple rhizomes and EFB contain P-solubilizer microbes. Irawan et al. [12] stated that the addition of organic matter can increase the available-P of Andisols soil from 5.73 ppm to 15.49 ppm. The increase in available-P after being given organic matter is likely to the decomposition process produces organic acids which can help release P bound by the amorphous fraction (allophane) so that the available-P concentration increases (Irawan et al. [12]. P-solubilizer microbes can increase phosphatase activity in the soil and the resulting acid can form stable complexes with P-binding cations such as Al and Fe so that metal-bound P can be released and become available to plants [13].

Table 3. Soil chemical analysis at harvest time of shallot plants

Treatment	pH	Total-N (%)	Available-P (mg kg^{-1})	Organic-C (%)	Exc.-K (me $100g^{-1}$)
P1K0	6.80	0.21	99.57	2.37	1.78
P1K1	6.49	0.19	179.22	1.26	1.48
P1K2	7.14	0.23	187.75	2.40	1.30
P2K0	7.38	0.23	452.31	1.92	1.47
P2K1	6.93	0.20	176.37	1.96	1.30
P2K2	7.26	0.19	73.96	1.63	1.35
P3K0	6.72	0.20	244.65	2.55	1.20
P3K1	6.59	0.19	219.04	1.91	1.58
P3K2	6.17	0.19	247.49	1.78	1.14

Note: P1 = banana weevil suspension extract; P2 = pineapple rhizome suspension extract;P3 = oil palm empty bunches suspension extract; K0 = No compost; K1 = Solid compost; K2 = Liquid compost.

3.2. The Effect of the Suspension Extract of Banana Weevil, Pineapple Rhizome, Oil Palm Empty Bunches and the Compost on the Yields ofShallot Plant

Based on the results of the analysis of variance (data not shown), the treatment of plant suspension extract significantly affected wet bulbs weight, dry bulbs weight, and bulbs volume, but had no significant effect on the loss of shallot bulbs weight. Likewise, there was an interaction between the plant suspension extract and the compost. It is likely the plant suspension extract has sufficient and balanced nutrient contents (Table 2) and there are local microorganisms in it, such as phosphate-solubilizing microbes so that the plant's need for nutrients can be met. Likewise, the presence of high P nutrient content in the soil (Table 3) can meet the needs of plants to grow and develop as well as the needs of microorganisms for their activities. This is following Sumarni et al. [14] who stated the high availability of soil-P because of the addition of P fertilizers significantly increases the yield of shallots. Sufficient availability of P in soil is very important to increase plant growth because P is needed to improve carbohydrate content and plant root development. Dermiyati [15] states that organic fertilizers improve soil structure by increasing the soil organic matter content, increasing the soil's ability to maintain soil water content, and can loosen solid clay soils. Besides, soil that is loose and contains a lot of organic material is very suitable for the growth of shallot plants [16].

Apart from macronutrients (N, P, K, Ca, Mg), the suspension extractsof banana weevils, pineapple rhizome, and oil palm empty bunches also contain micronutrients Fe and Mn (Table 1). This is by Rosmarkam and Yuwono [17], that in the growth and development of plants also require micronutrients even though in small amounts other than macronutrients. Sutedjo [18] stated that the imbalance of macro and micronutrients can hinder plant growth and development and have a direct effect on plant productivity. The urea, SP-36, and KCl fertilizers are also applied to meet the plant nutrient needs so that they are balanced between organic and inorganic fertilizers. Thus, to achieve optimal growth, the available nutrients must be balanced and according to plant needs, so that none of the nutrients is a limiting factor for plant growth [19]. The use of organic fertilizers can increase nutrients in the soil, increase the activity of microorganisms, increase humus levels, and improve soil structure [20].

Based on the results of the DMRT test at the 5% level (Figure 2), the volume of shallot bulbs in the oil palm empty bunches suspensionextract(P3) was significantly higher than the pineapple rhizome suspension extract (P2) and banana weevil suspension extract (P3). Meanwhile, the volume of shallot bulbs between the suspension extract of pineapple rhizome (P2) and banana weevil (P1) was not significantly different. This is thought to be an extract suspension oil palm empty bunches that can provide sufficient macro and micronutrients for shallot plants. The data from the results of this study showed that the OPEFB extract suspension contained higher macro and micronutrients than the suspension of pineapple rhizome extract and banana weevil (Table 1).

