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Effect of Mulch and NPK on Production of Shallots (*Allium ascalonicum* L.)

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Abstract:
This study aimed at deriving the effects of applying various types of mulch and NPK fertilizer applications on the growth and production of shallots (Allium ascalonicum L.). The study was conducted in Tigarunggu, Tigarunggu Urban village, Purba Sub-district, Simalungun Regency, North Sumatera Province. The location is ±1400 meters above sea level. The study started from February to May 2021, and was carried out by Randomized Block Design involving two application factors namely, types of mulch and NPK fertilizer dosages. The applied factors were: Factor 1: The Usage of Mulch (M) consisted of three types namely, M_1 (without mulch); M_2 (paddy straw as mulch); M_3 (black silver plastic mulch) and Factor 2: NPK fertilizer dosages (N) comprised of three applications namely, N_1 (25g/plot), N_2 (30g/plot), N_3 (35g/plot). The research resulted in the highest diameter of shallot tuber on application M_3N_2 (2.75cm) while the lowest diameter of shallot tuber on M_2N_1 (2.06cm); the highest number of shallot tubers on application M_2N_3 (5.13tubers) meanwhile the lowest number of shallot tubers on M_1N_2 (4.29tubers); the highest fresh weight of tuber/sample on application M_3N_2 (238.63g) while the lowest fresh weight on M_2N_2 (123.88g); the highest dry weight of shallot tuber/sample on application M_3N_2 (225.25g) whereas the lowest dry weight of the shallot tuber on M_2N_2 (106.60g).
Key Word*:Mulch, NPK, Shallots*

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I. Introduction

Shallot is a main vegetable commodity that has been intensively cultivated by farmers. This commodity has been a source of income and its cultivation and production have called for many more unemployed people to be employed so that it can be conclusively stated that it has contributed much to the economy development of an area[13]. Based on the data displayed by Central Bureau of Statistics[2], the yield of shallots in Indonesia consequently from 2015- 2019 was 1,229,184 tons; 1,446,860 tons; 1,470,155 tons; 1,503,436 tons; 1,580,247 tons. It showed that every single year the production of the plant increased.

This main vegetable commodity is also highly favored by most society thus it needs efforts to better its cultivation. Way by way has been constantly done to fulfill the need of the plant and innovations have been introduced to improve the production of shallots. There are many ways to get the yield increased. Some are utilization of mulch and application of NPK fertilizer. The usage of mulch in planting is a way to manipulate the growing environment/ area where shallots are planted. In this study, there are two types of much applied namely, paddy straw as organic mulch and silver black plastic mulch as an-organic mulch. Based on the result of a study conducted by[16], it is stated that the volume level and application of mulch on shallots resulted in real interactive impacts. The usage of mulch benefits physical, chemical and biological properties of the soil. This fact has been proved right in the heights of fresh and dry weight of shallots while applying mulch if compared to those without applying mulch. This research is supported in a study by[5] which states that one of mulch roles is to retain micro-climate around root growing area optimal so that it supports the optimal growth of the plant. Besides, the result of a study by[8] demonstrates that the utilization of black silver plastic mulch could result in the best yield of shallots. Other than application of mulch, in order to enhance the growth and production of shallots it is by fertilization. Black silver plastic mulch is able to stop the evaporation of water within the soil so that the physical, chemical and biological texture of the soil stays optimal. This condition encourages more optimal formation of fibrous root system on shallots that enable growth and development of the plant. Based on a study by[10], it states that paddy straw mulch can diminish humidity up to 36% as compared to applying no mulch at all. Other than the ability to dropping down the temperature of the soil in the daylight, paddy straw mulch can also form good soil infiltration. Decomposed paddy straw mulch will be then a source of nutrients for microorganisms in the soil. Thus, paddy straw mulch has superiorities like curbing evapotranspiration, dropping downthe air and soil temperature in order to avoid water deficiency in the soil surface and prevent threat of drought[4]. So, the straw mulch application can diminish the soil temperature and retain the soil moisture around

the root growing area. The thicker the paddy straw mulch applied, the more it diminishes the soil temperature which affects the root respirational rates. According to[12], it is stated that low soil temperature has the ability to slow down root respirational rate so that assimilates transferred as nutrients will be much more. The loss of water in a single species of plant can occur through evapotranspiration process since the period of the plant growth[11]. The higher evaporation rates follow higher evapotranspiration rates of the plant. Efficiency in using water by a plant can also be done by the application of mulch. [3]stated that the application of mulch supports the subtraction of water consumption during the growth of tubers of onion so that the loss of water is probably smaller if compared to applying no mulch.

