Concentration Test of Liquid Bioslurry and Mushroom Baglog Waste as a Plant Medium on Growth and Results of Strawberries (Fragaria sp.)

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Abstract. Backlog mushrooms are organic waste used as a plant medium. Also, bio-slurry is a waste of biogas, used as an organic fertilizer, due to containing many rotting microbes. When the two ingredients are combined, it becomes a good source of organic fertilizer for plants. Furthermore, strawberry fruits (Fragaria sp.) are increasingly getting demanded, due to their vitamin content, which is very good for the health. The purpose of this study was to determine the interaction between the treatment of bio-slurry concentration and the composition of the growing media on the growth and yield of strawberries. Also, the study was conducted in the integrated laboratory of the Agrotechnology education park, Muhammadiyah University of Malang, between February to May 2019. This research used factorial experiments which were arranged randomly in groups. The first factor was the concentration of liquid bio-slurry, such as C0 (water, without bio-slurry), C1 (100 ml / l), C2 (125 ml / l), and C3 (150 ml / l), while that of the second was the volumetric comparison of the planting medium composition (soil : husk charcoal : mushroom baglog waste), namely M1 = (1: 1: 2), M2 = (1: 2: 1), and M3 = (2: 1: 1), with each treatment combination repeated 3 times. These results further showed no interaction between the concentration of bio-slurry, and the composition of planting media on the growth and yield of strawberries.

1. Introduction
Strawberry fruit (Fragaria sp.) has a sweet-sour taste, due to its natural anti-oxidant properties, including anthocyanins, flavonoids, and phenolic compounds [1-2]. Apart from antioxidants, strawberries also contain lots of fibre, vitamin C, and are low in calories. Furthermore, due to the high vitamin content, strawberries are in great demand by the public, resulting in the increasing need for this fruit [3]. Also, the success of strawberry cultivation depends on soil organic matter, which helps to increase water and cation storage capacity, while also improving farmland's physical, chemical, and biological properties [4]. Without paying much attention to fertilization, strawberry farmers are still conventional on a small scale, which in turn leads to low production in the quality and quantity of the product [5-8]. Moreover, the slurry is a product of biogas processes, which is obtained from livestock manure and water, through a process without oxygen (anaerobic), in a closed room (fermentation) [9]. The slurry is very good for fertilizing the land, and increasing the production of cultivated crops. Also, improving the quality of the slurry requires treatment with fermentation technology [10]. Bio-slurry is very good as a source of nutrients, which aids in the addition of more microbes to the soil. Furthermore, the backlog is a waste, which is derived from oyster mushroom growing media after harvesting [11]. The oyster mushroom media waste still contains various nutrients, which makes it very appropriate to
be used as the main material for compost. Also, when being used as a cultivation medium, this waste plays an important role in the influence of plant growth [12]. The purpose of this study is to determine the interaction between the treatment of bio-slurry concentration and the growing media composition on the growth and yield of strawberries.

2. Materials and Methods
The research was conducted in the integrated laboratory of the Faculty of Agriculture and Animal Husbandry, University of Muhammadiyah Malang, between February to May 2019. It was a factorial experiment, which was arranged randomly into groups, and repeated 3 times. Furthermore, the first factor was the concentration of liquid bio-slurry, consisting $C_0 =$ water, $C_1 = 100 \text{ ml} / \text{L}$, $C_2 = 125 \text{ ml} / \text{L}$, and $C_3 = 150 \text{ ml} / \text{L}$. Also, the second factor was the composition of the planting medium (soil : husk charcoal : backlog waste), consisting $M_1 = (1: 1: 2)$, $M_2 = (1: 2: 1)$, and $M_3 = (2: 1: 1)$.

California varieties of strawberry seeds came from the fruit's plant stolons/shoots, which were approximately 1 month old, since being seeded. Also, the liquid bio-slurry was obtained from cow dung, which had become biogas pulp, with a pH and temperature between 6.5 - 7.0 and 25°C - 30°C, respectively. Moreover, treatment concentrations were 0 ml / L, 100 ml / L, 125 ml / L, and 150 ml / L. The strawberry seeds were planted in polybags with a capacity of 5 kg, which had also been filled with planting media, such as soil, husk charcoal, and mushroom media waste (backlog), with a ratio according to treatment.

