The Effect of Liquid Organic Fertilizer of Vegetable Waste and Planting Media on Growth and Yield of Strawberry (Fragaria spp.) Earlibrite Cultivar

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Abstract. Strawberry becomes one of the popular plants in agro-tourism by combining strawberry plantation with culinary tourism. Increasing growth and yield of strawberry plant can be achieved by applying liquid organic fertilizer (LOF) of vegetable waste and planting media. This research was conducted to study interaction between LOF and planting medium (PM) and to inquire about the best dosage of LOF and planting medium for the growth and yield of strawberry. This research was conducted in the sub-district of Cibiru, Bandung City, West Java. The research design was Randomized Block Design with two factors and three replications. The first factor was vegetable waste of LOF with four treatments level respectively: p0: without LOF application, p1: 250 ml, p2: 500 ml, and p3: 750 ml. The second factor was planting media with three treatments level respectively : m0: without husk charcoal, m1: (1:1) soil and husk charcoal, m2: (1:2) soil and husk charcoal. The research finding came up by the existence of interaction in leaf width with the highest number by 835.42 cm² in combination of p2m2 treatment.

1. Introduction

The strawberry plants are herbaceous fruit plants found first in Chile, South America. One species of strawberry plants (Fragaria chiloensis L) spread to various countries of America, Europe and Asia. Furthermore, another species, namely Fragaria vesca L is more widespread than other species. This strawberry is the first introduce to Indonesia. The strawberries we find in supermarkets are hybrids produced from the North American Fragaria virginiana L. var Duchesne cross with Fragaria Chiloensis L. var Duchesne from Chile. The crossing resulted in a hybrid of modern strawberries (commercial) Fragaria x annanassa var Duchesne [1].

Today we encounter many of the restaurants that are integrated with the agro-tourism of strawberry plants as an appeal to consumers. The number of strawberry-based agro-tourism restaurants indicates the large market demand for agro-tourism of strawberry plants. Strawberry plants can be used as an ornamental plant in the yard of the house in addition to beautifying the home page can also be used as an additional nutritional family. Selection of appropriate and appropriate strawberry plant media is expected to make the media easy to carry and have a long-lasting production period and good for the growth of strawberry plants during the production period. Strawberry planting medium is a good planting medium in accordance with the needs of the production of strawberry plants that have a water holding, light, filled with oxygen and has a good soil structure and texture. Strawberry planting media usually use loose soil because strawberry plants can grow well on loose soil.

A lot of rubbish is scattered in landfills, the composition of Bandung's highest garbage is organic waste 63.56%, 10.42% paper, 9.76% Metal, 1.7% Glass, 0.95% Textile Plastic or Rubber 1.45% and others 12.6%. Judging from its characteristics, waste can usually still be processed into a more useful product that has economic value. Even the waste can be used as a new product (Waste to Product) and become energy (Waste to Energy). For example, organic solid waste can still be used for raw materials of organic fertilizer, animal feed, and biogas [2].
Based on the shape, organic fertilizer is divided into two, namely liquid organic fertilizer and solid. Liquid fertilizer is a soluble solution containing one or more nutrient carriers that the plant needs. The advantages of liquid organic fertilizer are to provide nutrients in accordance with the needs of plants. Other than that the application can be more evenly and concentration can be arranged according to the plants requirement [3]. Organic material is now promoted by farmers to support the application of organic farming. The number of microorganism population at soil used as an indicator for soil degradation [4]. The organic farming is not allowed the use of artificial chemical substances even the pesticides in the control of pests and diseases. The natural pesticide was proven to be better and more profitable, biological control of pest will avoid ecology contamination with chemical pesticides, and be compatible with other methods of pest control [5].

