

## Analysis of Mulching Effects on The Growth Performance of Spring Onion Freda Variety (*Allium fistulosum* L.)

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### ABSTRACT

*The use of mulch aims, among others, to provide a more ideal microclimate to support the growth of spring onion. The purpose of this study was to analyze the effect of mulch on the growth performance of the spring onion Freda Variety. The research location was conducted at the Salaran Experimental Garden belonging to the SWCU Agriculture and Business Faculty from May 2021 to August 2021. This experiment used RAK which consisted of five treatments, namely M0 (without mulch), M1 (black-silver plastic mulch), M2 (transparent plastic mulch), M3 (corn stem mulch), M4 (reed mulch). Each treatment was repeated five times and the data were analyzed using variance and DMRT 5%. The result showed that the best treatment to support spring onion performance was reed mulch because it had the highest average of all growth components and plant fresh weight of 53,17 cm, stem diameter 14,92 mm, number of leaves 6,50 leaves, number of tillers 1,90 and fresh weight 441 grams and has the highest soil organic matter content, lower temperature soil and increase soil moisture.*

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## 1. INTRODUCTION

Spring onion or leek (*Allium fistulosum*) is a plant that has the potential to be developed. This can be seen from the harvested area of spring onion in Indonesia in 2020 of 61,963 hectares where this figure has increased from the previous year (BPS, 2020a). The increase in population causes the demand for green onions to increase. This scallion is in great demand, especially by the instant food industries as a seasoning (Sutrisna *et al.*, 2003). Spring onion production in Indonesia by 2020 is inversely proportional to data on harvested area. Data in 2019 on spring onion production was 590,596 tons and decline to 579,748 tons in 2020 (BPS, 2020b). This decline in spring onion production can be caused by one of them in microclimate management cultivation techniques that are not yet optimal to increase crop yields (Wisudawati *et al.*, 2016).

One alternative in maintaining the microenvironment of spring onion plants is the use of mulch (Dewi, 2013). Mulch in plant cultivation serves to suppress weed growth, maintain soil moisture and reduce the amplitude of soil temperature (Maulana & Chodzin, 2011), besides the use of mulch can also protect the soil surface from rain and maintain soil fertility (Alhadi, 2018). The use of organic mulch can increase the organic matter content of the soil if it has been decomposed slowly, so that it can improve the physical, chemical and biological properties of the soil (Harsono, 2012). Inorganic mulch has the advantage that it is not easily damaged by weather (Fahrurrozi, 2018). The purpose of this study was to analyze the effect of the types of mulch on plant performance to increase plant growth and yield, especially on spring onions.

## 2. MATERIALS AND METHODS

This research was carried out in the Salaran experimental garden belonging to the Satya Wacana Christian University Faculty of Agriculture and Business (-7.3742, 110.4259) which has an altitude of 1,050 meters above sea level. The study was conducted from May 2021 to August 2021. The study used a Randomized Block Design (RAK) consisting of 5 treatment levels and 5 replications, so that there were 25 experimental units. The beds made are 2 m x 1 m, and in each bed there are 20 plants where 3 plants were sampled. The treatment levels in this study were M0 = no mulch (control), M1 = black-silver plastic mulch, M2 = transparent plastic mulch, M3 = corn stalk mulch, M4 = reed grass (*Imperata cylindrica* L.) mulch. The data were analyzed using variance (F-test), if the results of the variance had a significant effect, then proceed with the DMRT test.

### 2.1. Plant Maintenance

Plant maintenance activities include replanting carried out in the early weeks of planting, weeding to clean weeds, watering carried out in the afternoon or when it is not raining, and mechanical pest control.

### 2.2. Analysis of Growth and Yield of Onion Plants

Growth analysis consisted of observing plant height, stem diameter, number of leaves, number of tillers and biomass. Measurements were made every week until the plants were ready to harvest.

### 2.3. Soil Test

Soil analysis was carried out, namely the total nitrogen test using the Kjeldahl method, C-organic with the Walkley and Black method. Soil organic matter (SOM) was calculated from the Equation (1) (Sabaruddin *et al.*, 2009) which was carried out after harvest.

$$\text{SOM} = \% \text{C-organic} \times 1.724 \quad (1)$$

## 3. RESULTS AND DISCUSSION

### 3.1. Effect of Mulch Types on Soil Temperature and Humidity

Table 1 shows average soil temperature and humidity in day time (12.00-13.00 PM). It can be seen that mulch type significantly affected soil temperature and soil humidity as well. The use of silver black plastic mulch and clear plastic slightly increased the soil temperature during the day with slightly lower humidity than those of without mulch. This is likely to be caused by the heat energy in the soil trapped by the plastic mulch.