Furthermore, according to the root length of the strawberry seedlings, the planting hole was made to a specific depth, with the media being planted around the compacted roots. Watering was carried out daily, or as required. Also, observation variables included plant height, number of leaves, amount of flowers, with sum and weight of fruits. Further observation of vegetative variables was also carried out, from the age of 2 - 12 weeks after planting.

The data obtained are analyzed using analysis of variance (ANOVA). When the results of the analysis of variance have a significant effect on the treatment, 5% LSD test should be proceeded.

3. Results and Discussion

3.1. Result

3.1.1 Plant height (cm)
The results of the analysis of variance showed that there was no significant interaction between the treatment of bio-slurry concentration and composition of plant medium, on the height of the strawberry plants. However, there was a significant effect between the treatment of bio-slurry concentration and composition of plant medium, on the height of the strawberry plants, at each observation age. The yield of plant height is presented in Figure 1.

In Figure 1, it was observed that the development of strawberry plant height, due to the treatment of bio-slurry concentration and composition (C) of plant medium (M), respectively, does not show significant differences. However, the treatment of the composition of soil, husk charcoal, and mushroom baglog waste with a ratio 2 : 1 : 1, showed good height growth of strawberry plants, at 12 weeks of age.

3.1.2 Number of leaf stalks
Furthermore, the results of the analysis of variance showed that there was no significant interaction between the treatment of bio-slurry concentration and the composition of the plant medium, on the number of strawberry leaf stalks. However, there was a significant effect on the treatment of bio-slurry concentration and the composition of the plant medium, with the number of strawberry petioles, at the age of 12 weeks. The results of the average number of strawberry leaf stalks are presented in Figure 2.

In Figure 2, it was observed that the development of leaf stalk numbers, due to the treatment of bio-slurry concentration and composition (C) of plant medium (M), respectively, does not show significant differences. However, as with the plant height variable, the treatment of the soil, husks charcoal, and mushroom baglog waste composition (2: 1: 1), showed a good increase in the number of strawberry petioles, at the age of 12 weeks.
3.1.3 Number of flowers, number of fruits and weight of fruit

The results of the analysis of variance further showed that there was no significant interaction between the treatment of bio-slurry concentration and the composition of the growing media, on the number of flowers, with the amount and weight of fruits. However, the treatment of bio-slurry concentration had a significant effect on all variables, while the composition of the plant medium did not show any form of relevant influence. The results of the average number of flowers, fruits, and the weight of strawberries, are presented in Figure 3.

Figure 1. The development of strawberry plant height, due to the treatment of bio-slurry concentration (C) and plant medium composition (M).

Figure 2. The number of leaf stalks, due to the treatment of bio-slurry concentration (C) and plant medium composition (M).
Figure 3. Number of flowers, number of fruit, and fruit weight of strawberries, due to the treatment of bio-slurry concentration (C) and the composition of the plant medium (M).

In Figure 3, it was observed that the treatment of medium composition (M) does not show significant differences with the variables (number of flowers, fruits, and weight of strawberries), while that of bio-slurry (C) concentration showed relevant influences with the number of flowers and fruits, with weight of strawberries. This was in accordance with the results of the analysis of variance, that the media composition treatment did not show any significant difference in the vegetative variables, while the bio-slurry concentration treatment showed a significant difference in the generative factors.

3.2. Discussion

The results of the analysis of variance showed that there was no significant interaction between the treatment of bio-slurry concentration and the composition of the planting medium, on the vegetative and generative growth of strawberries, meaning that the change in concentration did not affect the plant media. The slurry treatment on the plant medium increased the growth and yield of strawberries, compared to the treatment without slurry (control). This was because the role of the slurry was like that of an organic fertilizer for plants. Furthermore, as stated by a previous study [13], biogas liquid waste improves soil properties because it contains micro-organisms, which are effective in fertilizing the land, adding nutrients, and increasing agricultural products, safe for the health [6,10]. Also, biogas liquid waste is more easily absorbed by plants, because the elements possessed within have been broken down [14]. This was due to the fact that biogas liquid waste fertilizer had undergone a decomposition process by anaerobic bacteria when it was in the storage tube, and had not been utilized properly by farmers [15]. Also, the soil provided with liquid fertilizer from biogas waste becomes loosened, and easily binds nutrients and water [13]. Moreover, the use of this fertilizer provides certain benefits, such as the improvement of the soil consistency, in order to become more loosened, for its easy usage [16-18]. Also, the bio-slurry obtained from cow dung is better known as "biogas" by people in the Pujon area, Malang Regency. It has the ability to increase the adaptability of the soil to bind or hold water longer, making it useful during the dry season, in order to enhance fertility.