2. Materials and Methods
This research was conducted at the field laboratory of UIN Sunan Gunung Djati Bandung, West Java. The method used is the experimental (experimental) method, the experimental design used in this study was the Factorial Randomized Block Design (RBD) of two treatment factors with three replications. The first factor is liquid organic fertilizer. Mite waste that is p0 = without liquid organic fertilizer. Waste, p1 = 250 ml, p2 = 500 ml, p3 = 750 ml is applied 2 times each stages at each dose. The second factor is Planting medium, respectively; m0 = Without Charcoal Skin, m1 = 1: 1 (Soil: Husk Charcoal), m2 = 1: 2 (Soil: Rice husk charcoal). There are 12 treatment combinations were obtained and each treatments was repeated three times.

Research Procedures include the manufacture of vegetable waste LOF (Liquid Organic Fertilizer), media preparation, planting, fertilizing, maintenance, harvesting, and pests and diseases.

a. LOF vegetable waste preparation of liquid organic fertilizer for vegetable waste is done for 2 weeks according to the method of making LOF for vegetable waste.

b. Media plant preparation by mix the soil until soil mix uniformly. The soil than mixed with rice husk charcoal to fulfill the treatments requirement that is m0 = without husk charcoal, m1 = 1: 1 (Soil: Husk Charcoal), m2 = 1: 2 (Land: Husk Charcoal)

c. Planting strawberry that have been 10 cm in size and have been propagated in good condition, fresh, upright, and free from pests and diseases. Then the seedlings are planted into the planting medium by first making the planting hole, with the depth of the root length and then the planting medium is compacted around the root.

d. Planting Seeds of strawberries vegetative propagation that has been measuring 10 cm and has been cultivated in a good state, fresh, upright, and free from pest and disease attacks. Then the seedlings are planted into the planting medium by first making a planting hole, with the depth of the root length and then the planting medium is compacted around the roots.

e. Fertilization Application of fertilization is done on the leaves and soil in the form of liquid organic fertilizer of vegetable waste in accordance with the concentration on the treatment by way of the pour. Application of liquid organic fertilizer vegetable waste done on 7 days before planting on planting medium and 21 DAP (day after planting). Application of artificial fertilizer application was 7.30 and 45 DAP with 75% dose as much as 2.80 gr N cropping, 3.75 g P cropping, and 3.5 g K planting by means of buried on medium parallel to strawberry leaf tip canopy.

f. Cultivation Plant maintenance includes weed weeding by weeding that grows around the plant and applied once every week, pruning is done by pruning old leaves and the disease because it can transmit disease to other plants, stolon pruning is intended that all the energy obtained by plants can be centered on growth and the development of the main crown so that it can bear fruit well.

g. Harvest Strawberry plants bear fruit when aged 75 DAP. Harvesting is done by way of picking by using scissors after matching the characteristics of ready-to-harvest with magenta red ripe traits.

h. Pests and Diseases Control of pests and diseases by sanitation, and physically and chemically. Pests and diseases contained in the study will be physically controlled or the disposal of pests or parts of plants affected by the disease, and if pests and diseases exceed the economic threshold it will be overcome by chemical means that is using pesticides and insecticides.
3. Results and Discussion

3.1. Plant Height (cm)

Plant height is one of the growth observation parameters to know the rate of photosynthate quantitatively, and in this study, the height measurement of the strawberry plant is done at age 30 DAP, 45 DAP, and 60 DAP with unit cm. The average Table of observation of plant height can be seen in Table 1. The effect of liquid organic fertilizer on vegetable waste and media type on the growth of plant height gives effect independently. At the age of 30 DAP and 45 DAP treatment p2 with dose 500 ml and p3 with dose 750 ml gave significant effect on p0 without LOF, and did not give significant effect to p1 with dose 250 ml, while at age 60 DAP, p3 give significant effect to p1 and p2, and p3 have a very significant effect on p0, whereas at p2 it has no significant effect on p1 and gives a significant effect on p0.

The effect of plant media use on plant height at age 30 DAP did not give any significant effect on each treatment, and at age 45 DAP gave a significant effect of giving a significant effect on m2 with comparison of rice husk charcoal (1: 2) compared with m1 with soil and rice husk charcoal (1: 1) and m0 without charcoal husk, whereas at 60 DAP m2 gives a significant effect on m0 and does not give significant to m1.