Fertilizing holds an important role in a way to improve the yield of shallots, one of the fertilizers is NPK fertilizer. It is a compound fertilizer in the same portions of each element and in the form of granules. It makes it a good basic fertilizer and even additional fertilizer. This fertilizer contains element N, P_2O_5, K_2O, MgO, CaO, and this fertilizer is easily dissolved in water so that it can be directly absorbed by a plant[7]. The result of a study by[14] showed that 200 kg/ha dosage of NPK fertilizer has given the best yield of shallots. The application of NPK fertilizer can be done by the application of compound or straight/single fertilizer. The use of compound fertilizer can complete the use of single fertilizer. Compound fertilizer has more superiorities than single fertilizer as it has more than one nutrients, it is more practical to order, transport, store, and apply easily. Another benefit of the compound fertilizer application is that it is more homogeneous in case of its spread[15]. The result of a study by[9] demonstrated that the treatment of NPK fertilizer can add more P content in the soil, the growth and yield of shallots, and also lower down the soil pH from 6.44 down to 6.27. Suitable soil pH to grow shallots is 5.6 to 6.5. At this soil pH, the soil has the ability to optimize the absorption of nutrients which is optimal at pH 6.5 to 7.0.

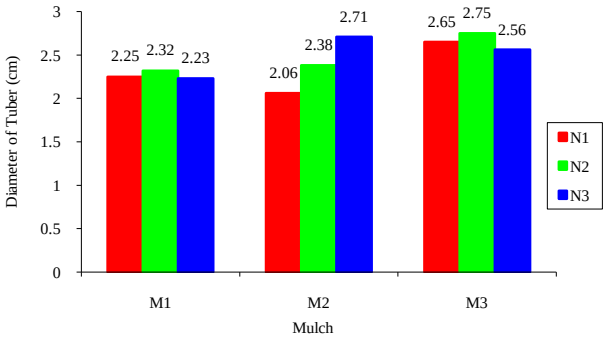
II. Material And Methods

The study was carried out by using randomized block design by treating two application factors namely, types of mulch and NPK fertilizer. The application factors are as following: Factor 1: The Usage of Mulch consisted of three applications namely, M_1 (without mulch), M_2 (paddy straw mulch), M_3 (black silver plastic mulch); Factor 2: The Usage of NPK fertilizer consisted of three treatments namely, N_1 (25g/plot), N_2 (30g/plot), N_3 (35g/plot). If the analysis of variance is real, then it will be continued with Duncan level 5%. Parameters observed were tuber diameter, the number of tubers, fresh weight of tuber, and dry weight of tuber. The variety of shallots which was used was BatuIjo variety. The tubers picked to use were those healthy tubers or free from diseases. They must have shiny color, and weigh ± 5 g. Prior to planting the tubers, their tips were cut as much 1/3, and then they were planted and covered with the soil. Before planting, mulch had been installed according to the applications. The installment of the black silver plastic mulch was conducted in the daylight when the sun was shining brightly in order to let the mulch to expand maximally. The mulch was given holes utilizing used milk can of 10 cm diameter, and the space among holes of mulch was 20 x 20 cm, whereas the installment of paddy straw mulch was done after planting the shallot tubers by putting it on the ground/ plot. The application of the NPK fertilizer was done 3 times namely after 2,4,and 6 weeks planting.

III. Result And Discussion

Diameter of Tuber (cm)

The result of photosynthesis by plant is accumulated in the form of tubers of the shallots. This is shown by the yield harvested. The ability of a plant to yield bigger tubers depends on the ability of the plant to do photosynthesis.