Furthermore, the treatment of medium composition (M) did not show a significant difference in the growth and yield of strawberries, presumably because the fermentation process was not complete. However, the results of the media composition analysis showed that the content of the organic material
was C (0.13%), C/N (1.86), pH (8.32), N-total (0.07%), P₂O₅ (0.21%), K₂O (0.07%), and total NPK (0.35). From the results of the analysis, it was observed that the fermentation process was still incomplete, which was indicated by the pH value still not neutral (still towards alkaline). Also, the incomplete decomposition process of baglog waste was indicated by the nutrient content of N, P, and K. A previous research [15] argued that slurry was very good for fertilization, and also in increasing the production of cultivated plants. The research [15] further stated that the slurry was likely to be treated with fermentation technology, which aims to accelerate the process of changing organic matter, in order for its quick availability to be easily absorbed by plants in the soil [10-11]. Based on the analysis of the result, the wet weight content in the biogas liquid waste fertilizer included C-organic (48%), N-total (2.9%), C/N (15.8%), P₂O₅ (0.2%), K₂O (0.3%) and C/N (9.09%), which is needed by plants [15]. Also, based on the results of the research, these nutrients are able to improve the physical and chemical properties of the soil, in order to increase plant growth and yield. [17-18].

Furthermore, bio-slurry is a biogas waste with no ability to be gassed. It is very good as a source of nutrition for the soil, and also increase the performance of microbial activities. Also, soil becomes more fertile and healthier, for plant productivity to be better. The microbes contained in the bio-slurry are,
(a) Nitrogen-fixing microbes, which are useful for providing nitrogen.
(b) Phosphate solubilizing microbes, which are useful for dissolving inorganic phosphate into phosphorus, which is readily absorbed by plants [19-20].
(c) Lactobacillus sp microbes, which plays a role in controlling the attack of plant pathogens.
Other ingredients in bio-slurry includes amino, fatty, organic, and humic acids, which retains nutrients, for the reduction of soil erosion [22]. Moreover, bio-slurry also contains vitamin B-12, auxin hormones, cytokinins, antibiotics, and micronutrients (Fe, Cu, Zn, Mn, Mo). Therefore, bio-slurry should be used as fertilizer, in order to increase plant growth and yield [23].

4. Conclusions
Based on the results of the research and discussion, it was concluded that there was no significant interaction between the treatment of bio-slurry concentration and the composition of the planting medium on the vegetative and generative growth of strawberries, meaning that the change in concentration did not affect the plant media.

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References
[1] Erkan M, Wan CY and Wang SY. 2008. Effect of UV treatment on antioxidant capacity, antioxidant enzyme activity and decay in strawberry fruit. Postharvest Biology and Technology 48(2) : 163-171.
[2] Wardani E K, Suprihati dan Maria MH. 2010. Peningkatan pertumbuhan, hasil dan nilai gizi buah stroberi (Fragaria chiloensis L) varietas sweet charlie melalui penambahan slurry biogas dan pupuk kandang. Jurnal Ilmu Pertanian (Agric) 22 (1) : 1-8.
[3] Oktariana OD, Ardian dan Armiani. 2017. Pertumbuhan dan produksi stroberi (Fragaria sp.) dengan pemberian berbagai konsentrası pupuk organik cair (POC) secara hidroponik substrat. JOM FAPERTA UR 4 (1) : 1-12.
[4] Ebrahimi R, Ahmadizadeh M, Ebrahimi F and Souri MK. 2012. Growth and yield of strawberries under different potassium concentrations of hydroponic system in three substrates. World Applied Journal 16 (10) : 1380-1386.
[5] Irshad M, Ashraf M, Enej AE and Hussain Z. 2013. Chemical characterization of fresh and composted livestock manures. Journal of Soil Science and Plant Nutrition 13(1): 115 121.
[6] Masi R, Cri WBY dan Novaty ED. 2015. Peningkatan kualitas produksi stroberi melalui pemanfaatan bio-slurry cair. Jurnal Agrotani 1 (1) : 45-56.
[7] Sukaryorini P dan Arifin. 2007. Kajian pembentukan caudex adenium obesum pada diversifikasi media tanam. Jurnal Pertanian Mapeta 10 (1) : 31-41.