The application of liquid organic fertilizer is very good against the growth of plant height in each observation is indicated by there is a significant influence on the dosing of 500 ml and 750 ml but the use of 500 ml doses more efficient at 30 DST and 45 DAP observation age because the dose of 750 ml is not gives a significant effect on the dosing of 500 ml this is because the vegetable waste LOF has enough nitrogen as the protein and plant chlorophyll material [6]. The highest rate of plant growth was demonstrated at 60 DAP at treatment of p3 with dose of 750 ml with a very significant effect on this matter.

| Table 1. Effect of Liquid Fertilizer Dosage and Type of Planting Media to Average Plant Height at 30 DAP to 60 DAP |
|---------------------------------------------------------------|
| Treatment | Mean of plant height (cm) | | | |
| | 30 DAP | 45 DAP | 60 DAP | |
| p0 | 3.36 a | 4.17 a | 4.91 a | |
| p1 | 3.52 ab | 4.47 ab | 5.56 ab | |
| p2 | 3.70 b | 4.68 b | 5.79 b | |
| p3 | 3.93 b | 4.74 b | 5.87 c | |
| Planting Medium | | | | |
| m0 | 3.40 a | 4.30 a | 5.28 a | |
| m1 | 3.80 a | 4.61 a | 5.52 ab | |
| m2 | 3.68 a | 4.64 b | 5.80 b | |

The average value of each column marked with the same letter shows a significant difference based on Duncan Multiple Range Test (α= 5%)

Plant media has a significant effect on the treatment of m2 with the ratio of soil medium to charcoal husk (1: 2) compared with m1 and m0, this is because the soil media and charcoal husk can improve the porosity of the media so good for root respiration, maintaining moisture that the growing media need to be considered to support for plants to grow more fertile. Sorts of planting medium that is often used is sand, charcoal husk, and fern, the three kinds of media have a good porosity so that the plant propagation easy to penetrate.
3.2. Leaf Area
There is an interaction on leaf area between liquid organic fertilizer of vegetable waste (LOF) with treatment of p₀ without LOF; p₁ 250 ml dose; p₂ 500 ml; and p₃ 750 ml with medium m₀ without rice husk charcoal; m₁ comparison of soil and charcoal husk (1: 1) and m₂ of husk charcoal (1: 2) ratio. The highest rate was in the treatment of p₂m₂ with the number 835.42 compared with the combination of other treatments and showed a significant effect, while the lowest number in the treatment combination p₀m₀ with the number 208.33 and did not give a significant effect.

Table 2. Effect of Liquid Organic Fertilizer Dosage and Type of Planting Media on Average Area Leaves at Age 75 (DAP)

| LOF | Planting Medium | m₀     | m₁      | m₂     |
|-----|----------------|--------|---------|--------|
| p₀  | A              | 208.33a| 285.42b | 372.92c|
| p₁  | B              | 452.08a| 543.75b | 622.92c|
| p₂  | C              | 385.42a| 52.92b  | 835.42c|
| p₃  | D              | 437.50a| 541.67b | 564.58b|

The average number followed by the same letter (capital letters horizontal and vertical italic letters) shows no significant difference according to Duncan Advanced Test at a significant level of 5% p = liquid organic fertilizer of vegetable waste; m = planting medium

Strawberry plants absorb nutrients in the form of ions and cations that have been dissolved by water, liquid organic fertilizer can easily be directly absorbed by the plant because there is no dissolution process, charcoal granting can provide porosity also provide enough oxygen for plants so that nutrients are available for plants, this makes the interaction between LOF and planting media.

