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The Effect of Tuber Size and Growing Media Combination on The Growth and Yield of Shallot (*Allium ascalonicum*.L.)

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Abstract.

The purpose of the research was to determine the effect of tuber size and different in growing media on the growth and yield of shallot. This was conducted in the experimental garden of Agriculture Faculty UPN "Veteran" Yogyakarta, between April and June 2019, using a Completely Randomized Design with factorial arrangement. Furthermore, tuber size is the first factor, consisting of small (1.0-2.5 g), medium (2.6-3.5 g), and large (3,6-4,6 g), while the second is growing media combination, encompassing soil, soil + husk charcoal, soil + baglog mushroom waste, and soil + husk charcoal + baglog mushroom waste. The result showed the absence of an interaction between the tuber size and the different growing media on the growth and yield of shallot, although the large and medium tuber tend to grow better than small sizes in the aspect of leaf number, tillers number, tuber number, fresh weight, air dry weight, and tuber diameter. Comparably, the media of soil + baglog mushroom waste and soil + husk charcoal + baglog mushroom waste provided the best result regarding number of tillers, fresh weight, and tuber diameter.

***Keywords**:* shallot, tuber size, growing media

1. Introduction

Shallot is an important vegetable, used as a major source of income for farmers in tropical countries, especially in Asia, including Indonesia. Furthermore, it has frequently been adopted in most houses as a flavouring and seasoning spice in the preparation of dishes such as pickles, fried shallot, salad, etc, and also for the medicinal benefits.

The shallot is consumed more by humans, consequently contributing to daily life. They have been well known as raw materials for the creation of high-quality fried shallot, due to the dense texture, delicious taste, distinctive aroma, as well as the vitamin and mineral content. Furthermore, it is also used in most salads and food, due to the ability of its fat to produce 45 calories/100 g fresh weight (Randle and Lancaster, 2002).

Based on Statistic Center data, an exponential increase was recorded in the aspect of production from 2014 to 2018, encompassing 1.233.984 ton (2014), 1.229.184 ton (2015), 1,446,860 ton (2016), 1.470.155 ton (2017) and 1.503.436 ton (2018).

The productivity enhancement is possibly conducted with the appropriate cultivation techniques, as some farmers actually using various tuber sizes. This is not an efficient approach, as the growth and yield tend to not be uniform, hence, the current size used is unideal for planting. In addition, it was reported that the large tubers provide better growth, in contrast with the small size, due to it high carbohydrate and water content. This size characteristic depends on physiological processes in plant and the uptake of nutrition in soil, therefore, using a bad seed tuber consequently decreases production. According Entaunayah *et. al* (2015), the large sizes tend to grow comparably higher. Also, a good seed tuber encompasses those without disease, deformation, or the experience of prolonged storage in warehouse, characterized by dormancy period, healthy, and of optimal size (Azmi, 2011)

Growing media is possibly adopted as an organic matter, which plays an important role in improving the physical nature of soil (Bellapama, 2015). Hence, its addition in sufficient quantity grossly improves soil structure, and some organic matter used includes husk charcoal and baglog mushroom waste. Husk charcoal is a major by-product obtained from paddy, encompassing a mixture of growing media with the capacity to bind water, enhancing the drainage and aeration, which subsequently affects plant growth. (Syawal *et al,* 2019). Suthamathy and Seran (2011) stipulated that husk charcoal contains a high percentage of potassium and phosphorus, in contrast with nitrogen. Similarly, Tarigan *et. al*. (2015,) reported its composition of SiO2 (52%), C (31%), K (0.3%), N (0.18%), F (0.08%), and Calsium (0.14%), and also some few elements, encompassing Fe2O3, K2O, MgO, CaO, MnO and Cu. In addition, the high silica contents exhibits more benefits as the plant becomes more resistant to pests and diseases, thus, the husk charcoal growing media provided a higher number of tillers.

Baglog is an oyster mushroom planting media created from sawdust and some source nutrients for fungi growth, including organic manure. In addition, their waste as organic compost is possibly adopted as organic manure (Hunaepi *et. al*, 2018), characterized by the experience of decomposition, consequently imposing a significant effect on the dry weight of shallot (Bellapama *et. al,* 2015). Also, baglog waste possesses some nutrients, which includes P (0.7%), K (0.2%), N total (0.6%) and C-organic (49%) (Hunaepi, 2018). The purpose of the research, therefore, was to determine the effect of tuber size and different growing media on growth and yield of shallot.