[8] Pratiwi NE, Bistok HS dan Dina B. 2017. Pengaruh campuran media tanam terhadap pertumbuhan tanaman stroberi (Fragaria vesca L.) sebagai tanaman hias taman vertikal. Jurnal Ilmu Pertanian 29 (1) : 11-20.

[9] Kusmarwiyah R dan Sri E. 2011. Pengaruh media tumbuh dan pupuk organik cair terhadap pertumbuhan dan hasil tanaman seledri (Apium graveolens L.). Jurnal Crop Agro 4 (2) : 7-12.

[10] Saufani I dan Wawan. 2017. Pengaruh pupuk cair limbah biogas pada tanaman selada (Lactuca sativa L.). Jurnal Online Mahasiswa Faperta 1 (1) : 65 – 73.

[11] Susilowati YE dan S Rahayu. 2018. Meningkatkan hasil tanaman stroberi dengan urine kelinci. Jurnal Ilmu Pertanian Tropika dan Subtropika 3 (1) : 25 – 29.

[12] Priyambudi E dan Agung N. 2017. Pengaruh model penanaman dan aplikasi pupuk P dan K pada pertumbuhan dan hasil tanaman stroberi (Fragaria sp.). Proton Student Journal 5 (6) : 17–24.

[13] Hilmi A, Saimul I dan Tintrim R. 2018. Pengaruh pemberian limbah biogas cair dan padat (bioslurry) sebagai pupuk organik terhadap pertumbuhan tanaman sawi hijau (Brassica juncea L.). e-Jurnal Ilmiah Sains Alami 1 (1) : 65 – 73.

[14] Simatupang H, Hapsoh dan Husna Y. 2016. Pemberian limbah cair biogas pada tanaman sawi (Brassica juncea L.). Jurnal Online Mahasiswa Faperta 3 (2) : 1 - 11.

[15] Rahmah NL, Anggarini S, Hidayat dan Wignyanto. 2014. Pembuatan kompos limbah log jamur : kajian konsentrasi kotoran kambing dan EM4 serta waktu pembalikan. Jurnal Teknologi Pertanian 15 (1) : 59 - 66.

[16] Simorangkir AC, Ary S, Ellis N dan Wisnu EM. 2017. Pemberian pupuk urine kelinci (Leporidae) dan KNO₃ pada pertumbuhan dan hasil tanaman stroberi (Fragaria sp.). Jurnal Produksi Tanaman 5 (5) : 782-790.

[17] Parman S. 2007. Pengaruh pemberian pupuk organik cair terhadap pertumbuhan dan produksi kentang (Solanum tuberosum L.). Jurnal Anatomi dan Fisiologi 15 (2) : 21-31.

[18] Mappanganro N. 2013. Pertumbuhan tanaman stroberi pada berbagai jenis dan konsentrasi pupuk organik cair dan urine sapi dengan sistem hidroponik irigasi tetes. Jurnal ilmiah Biologi 1 (2) : 123-132.

[19] Zhang M, Xiao G, Peng J and Salokhe VM. 2003. Effect of modified atmosphere package on preservation of strawberries. International Agrophysics 17 (3) : 143-148.

[20] Syahputra E, Marai R dan Siad I. 2014. Pengaruh komposisi media tanam dan konsentrasi pupuk daun terhadap pertumbuhan dan hasil tanaman selada (Lactuca sativa L.). Jurnal Floratek 9 : 39-45.

[21] Razzaque AHM dan Hanafi MM. 2001. Effect of potassium on growth, yield and quality of pineapple in tropical peat. Journal Fruits 56 (1) : 45-49.

[22] Marschner P. 2012. Mineral nutrition of higher plant (third edition). School of agriculture, food and wine. J. Science Research 21(3): 518-524

[23] Mechrin S. 2006. Aplikasi teknik irigasi tetes dan komposisi media tanam selada (Lactuca sativa). Jurnal Teknologi Pertanian 7 (1) : 27-36.