The average strawberry leaf area (cm²) in Table 7 shows p₂m₂ with a 500 ml LOF dose and media ratio (1: 2) had a significant effect and was the highest number compared with other treatments. This is because with the addition of organic liquid fertilizer dosage of vegetable waste, nutrient availability will be fulfilled, so that if enough nutrients then the leaves will be more extensive and will affect the results of photosynthate to be produced. The fulfilment of plant nutrients, the result of photosynthetic is increasing. This is inseparable from the role of organic fertilizer application of liquid vegetable waste, in accordance which states that plants that do not get additional N elements as needed will have a small leaf formed, otherwise plant will get N elements as needed wide leaves [7]. Nitrogen has a significant effect on leaf expansion, especially on the width and extent of the leaves. The element of nitrogen as an element that plays an important role in the growth of plant leaves [8].

Strawberry plants not only require good fertilization but strawberry plants also require planting media that has a good porosity, in Table 7 average leaf area (cm²) p₂m₂ as the best treatment with the ratio of land charcoal husk (1: 2), This shows that strawberry plants require a good porosity because charcoal husk is one of the mixture of planting medium that can provide good porosity of soil and is a natural nutrient material that can fertilize the plant because of its crumb and easy structure to store oxygen. Root plants will grow perfectly when sufficient water and oxygen in the soil is available [9].

3.3. Fresh Treaded Weights (g)
The effect of organic fertilizer application of liquid vegetable waste to fresh weight of strawberry berries made a very significant effect on the treatment of p₃ with dose of 750 ml compared to p₀ without
vegetable LOF, and significantly more significant compared to \( p_2 \) with 500 ml dose and \( p_1 \) with 250 ml dose.

The effect of using planting media on fresh weight of strawberry berries has a significant effect on \( m_1 \) with soil composition: husk charcoal (1: 1) and \( m_2 \) with soil composition: husk charcoal (1: 2) compared with \( m_0 \) without charcoal husk, treatment \( m_1 \) is most efficient than \( m_2 \) because \( m_2 \) does not have a significant effect on \( m_1 \). The average fresh weight of trimmed can be seen in Table 3.

The fresh weight of the tangle is measured by weighing the whole plant part. This means that the fresh, tangled weight is supported by the height of the plant and the number of leaves. The large number of leaves and plant height is directly proportional to the size of the fresh weight of trimming plants. The amount of leaf and plant height depends on the availability of nutrients absorbed. Liquid organic fertilizer vegetable waste plays a role in the provision of nutrients and nutrients for plants.

### Table 3. Effect of Liquid Organic Fertilizer Dosage and Type of Planting Media Against Average Freshly Weeded Weights (g)

| Treatment | Average of Fresh Weight (g) | Age of Plant 75 DAP |
|-----------|-----------------------------|----------------------|
| LOF       |                             |                      |
| \( p_0 \) | 30.19 a                     |                      |
| \( p_1 \) | 46.09 b                     |                      |
| \( p_2 \) | 46.45 b                     |                      |
| \( p_3 \) | 56.92 c                     |                      |
| Growing Media |                        |                      |
| \( m_0 \) | 40.04 a                     |                      |
| \( m_1 \) | 42.52 b                     |                      |
| \( m_2 \) | 42.18 b                     |                      |

Note: The average value of each column marked with the same letter shows a significant difference based on Duncan Advanced Test at 5%.

This is consistent with statement, that plant height and number of leaves affect the fresh weight of plant canopy. The larger the plant height and the greater the number of leaves, the fresh weight of the canopy will increase. Liquid organic fertilizer waste can increase the availability of nutrients Ca, Mg and K surrounding soil and the presence of growth regulators such as auxin, spur leaf formation [10].

Organic fertilizers can provide ingredients of amino acids, proteins and contain substances that grow the auxin that plays a role in spurring root growth and ready to build a network of plant growth. Increased root growth and the formation of tissues on and leaves in large and large quantities can support the increase in fresh weight of plants [11]. Good roots required porous planting medium so that can hope well with good planting media in this study can be seen on \( m_2 \) which have significant effect on \( m_0 \) without charcoal husk. Charcoal husk provides porosity to the soil pore space (empty space) contained in a volume of soil that can be occupied by water and air, so it is an indicator of drainage conditions and soil aeration. The porous soil means enough tanh to have a pore space for movement of water and air in and out of the ground freely [12].