2. Materials And Method

This research was conducted in the experimental garden, Faculty of Agriculture, UPN "Veteran" Yogyakarta between April and June 2019. The site was located on altitude 104 m above sea level, the shallot of Bima Brebes variety were used, and the planting was conducted in polybag of size 35x35 cm.

A Completely Randomized Design was used, involving the application of two factors, including (1) The tuber size, which consists of small (1.0-2.5 g), medium (2.6-3.5 g), and large (3.6-4.6 g). (2) Growing media combination, including soil, soil+husk charcoal, soil+baglog mushroom waste, and soil+husk charcoal+ baglog mushroom waste. Furthermore, the observed data were analyzed using Analysis of Varian (ANOVA) at a significance level of 5%, and if there were a significant effect continued by DMRT (Duncan Multiple Range Test), at level 5%.

3. Result And Discussion

The analysis of variance revealed a significant effect of tuber size and growing media combination. There is no interaction between the tuber size and the growing media combination on shallot growth and yield. Table 1 indicates the effect of tuber size and growing media combination on plant height, leaf number and tiller number of shallot.

Table 1. Average of plant height, leaf number and tiller number affected by tuber size and different growing media of shallot

Treatment	Plant Height (cm)	Leaf Number (blade)	Tiller Number
Small (1, -2,5 g)	23,90 b	24,42 b	6,33 b
Medium (2,6-3,5 g)	23,95 b	27,58 a	7,83 a
Large (3,6-4,6 g)	28,59 a	26,67 a	8,67 a
Soil	23,27 q	24,89 q	6,78 r
Soil+Husk Charcoal	25,53 q	26,11 p	8,00 q
Soil+Baglog Mushroom Waste	28,06 p	26,67 p	8,11 pq
Soil+ Husk Charcoal+Baglog Mushroom Waste	28,55 p	27,67 p	9,00 p

The means of each parameter followed by same letter within a column are not significantly different according to Duncan Multiple RangeTest 5%.

The large tuber comparably provided the best result in terms of plant height, as they have generally been considered to contain higher amounts of reserved carbohydrates than the small tuber. In addition, large and medium tubers contain more significant food reserves compared to small tubers. These are possibly used for the development of newly formed organs, and the maturation of leaves make them a photosynthate source.

The treatment of varying growing media showed that soil+baglog mushroom waste and soil+husk charcoal+baglog mushroom waste provided plants with comparably better height than others. This is probably because the growth phase requires sufficient N and P to attain increase inplant height, and adequate leaf number is present in baglog mushroom waste. This is in line with the statement by Hunaepi (2018), which stipulated its nutritional composition of P (0.7%), K (0.2%), N total (0.6%) and C-organic (49%). According to Firmanto (2011), N is needed by shallot during the vegetative phase, being the main constituent of chlorophyll and protein, while the husk charcoal possesses lesser amount (0.18%). Wuryaningsih (1997) reported its slow decompose ability, which indicates the enhanced propensity of slow absorption by the shallot plant. Also, N is one of the nutrients for vegetative growth, in the aspect of leaf number, hence a higher supply is reflected in the promotion of plant height and in the number of leaves.

The medium and large tuber provided better number of tillers, in contrast with the small tuber. According to Putrasameja (2007), the best measure for tuber was about 3 g, due to the tuber capacity to have more tillers. This is characterized by, the endosperm possession of larger sizes, consequently improving the plant growth prosses (Purnawanto, 2013). Furthermore, soil+husk charcoal, soil+baglog mushroom waste and soil+ husk charcoal+baglog mushroom waste provided better leaf number than the soil media, although three media with husk charcoal and baglog mushroom waste content produced better number of tillers. Also, the treatment with soil+baglog mushroom waste showed no significant differences with soil+ husk charcoal+baglog mushroom waste and soil+husk charcoal. This is probably due to the soil media inadequate N nutrient content, followed by slow growth of tiller number.