The heat energy released by soil under the plastic mulch is a radiation in the range of infrared (long wavelengths). Glasses and plastic sheets are transparent to shortwave radiations such as solar radiation, but it is opaque to long wavelength radiations (Haryanto, 2015). Therefore, heat energy is trapped and built up in the soil under plastic mulches. The use of transparent plastic mulch further increases the temperature of the soil because more and more short-wave radiation from outside is transmitted through the plastic but is then reflected as long-wave so that it cannot escape. The low soil moisture is caused by the relatively high soil temperature which triggers evaporation so that the loss of soil moisture through evaporation is relatively high.

**Table 1.** Average soil temperature and humidity at 12.00-13.00 PM

Mulch types	Soil temperature (°C)	Soil humidity (%)
No mulch (M0 = Control)	30,88a	73,2b
Plastic black-silver (M1)	31,32a	72,8b
Plastic transparent (M2)	32,06a	72,0b
Corn stalks (M3)	28,76b	82,8a
Reed grass (M4)	25,70c	83,8a

From Table 1, it can be seen that the use of organic mulch, namely corn stalks and reed grass, resulted in lower soil temperature during the day and higher soil moisture, when compared to without mulch or with plastic mulch. This happens because the heat energy from the soil can come out through between the corn stalks and weeds, so that heat does not accumulate under the organic mulch. In addition, high soil moisture also causes the soil temperature to not easily increase due to the presence of water in the soil. The relatively higher soil moisture is caused by the loss of groundwater through lower evapotranspiration and over time, the organic matter can store water so that the soil moisture is relatively higher than the use of plastic mulch which cannot store water.

In addition to environmental factors, plant growth is also supported by the availability of nutrients. Table 2 shows the content of soil with different mulch treatments, soil organic matter treated with corn stalks and alang-alang organic mulch was higher when compared to soil organic matter treated with black silver plastic mulch and clear plastic as well as control. Mulching with organic matter can increase the BO content of the soil while mulching with plastic cannot increase the organic matter of the soil (Basuki *et al.*, 2009). Plant parts that are used as mulch will be a source of N for microorganisms in breaking down organic matter, so the higher the total N content of the soil, the higher the soil organic matter. Mulch from organic matter will decompose into organic compounds, the addition of these organic compounds will increase the C-organic content. Organic compounds will be decomposed into inorganic compounds and will be absorbed by plants (Antari *et al.*, 2014).

### 3.2. Effect of Mulch Type on Soil Organic Mater

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**Table 2.** The content of soil with different mulch treatments

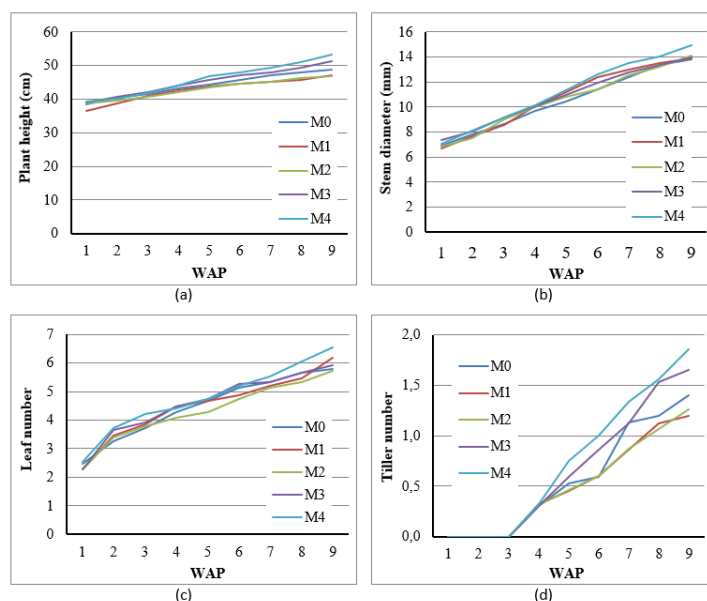
Mulch types	C-organic (%)	Total N (%)	SOM (%)
No mulch (M0 = Control)	4,45	0,44	7,67
Plastic black-silver (M1)	3,56	0,33	6,14
Plastic transparent (M2)	3,75	0,40	6,47
Corn stalks (M3)	5,56	0,47	9,59
Reed grass (M4)	6,57	0,48	11,33