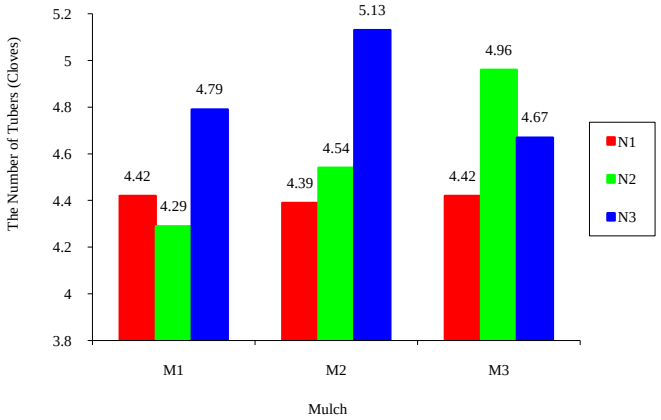
Picture 1. The diameters of shallot tubers on application of types of mulch and NPK fertilizer.

Picture 1 displays the effect of mulch applications and NPK fertilizer on diameters of tubers. It results in the highest average of diameter of tubers on application of black silver plastic mulch with NPK fertilizer 30 g/plot (M_3N_2) that is 2.75 cm; and the lowest average of tubers' diameters is on application of paddy straw

mulch with NPK fertilizer 25g/ plot (M_2N_1) which is 2.06 cm. This is proposed as black silver plastic mulch has the ability to retain temperature and moisture in order that the photosynthesis process occurs successfully. In addition, utilization of mulch also suppresses growth of weeds while the weeds can absorb nutrients and minerals and can locate space. This is supported by the result of a study conducted by[1] which stated that the ability of mulch to suppress fluctuations of soil temperatures and give more space for a plant to grow enable the photosynthesis process to last successfully in order to produce nutrients which are then trans-located to form tubers. The application of NPK fertilizer 30 g/plot resulted in the highest diameter of tubers. This is proposed because that much concentration of fertilizer suffices nutrient needs of the plant so that the plant succeeds in its optimal growth and production.

The Number of Tubers (Cloves)

The application of paddy straw mulch with NPK fertilizer up to 35 g/plot is capable of producing the highest number of tubers. This occurs because fertilizing as that much of NPK fertilizer can accelerate the growth and development of plant organs that then make the plant to grow more leaves. Nitrogen element in NPK fertilizer plays an important role as protein component while Phosphor and Calcium function to acceleratedivision of meristematic cells and stimulate root and leaf growth. The more the number of leaves of the plant, the more is the result of the photosynthesis that will be stored in the form of tubers of shallots.

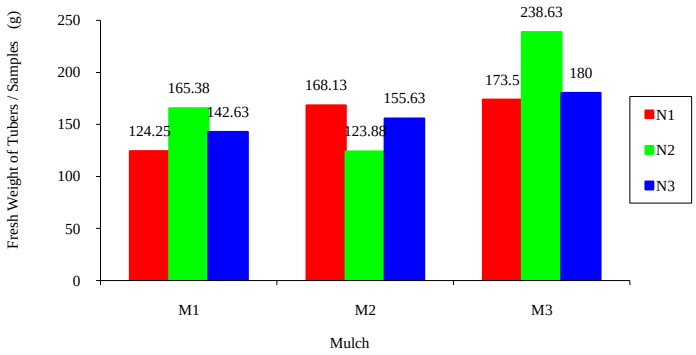


Picture 2. The number of shallot tubers by the application of several types of mulch and NPK fertilizer application.

Picture 2 exposes the impact of mulch treatments and NPK fertilizer applications. The highest average number of shallot tubers is on paddy straw mulch treatment and NPK fertilizer 35 g/plot (M_2N_3) which is 5.13 cloves whereas the lowest average number of shallot tubers is on treatment without mulch and application of NPK fertilizer 30 g/plot (M_1N_2) which is 4.29 cloves.

Fresh Weight of Tubers/Samples (g)

Weight increase in shallot tubersis one of photosynthesis impacts. The result of photosynthesis in the form of photosynthates will be stored in the shallot tubers. The more photosynthesis processes carried out, the more is the fresh weight of the shallot tubers.