The results in table 2 indicate the presence of significant differences in terms of fresh weight, air dry weight, tuber number and tuber diameter of shallot. Furthermore, the large and medium tuber exhibited a better outcome in contrast with small tubers.

Table 2. Average of fresh weight, air dry weight, tuber number and tuber diameter of shallot as influenced by tuber size and growing media combination of shallot

Treatment	Fresh Weight (g)	Air Dry Weight (g)	Tuber Number	Tuber Diameter (mm)
Small (1, -2,5 g)	34,29 b	27,12 b	8,27 b	17,82 b
Medium (2,6-3,5 g)	36,39 a	29,93 a	9,90 a	22,13 a
Large (3,6-4,6 g)	36,61 a	31,78 a	10,87 a	20,84 a
Soil	33,28 r	25,34 r	7,60 q	16,66 r
Soil+Husk Charcoal	35,07 q	29,96 q	10,71 p	19,52 q
Soil+Baglog Mushroom Waste	36,72 p	31,74 q	10,29 p	22,67 p
Soil+ Husk Charcoal+Baglog Mushroom Waste	37,99 p	34,20 p	10,87 p	22,03 p

The means of each parameter followed by same letter within a column are not significantly different according to Duncan Multiple Range Test 5%

The result of Uke *et al* (2015), showed a significant effect of large tuber sizes on fresh weight, air dry weight, tuber number and tuber diameter. Also, the large and medium tuber sizes produce more significant increase in growth and yield than the small tuber. According Levy (1981), large tuber possess a higher food supply and also have a relatively higher water content, while Islam (2010) reported on the significant positive influence of increasing moisture content on enhanced growth and yield. Therefore, the recorded higher water content of large and medium tuber possibly aids in growth and the subsequent production of a bigger mass. These were reported by Entaunayah (2015) to possess more tuber layer, hence, a larger tuber consists of the enhanced root number and a wider cross section area of root. Furthermore, the occurrence is possibly due to the sufficiency in the amount of absorbable nutrients that is responsible for increased fresh weight, air dry weight, tuber number and tuber diameter.

The treatment with varying growing media showed the enhanced propensity for soil+baglog mushroom waste and soil+ husk charcoal+baglog mushroom waste to provide a better on fresh weight, tuber number and tuber diameter outcome in contrast with other treatments. Also, the use of soil+husk charcoal+baglog mushroom waste specifically displayed the best result on dry weight, possibly due to the more complete nutritional content of the mixture. According to Tarigan *et. al*. (2015), husk charcoal contains SiO2 (52%), C (31%), K (0.3%), N (0.18%), P (0.08%), and Calcium (0.14%), and silica is particularly needed in tuber formation.

The husk charcoal is known to contribute towards the supply of potassium nutrients, and the availability in tuber formation. This was in line with the report by Riadi (2010), which stated the propensity for husk charcoal to improve the physical properties of soil. Futhermore, they also increase the uptake of P, Ca, and Mg, further contributing to the availability of potassium (K), which accelerates the process of photosynthesis (Gunandi, 2015). This consequently increases the yield of shallot, while silica plays an important role in metabolism, which is a nutrition quality determinant, and as an element responsible for the photosynthesis process. Conversely, baglog mushroom waste possesses the following nutrient content: P

(0.7%), K (0.2%), N total (0.6%) and C-organic (49%) (Hunaepi, 2018), where nitrogen is needed by shallot during the vegetative phase, due to the it's a constituent for chlorophyll and protein. However, the combination of soil+husk charcoal did not provide good shallot yield, based on the less nitrogen contained in contrast with baglog mushroom waste. Furthermore, in the soil media provide lowest on fresh weight, air dry weight, tuber number and tuber diameter of shallot, due to its low capacity to provide nutrient and store water for shallot.

4. Conclusion

Based on the results and discussion, the following conclusion were made, there is no interaction between the tuber size and the different in growing media on shallot growth and yield. The large and medium sizes grew better than small tubers in the aspect of leaf number, tillers number, tuber number, fresh weight, air dry weight, and tuber diameter. The different in growing media significantly affects all parameters. In addition, soil+baglog mushroom waste and soil+husk charcoal +baglog mushroom waste provided superior outcomes in terms of plant height, fresh weight, and tuber diameter.

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