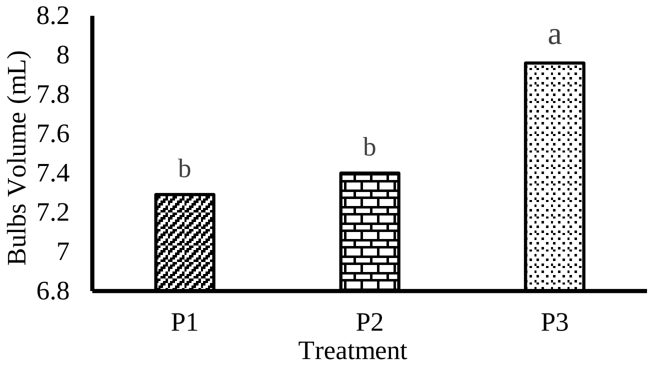

Figure 2 Effect of suspension extract of banana bulb extract, pineapple rhizome, oil palm empty bunches on bulb volume of shallots. (P1 = Banana Weevil suspension extract; P2 = Pineapple Rhizome suspension extract; P3 = Oil Palm Empty Bunches suspension extract). The mean value followed by the same letter is not significantly different based on the DMRT test at the 5% level

Based on the results of the DMRT test at the 5% level (Figure 3), the volume of shallot bulbs in the solid compost (K1) and liquid compost (K2) treatment was significantly higher than without compost (K0). This is likely the provision of compost containing straw can increase the K nutrients needed by plants in the bulbs formation process. The formation of shallot bulbs comes from enlargement of the layers of the leaves which then develop into shallot bulbs. The high K content causes K^+ ions which bind to water in the plant body to accelerate the photosynthesis process. The result of photosynthesis is what stimulates the formation of larger bulbs so that they can increase the weight of shallot bulbs [21]. Besides, compost can loosen the soil, improve soil structure and texture, increase porosity, aeration, and soil microorganism composition, increase soil binding power to water, facilitate plant root growth, retain soil water longer, prevent dry layers in the soil, prevent some root diseases, save the use of chemical fertilizers and increase the efficiency of using chemical fertilizers [22]. The results showed that the volume of shallot bulbs was between the treatment of liquid compost and solid compost was not significantly different. It can be seen that each form of compost used has advantages, liquid compost has a higher content of Ca, Mg, Fe, and Mn than solid compost, on the other hand, solid compost has higher N, P, K, and C-organic than liquid compost (Table 1).

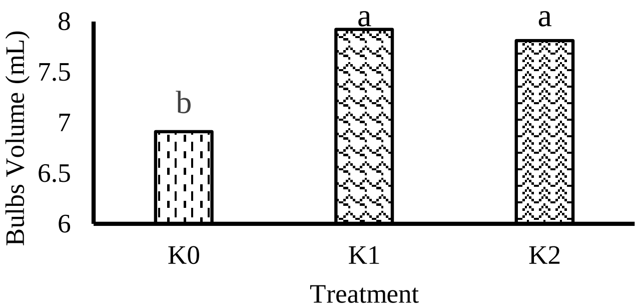

Figure 3 Effect the compost type on shallot bulb volume (K0 = without compost; K1= solid compost; K2 = liquid compost). The mean value followed by the same letter is not significantly different based on the DMRT test at the 5% level

Sundharaiya et al. [23] found that the application of manure significantly increased soil moisture, macro- and micro-nutrients, thereby increasing the number of bulbs and bulbs diameter. Increased K uptake leads to increase carbohydrate accumulation and the aroma of shallots. This increase in carbohydrate accumulation can then contribute to an increase in the diameter and length of shallot bulbs. Dhaker et al. [24], explained that the diameter of the bulb increased significantly with different treatments (using organic animal manure, inorganic fertilizers, and biological fertilizers). The results also showed that the number of bulbs produced ranged from 8-12 bulbs.

Based on the results of the analysis of variance (Data not shown), the treatment of plant extract suspension and the interaction between the treatments of plant extract suspension and compost had a significant effect on wet bulbs weight and dry bulb weight of shallots. This is presumably because organic fertilizers contain complete nutrients, both macronutrients, and micronutrients. Saifudin [25] stated that applying liquid organic fertilizers at the right time and concentration stimulates plant roots, accelerates growth, increases resistance to bad weather, and activates nutrient absorption to increase the quality and quantity of production. Plants grow shoots faster and do not become damaged or die quickly [6].

