THE EFFECT OF HYDROGEL AND WATER ON THE GROWTH OF SHALLOT PLANTS *(Allium ascolanicum L)*

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Abstract

The research was carried out in the greenhouse of the Faculty of Agriculture, Islamic University of North Sumatra. Gedung Johor Village, Medan Johor District, Medan City, North Sumatra Province with an altitude of ± 25 m above sea level. This research will be conducted from December 2018 to February 2019. The aim of this study was to determine the effect of hydrogel and water on the growth of shallots (Allium ascolanicum L). The design used was a factorial Completely Randomized Design (CRD) which consisted of two factors, namely: the hydrogel administration factor consisted of 4 levels, namely: Control, 1 g/pot, 2 g/pot, 3 g/pot and the volume of water sprinkling consisted of 3 levels, namely: 125 ml/pot (0.25 soil water content field capacity), 250 ml/pot (0.5 soil water content field capacity), 500 ml/pot (soil water content field capacity). The results showed that water spray affected growth, namely on plant height and plant wet weight. The hydrogel did not affect growth, but the combination of water spray and hydrogel affected the growth of plant height, plant wet weight and efficiency of watering as much as 250 ml where plant height and plant wet weight of the 250 ml watering treatment and the 3 g hydrogel were not significantly different from the 500 ml watering treatment and 3 g hydrogel.

Keywords: Hydrogel, Water, Shallot Plant

INTRODUCTION

Shallot Shallot (*Allium ascolanicum* L) is one of the leading vegetable commodities which has been cultivated intensively by farmers for a long time. Shallots are also a vegetable commodity that has high economic value, both in terms of fulfilling national consumption, a source of income for farmers, and its potential as a foreign exchange earner (Deptan, 2007).

Climate change has an impact on the failure of agricultural production. The threat of floods and droughts, as well as the development of pests and diseases is the impact of climate change which has affected the production of shallots and various other types of crops. Shallot development in conditions of uncertain climate change is a challenge that needs to be anticipated. In Indonesia, the impact of climate change that is happening is dynamic, both its effect on water-saturated soil conditions during the rainy season and drought during the dry season. This makes it difficult for farmers to follow the planting calendar. Climate change will shift the chances of successful farming from 1:1 in normal conditions between successful and failed crops, increasing to 2:1 or even decreasing to 1:2 (Suwandi, 2014). This means that climate change that supports better environmental conditions for plant growth can double production, conversely climate change that does not support the plant environment in the field can fail harvests. This is a challenge in producing innovative shallot production systems that are adaptive to climate change.

Climate change is manifested in the form of seasonal rainfall which varies depending on the location.

Water is a limiting factor in shallot cultivation and production, there needs to be technology to overcome this problem. Regular watering or irrigation on marginal land is very difficult and requires a lot of money. For this reason, a technological breakthrough is needed that is able to store water for a certain period of time and will release it when the plant media is dry. One application of this technology is by adding a hydrogel to hold the availability of water in the field, the hydrogel is expected to help store, efficiently and provide water for shallot plants.

In the last decade, research on hydrogels has made various advances. Hydrogel (polyacrylamide) is a hydrophilic polymer that has the ability to expand in water and form an equilibrium state (Barakat *et al.*, 2015). The use of hydrogel in planting media is an alternative to increase the efficiency of water use. The use of hydrogels can be utilized in various fields including as a super absorbent polymer material. According to Erizal *et al*, (2009) The advantages of using hydrogel when compared to other absorbent materials such as paper, cellulose and cotton are the ability to absorb hydrogel 350 times its dry weight, resistance to pressure and 90% of the material can be decomposed making it environmentally friendly. Other benefits of using hydrogels are reducing the frequency of watering or irrigation by 50%, reducing the loss of water and plant nutrients caused by leaching and evaporation, improving the physical properties of very dense soil by forming good air aeration, reducing mortality.

LITERATURE REVIEW

El Niño impact

Climate change is a fairly new problem, especially in Indonesia, where this unpredictable weather anomaly has a major impact on human activities and survival. The agricultural sector is the sector that suffers the most from this climate anomaly, one example is the occurrence of Puso or crop failure due to dry land, increased plant-disturbing organisms and high evaporation. Apart from the agricultural sector, this climate change also has an impact on the environment, for example forest fires which have become a major problem in Indonesia in the last 5 years and have an impact on public health due to the resulting haze (Department of Agriculture, 2014).