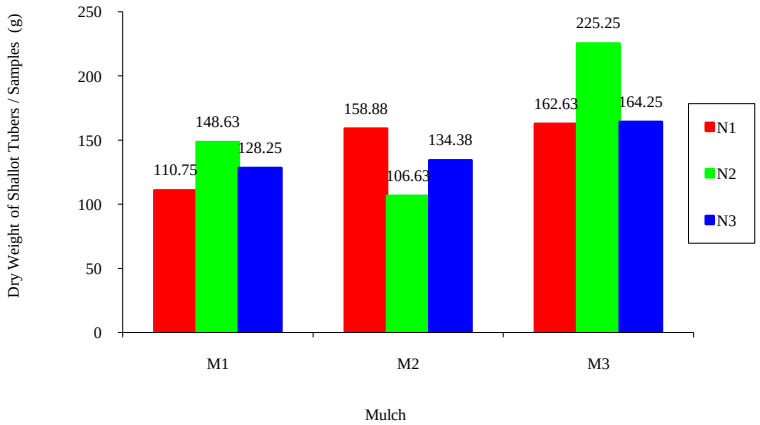


Picture 3. Fresh weight of shallot tubers/shallot samples by the treatment of several types of mulch and applications of NPK fertilizer

Picture 3 displays the impact of several types of mulch treatment and application of NPK fertilizer on fresh weight of shallot tubers. The highest average of shallot tubers' fresh weight is on black silver plastic mulch treatment with application of NPK fertilizer 30 g/plot (M_3N_2) which is 238.63 g while the lowest average of shallot tubers' fresh weight is on paddy straw treatment with application of NPK fertilizer 30 g/plot (M_2N_2) that is 123 g. This result is proposed as black silver plastic mulch has the ability to retain water in the soil, temperature and moisture so that the sufficiency of water for the plant can be fulfilled. The utilization of black silver plastic mulch is a way to manipulate the growing area of a plant. This usage of mulch can also better air condition of the soil and ensure the adversity of water for the plant. Meeting these conditions, the plant has the ability to last photosynthesis successfully. Increase of photosynthates will add up fresh weight of the tubers. This fact is supported by[1] in a research which proposed that the compact texture of mulch can retain water to stay longer within the soil and this availability of water in the soil plays an important role to accumulate water content within the shallot tubers. According to[6], black silver plastic mulch can protect the soil from kinetic energy of raindrops so nutrient leaching will not occur around the root growing area of the plant. Plastic mulch increases mineralization and curbs nutrient leaching in order to improve production of the plant in the form of better tubers.

Dry Weight of Shallot Tubers/Samples (g)

The results of photosynthesis processes of the plant accumulate in the plant tubers which can be measured by the fresh weight of the shallot tubers. Dry weight of tubers show dry materials accumulated during the plant growth. Analysis of the growth can be representedin the dry weight of the tubers as a result of the ability of the plant to carry out photosynthesis. The dry weight of the plant depicts efficiency of physiologic processes on the plant.



Picture 4. Dry weight of the shallot tubers/ samples by the treatment of several types of mulch and application of NPK fertilizer.

Picture 4 shows the impact of treatment of several types of mulch with the application of NPK fertilizer on dry weight of the shallot tubers. The highest average dry weight of the shallot tubers is on the treatment of

black silver plastic mulch with the application of NPK fertilizer 30 g/plot (M_3N_2) that is 238.63 g while the lowest average dry weight of the shallot tubers is on the treatment of paddy straw mulch with the application of NPK fertilizer 30 g/plot (M_2N_2) which is 106.63 g. This is proposed so because black silver plastic mulch has the capability to retain the soil temperature and moisture and also the sufficiency of water so that physical conditions and nutrient contents of the soil remain well. This condition then causes the plant to grow successfully and results in increase of fresh and dry weight of the plant. This fact is supported by [16] in aresearch which demonstrated that the usage of mulch enables to better the soil structure in order to encourage the development of tubers.

IV. Conclusion

Based on the results of the study, it is concluded that the highest diameter of the shallot tubers was on the application M_3N_2 (2.75 cm), whereas the lowest diameter of the shallot tubers was on the application M_2N_1 (2.06 cm); that the highest number of the shallot tubers was on the application M_2N_3 (5.13 cloves), while the lowest number was on the application M_1N_2 (4.29 cloves); the highest fresh weight of the shallot tubers was on the application M_3N_2 (238.63 g), while the lowest fresh weight was on M_2N_2 (123.88 g); that the highest dry weight of the shallot tubers was on the application M_3N_2 (225.25 g), while the lowest dry weight was on the application M_2N_2 (106.60 g).

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