Also, it is suspected that the application of organic fertilizers can reduce soil bulk density which causes the soil to become lighter, thus providing good conditions for root development and affecting plant growth and yield. Agus et al. [26] stated that soil volume weight is one of the physical properties of soil that is most often determined because it is closely related to the ease of root penetration in the soil, drainage, and soil aeration. It is further stated that soils with high organic matter content have a relatively low volume weight. This is following the results of research by Lihiang [27], who stated that organic fertilizers can improve soil fertility so that it is very beneficial for the growth of shallots with shallow root systems.

The DMRT test results at the 5% level (Table 4), the weight of the wet bulbs of shallot in thesuspension extract of pineapple rhizome (P2) with liquid compost (K2) was significantly higher than the extract suspension of pineapple rhizome with other compost. This is likely due to the available nutrients such as N, P, and K in the weight of the wet bulbsin which each nutrient has an effect on bulbs formation where the K element plays a general role in bulbs formation and can increase photosynthetic activity and leaf chlorophyll content so that can increase plant dry weight. Also, the Ca and Mg content in both treatments (P2 and K2) were very high (Table 1). According to Napitupulu and Winarto [28], potassium plays a role in increasing the vegetative growth of plants such as formation, enlargement, and lengthening of bulbs and affect an increasing the weight of shallots. Damanik et al. [29] also stated that potassium is needed for the process of photosynthesis formation and can increase bulbs weight.

Table 4 Interaction between theplant suspension extractsand the compost on the shallots wet bulbs weight

Treatment	Wet Bulbs Weight (g plant^{-1})		
	Without Compost (K0)	**Solid Compost (K1)**	**Liquid Compost (K2)**
Banana weevils extract	88.67 (a)	89.33 (a)	90.00 (a)
suspension (P1)	A	A	A
Pineapple rhizomes extract	85.00 (a)	86.33 (a)	95.67 (b)
suspension (P2)	A	A	A
OPEFB extract suspension	93.33 (a)	109.00 (b)	90.00 (a)
(P3)	A	B	A

Note: The value followed by the same letter is not significantly different based on the DMRT test at the 5% level, capital letters are read vertically and lowercase letters are read horizontally

Table 5 Interaction between the plant suspension extracts and the compost on the shallots dry bulbs weight

Treatment	Dry Bulbs Weight (g plant^{-1})		
	Without Compost (K0)	**Solid Compost (K1)**	**Liquid Compost (K2)**
Banana weevils extract	77.00 (a)	78.67 (a)	77.67 (a)
suspension (P1)	A	A	A
Pineapple rhizomes extract	76.00 (a)	75.33 (a)	80.67 (a)
suspension (P2)	A	A	A
OPEFB extract suspension	79.67 (a)	94.00 (b)	81.00 (a)
(P3)	A	A	A

Note: The value followed by the same letter is not significantly different based onthe DMRT test at the 5% level, capital letters are read vertically and lowercase letters are read horizontally

The DMRT test results at the 5% level also showed that the wet-bulb weight of shallots in solid compost (K1) with suspension extract of oil palm empty bunches (P3) was significantly higher than that of solid compost treatment with other plant suspension extract (Table 4). This is presumably because the application of solid compost with a dose of 20 t ha^{-1} and the extract suspension of oil palm empty bunches has reached the optimal dosage and is sufficient for the nutrients needed by shallots compared to other treatments. The formation of shallot bulbs requires sufficient nutrients. Wibowo [30] stated that the addition of nutrients from fertilization will provide the nutrients needed for the growth of shallot bulbs. Furthermore, according to Samadi and Cahyono [31], the formation of shallot bulbs will increase in suitable environmental conditions where the lateral shoots will form new discs, then layered bulbs will be formed. Each bulbs that grows can produce 2- 20 new shoots that will grow and develop into tillers, each of which will produce bulbs.

Nutrients are closely related to plant metabolism where they are used in various energy processes in plants. Plants that get the optimum amount of nutrients, the plant height, and the number of shallots produced will also be good which greatly affects the plant's wet weight. According to Yahya et al. [32], the faster the vegetative growth of the plant, especially the plant height, the number of leaves and roots can provide a greater wet weight. Winarso [33] added that if enough nutrients are available in the soil, the biosynthesis can run smoothly so that more carbohydrates are produced and can be stored as food reserves. The nutrients obtained by plants will be used to form stored carbohydrates, proteins, and fats.