### 3.4. Plant Dry Weight (g)

The dry weight of the plant was weighed with analytical scales after the oven at 80 °C for 3 days. The influence of the use of liquid organic fertilizer of vegetable waste to the dry weight of strawberry plants had a very significant effect on the treatment of \( p_3 \) with a dose of 750 ml compared with \( p_0 \) without liquid organic fertilizer of vegetable waste, and \( p_1 \) influenced compared with \( p_2 \) with dose 500 ml and \( p_1 \) 250 ml.

The effect of plant media use gave a significant effect on the treatment of \( m_2 \) with the ratio of soil and charcoal husk (1: 2) to \( m_1 \) with the ratio of soil and husk charcoal media (1: 1) and \( m_0 \) without using husk charcoal (Table 4).
Growth and development of plant tissue will cause the increase in the number of leaves, the more widely formed leaves, stems and roots are getting bigger so that the weight of plant and dry weight will increase. Provision of liquid organic fertilizer vegetable waste with a dose of 750 ml produces plant height, leaf area, fresh weight of plant and also the highest dry weight of strawberry plants.

### Table 4. Effect of liquid organic fertilizer vegetable waste and planting media on average dry weight of strawberry plants (g)

| Treatment  | Average of Plant Dry Weight (g) |
|------------|---------------------------------|
| LOF        |                                 |
| p0         | 6.55 a                          |
| p1         | 8.58 b                          |
| p2         | 9.05 b                          |
| p3         | 11.62 c                         |
| Growing Media |                                 |
| m0         | 8.05 a                          |
| m1         | 8.90 ab                         |
| m2         | 9.90 b                          |

Note: The average value of each column marked with the same letter shows a significant difference based on Duncan Multiple Range Test at 5%

This is certainly related to the increasing number of nutrients that can be supplied and absorbed by strawberry plants as a result of increasing doses of liquid organic fertilizer vegetable waste is given. This result confirmed previous research that the dosage of nitrogen fertilizer used can change the plant physiology variables including leaf chlorophyll, leaf specific weight, photosynthesis rate, light efficiency reduces CO₂, and leaf maintenance respiration coefficient.

The average dry weight of the plant shows the highest number at m₂ level with the number 9.90 and has a significant effect on m₁ and m₀, because if the charcoal husk is added to the soil and the plant will be able to give good porosity, then released to the micro pore to be absorbed by the plant and promotes the growth of useful microorganisms for soil and plants. This is confirmed that charcoal husk is not easily decayed and become the source of potassium needed by the plant, besides that this material does not quickly coagulate or solidify so that plant roots can grow perfectly.

### Table 5. Effect of liquid organic fertilizer of vegetable waste and planting media on average fruit crop weight (g)

| Treatment  | Average of Weight per Plant (g) |
|------------|---------------------------------|
| LOF        |                                 |
| p₀         | 4.59 a                          |
| p₁         | 6.52 b                          |
| p₂         | 8.24 c                          |
| p₃         | 8.61 d                          |
| Planting Media |                                 |
| m₀         | 6.51 a                          |
| m₁         | 6.72 b                          |
| m₂         | 7.75 c                          |

The average value of each column marked with the same letter shows a significant difference based on Duncan Multiple Range Test at 5%
3.5. Fruit Weight (g)
Measurement of fruit weight by weighing fruit one by one in one sample of treatment, performed simultaneously at 75 DAP. The effect of organic fertilizer application of liquid vegetable waste to fruit weight of planting showed that p3 with doses of 750 ml had a very significant effect on p1 with a dose of 250 ml and a significant effect on p2 with a dose of 500 ml.