### 3.3. Effect of Mulch Type on Onion Growth

Figure 1 reveals the development of plant growth represented by plant height, stem diameter, leaf number, and number of tillers. From Figure 1, it can be seen that the graph of the growth pattern of plant height, stem diameter and number of leaves from various types of mulch treatments was relatively the same. The difference only appears from the speed of growth, where the treatment using *Imperata* mulch seems to be higher than the treatment of other types of mulch or without mulch. The advantage of using *Imperata* mulch in spurring several components of spring onion growth is because *Imperata* mulch can maintain a favorable microclimate in the soil (lower soil temperature and higher humidity), increase soil organic matter content, organic C content, and maintain a slightly higher soil N content than without mulch or other types of mulch (Table 2).

These conditions seem to be very supportive for plant cells to develop better than those of other treatments. Soil humidity that is maintained high causes daily soil temperature to be stable with low fluctuations, so that plants do not experience periods of stress due to fluctuations in temperature and soil moisture. High soil moisture supports the dissolution of nutrients in the soil, including nitrogen, so that plants can meet their water and nutrient needs for photosynthesis. Nitrogen has a role to stimulate overall plant growth, especially stems, branches and leaves (Laude & Tambing, 2010).

Table 3 shows the average plant growth in week 9 or the last week. From Table 3, it can be seen that various types of mulch affect all components of spring onion growth observed. When compared with the treatment without mulch, plant height, stem diameter and fresh weight of spring onion plants could increase significantly when using organic mulch made from weeds. The increase in fresh weight of spring onion plants from various types of mulch treatments was relatively the same, but what was different was the speed of increase and the final yield. Plant fresh weight is a combination of several plant organs, namely leaves, stems and roots.



**Figure 1.** Development of plant growth for 9 weeks: (a) Plant height, (b) Stem diameter, (c) Leaf number, and (d) Tiller number.

**Table 3.** Effect of mulch type on several components of plant growth

Mulch types	Plant height (cm)	Stem diameter (mm)	Leaf Number	Tiller number	Fresh weight (gram)
No mulch (M0 = Control)	48,91b	13,82b	5,80ab	1,40ab	344c
Plastic black-silver (M1)	47,21b	13,89b	6,20b	1,20b	356b
Plastic transparent (M2)	46,80b	14,10b	5,70b	1,30b	357b
Corn stalks (M3)	51,39a	13,97b	5,90b	1,70ab	358b
Reed grass (M4)	53,17a	14,92a	6,50a	1,90a	441a
	**	*	*	**	**

Note: \*) significant; \*\*) very significant

The highest fresh weight of spring onion plants occurred in the treatment of Imperata mulch. This was caused by the size of the plant height, stem diameter, number of leaves and the number of tillers were more than in other treatments. Plastic mulch and corn stalk mulch were shown to be able to increase the fresh weight of spring onion plants when compared to no mulch. This was due to an increase in growth in the components of plant height, stem diameter, number of leaves and number of tillers, but when compared with the treatment of Imperata mulch, the fresh weight of the plant was still lower. The description on the packaging of the spring onion seeds of the Freda variety is slow flowering, strong branching power, the average height is almost 60-80 cm and the average weight is 300-400 grams. From the various types of mulch treatments, it turned out that the performance of spring onion plants using Imperata mulch was closest to its potential description.

#### 4. CONCLUSION

Various types of mulch treatment affect the components of plant height, stem diameter, number of leaves, number of tillers and plant fresh weight. The use of mulch can increase the performance and yield of spring onions and the best type of mulch in increasing plant performance and yield is *Imperata* mulch because it caused relatively low soil temperature, high relative humidity, soil organic matter, organic C and relatively higher soil nitrogen content. Spring onions cultivation using *Imperata* mulch produced the highest mean for plant height of 53.17 cm, stem diameter of 14.92 mm, number of leaves 6.50 strands, number of tillers 1.90 and fresh weight of 441 grams.

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