Table 6 Weight loss and wet bulb weight of shallot plants

Treatment	Wet bulbs weight (g plant^{-1})	Wet bulbs weight (t ha^{-1})*
P1K0	88.67	17.73
P1K1	89.33	17.87
P1K2	90.00	18.00
P2K0	85.00	17.00
P2K1	86.33	17.27
P2K2	95.67	19.13
P3K0	93.33	18.68
P3K1	109.00	21.80
P3K2	90.00	18.00

Note: P1 = Banana Weevil extract suspension; P2 = Pineapple Rhizome extract suspension; P3 = Oil Palm Empty Fruit Bunches extract suspension; K0 = Without Compost; K1 = Solid Compost; K2 = Liquid Compost.
* Conversion from wet bulbs weight per plant to per hectare based on 80% of total plant population in a hectare with a planting distance of 20 cm x 20 cm.

The results of the DMRT test at the 5% level showed that the weight of the dry bulbs of shallot plants in the treatment of OPEFB extract suspension (P3) with solid compost (K1) was significantly higher compared to other treatments. It is suspected that the application of compost at a dose of 15 tonnes ha^{-1} reaches the optimal dose, so it tends to meet the nutrient needed by shallot plants. The application of compost at a dose of 15 t ha^{-1} and NPK fertilizer according to the recommended dosage is sufficient to absorb the nutrients needed so that it can maintain the dry weight of shallot bulbs. As to Firmansyah et al. [34], plant growth is characterized by the increase in plant dry weight, the optimal availability of nutrients for plants will be followed by an increase in photosynthetic activity which will produce more assimilates which will support the plant dry weight. Besides contributing nutrients and organic compounds, compost also plays a role in improving soil physical and biological properties. The increase in dry bulb weight of shallots is related to the parameter of the number of bulbs per clump, where the photosynthate stored in the bulbs will increase the weight of the bulbs, as stated by Lakit [35], that the increase in dry weight is determined by the photosynthate produced during the bulbs formation process. Jumin [36], stated that plant vegetative growth is inseparable from the availability of K elements. The K element released by the OPEFB compost decomposition acts as an activator in the formation of carbohydrates which has a significant effect on plant dry weight, which is a process of accumulation of assimilates through the process of photosynthesis. Also, giving sufficient plant extract suspension will affect the activity of lateral meristem cells. Cell division and enlargement result in the number and size of cells increasing, causing the diameter of the bulb to increase (Gardner et al. [37]; Ruli et al. [38]).

The results of the analysis of variance showed that the weight loss of shallot bulbs was not affected by a single treatment of plant suspension extract or a single treatment of compost, and there was no interaction between the two (data not shown). The weight loss of shallot bulbs in the suspension treatment of plant extracts and compost was in the range of 13.76% - 16.1% (Table 6) lower than the average weight loss of shallot plants, namely 21.54% (Hendro et al.[39]. The lower the weight loss, the higher the quality of the shallots produced.

The shallot production from this study also exceeds the average production of shallots. The highest weight of dry bulbs and wet bulbs was in the P3K1 treatment of 18.8 t ha^{-1} and 21.8 t ha^{-1}, respectively, while the lowest was in P2K0 treatment, respectively 15.2 t ha^{-1} and 17 t ha^{-1} much higher than the average dry bulbs weight of 9.9 t ha^{-1} and wet bulbs 12 t ha^{-1} (Hendro et al. [39]. This is because there is sufficient nutrient availability from the plant suspension extract and the compost which act as organic fertilizers and from chemical fertilizers (urea, SP-36, and KCl) which enable the fulfillment of the nutrient needs of shallot plants.

Besides, shallot plants are planted in the dry season with rainfall ranging from 2 mm - 64.8 mm so that they do not experience pests and plant diseases, while the need for water for onion plant growth is met through watering the plants as needed. The average air temperature during the study was also in the range of 25ºC - 30ºC, approaching the optimum air temperature for the growth of shallot plants, which is between 25ºC - 32ºC [40].

4. CONCLUSIONS

The oil palm empty fruit bunch suspension extract significantly increased the height of shallot plants, wet bulbs weight, dry bulbs weight, and bulbs volumeat 5 WAP. The types of compost, both solid and liquid compost, had no significant effect on the growth and production of shallot plants, except for bulbs volume.

The OPEFB suspension extract with solid compost significantly increased the wet and dry weight of shallots compared to the OPEFB suspension extract with liquid compost and without compost. Likewise, solid compost with the suspension extract of OPEFB significantly increased the wet and dry bulbs weight of shallots compared the suspension extracts of banana weevil and pineapple rhizome.

In conclusion, the suspension extracts of banana weevils, pineapple rhizomes, and oil palm empty fruit bunches are potential as organic fertilizers.

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