The effect of planting media on strawberry crop production has a very significant effect on m2 level with the proportion of soil and 1: 2 husk to m0 without charcoal husk, and m2 has significant effect on m1 with ratio of 1: 1 husk charcoal soil (Table 5).

The application of adequate nutrients can increase the production of strawberry crops so well, by providing liquid organic fertilizer at several treatment doses show a significant difference. This is consistent which states that plant nutrients and water availability affect the growth or expansion of cells such as vegetative or plant-fertilizing organs [13]. The increase of fruit weight based on planting medium in each comparison gives a significant effect because charcoal husk as a mixture of planting medium can provide nutrients for this plant because in charcoal husk has potassium and phosphor. The husk charcoal is the residual solid of combustion of non-volatile organic matter, may increase pH and liberate or increase essential soil such as potassium, magnesium, potassium and phosphor, so as to increase crop yield.

3.6. Quality of Fruit
The quality of fruit is sorted by its classification of A grade> 20 g, grade B 12-20 g, grade C 8-12 g, and grade D 7-8 g, fruit yield average yield on p1m, p2m0, and p3m2 with average on each replication obtained Grade C (8-12 g) (Table 6). Not all treatments get grading and a decrease The quality of fruit in strawberry plants occurs due to disturbed metabolism in plants strawberries as a result of an incompatible growth requirement.

| Table 6. Effect of liquid organic fertilizer vegetable waste and planting medium on fruit quality |
|-------------------------------------------------|----------|----------|----------|----------|
| Treatment | Replication | Grade |          |          |
| p3m0      | 3.35      | 4.78    | 3.55     |          |
| p3m1      | 3.90      | 3.83    | 5.20     |          |
| p3m2      | 4.40      | 5.15    | 7.20     | 1        |
| p2m0      | 5.78      | 5.78    | 7.58     | 1        |
| p2m1      | 6.60      | 6.33    | 6.00     |          |
| p2m2      | 7.15      | 6.83    | 6.63     | 1        |
| p2m0      | 6.88      | 7.40    | 7.78     | 2        |
| p2m1      | 5.98      | 8.00    | 9.83     | 1        |
| p2m2      | 8.35      | 9.40    | 10.58    | 3        |
| p3m0      | 8.38      | 8.60    | 8.25     | 3        |
| p3m1      | 7.93      | 9.55    | 7.55     | 1        |
| p3m2      | 9.55      | 9.18    | 8.55     | 3        |

This is because strawberries can grow optimally at an altitude of 1,000-1,200 m above sea level. The Strawberry plants can grow well in areas with rainfall 600-700 mm per year [14]. The duration of sunlight exposure required in growth is 8 to 10 hours per day. Strawberries are subtropical plants that can adapt well in the tropical highlands that have a temperature of 17-20 °C. Good air humidity for the growth of strawberry plants between 80-90%.

There is the fruit crop the so called strawberry which is famous as refreshing fruit and served as juice and drink after or before lunch. It is a value of domestic plant and there are many natural plants
producing valuable usage for human both food and medicine. Reserpine is the main component of serpentine which accumulated in roots and is known to have antihypertensive properties [15]. The active compounds in the root of serpentine can lower the high blood pressure than other alkaloids. And another plant of dual benefits as refreshing and medicine is the dragon fruit plant. Dragon fruit is delicious to serve as desert and it also contains medicinal effect. The prebiotic properties of dragon fruit performed because of carbohydrate in dragon fruit is white and red are glucose, fructose and some classes of oligosaccharides with a total concentration of between 86.2 g/kg and 89.6 g/kg which has a function as a prebiotic [16].

4. Conclusions
There is an interaction of the observation of leaf area between the provision of liquid organic fertilizer (LOF) of vegetable waste and media type in earlbrite variety strawberry plant, with the best treatment combination on p₂m₂ treatment combination with the highest number of 835.42 cm². The best LOF dosage was found in treatment of p₃ with dosage of 750 ml and the best media type was m₂ with 1: 2.

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