Use of Hydrogels

Hydrogel is a soil conditioner that functions to increase the capacity of the soil to hold water in very limited conditions. Hydrogel is able to supply more water for plant growth resulting in an increase in plant growth in general. Using alcosorb in pots/polybags in the form of granules will lengthen the watering period and reduce the amount of water needed. Hydrogels can also be used when transplanting any type of plant. This can reduce stress/shock to the plants during transfer. The use of hydrogel in plantations/agriculture can regulate and maintain water levels in critical land conditions. In general, the recommended dosage for using hydrogel is 1-5 g of hydrogel/tree (Anonimus, 2014).

METHOD

This research was conducted in the greenhouse of the Faculty of Agriculture, Islamic University of North Sumatra. Gedung Johor Village, Medan Johor District, Medan City, North Sumatra Province with an altitude of ± 25 m above sea level. This research was conducted from December 2018 to February 2019.

This study used a factorial Completely Randomized Design (CRD) consisting of two factors. The factors studied are as follows. The hydrogel administration factor consists of 4 levels, namely: A_0 = control, A_1 = 1g/pot, A_2 = 2g/pot, A_3 = 3g/pot. The water sprinkling volume factor consists of 3 levels, namely: R_1 = 125 ml/pot (0.25 soil water content field capacity), R_2 = 250 ml/pot (0.5 soil water content field capacity), R_3 = 500 ml/pot (field capacity soil water content).

Provision of hydrogel was carried out simultaneously at the time of planting the seedlings into the research pot planting medium with a volume size of 5 l. The soil is perforated with a diameter of 10 cm, then put 1 g, 2 g, and 3 g of the hydrogel according to the treatment into the hole at a distance of approximately 10 cm from the plant seeds, then cover it again with soil. The point is that the treatment does not interfere with the seeds to be planted (Anonimus, 2014).

In this study the watering technique used was a measuring cup with a volume of 500 ml. Then flush the plants with 500 ml, 250 ml, 125 ml of water for each treatment. Watering is done at 07.00 and the longest watering is done at 10.00 WIB according to the treatment that has been set, with watering time every 2 days until the plants are 50 days old.

RESULTS AND DISCUSSION

Plant Height (cm)

The results of the analysis of variance showed that the volume of water sprinkling treatment affected plant height, but the hydrogel treatment and the interaction of the two treatment factors did not affect shallot plant height at 50 days after planting (DAP). The average height of shallot plants at the age of 50 days after planting is presented in Table 1.

Table 1. Average Shallot Plant Height (cm) in Hydrogel Treatment and Watering Volume at 50 HST.

Treatment	Water Flushing Volume		
	R_1 (125 ml)	R_2 (250 ml)	R_3 (500 ml)
Hydrogel			
A_0 (control)	34.40a	32.90a	39.30a
	A	A	B
A_1 (1 g)	32.93a	34.87ab	39.23a
	A	A	B
A_2 (2 g)	32.23a	36.83ab	38.63a
	A	B	B
A_3 (3 g)	34.30a	37.70b	41.03a
	A	AB	B

Note: Numbers followed by the same letters are not significantly different according to Duncan's test at the 5% level of significance. Lowercase letters are read vertically (columns) and capital letters are read horizontally (rows).

The highest plants were obtained in treatment A_3 (3 g/pot) which was 41.03 cm, followed by treatment A_0 (0 g/pot) namely 39.30 cm, treatment A_1 (1 g/pot) namely 39.23 cm and treatment A_2 (2 g/pot) is 38.63cm.

Treatment of the volume of watering affects plant height. The highest plants were obtained in treatment R_3 (500 ml/pot), namely 41.03 cm, followed by treatment R_2 (250 ml/pot) namely 37.70 cm and treatment R_1 (125 ml/pot) namely 34.30 cm.

Figure 1. Growth differences in the highest (A_3R_3) and lowest (A_0R_1) treatment combinations

In general, there are differences in plant height growth caused by differences in the volume of watering and hydrogel application. The higher the volume of watering, the higher the plant growth, as well as the hydrogel administration factor. watering 125 ml/pot (R_1) at the beginning of its growth was not optimal because of the lack of water availability at the beginning of planting caused by the low volume of watering. This is in line with research by Asandhi *et al*. (2005). At the beginning of growth, plants grow well. However, in mid-growth, the plants experience a lack of water because the dry season is quite dry. As a result, the plants are harvested at the age of 50 days, so that the effective absorption of fertilizer is only until the second fertilization, which is 1 month after planting. At the age of 35 and 40 DAP, the plant height did not change, this is presumably due to the constant growth of the shallot plant, meaning that it has not experienced an increase in height.

Water will easily dissolve the nutrients in the soil and plants can absorb the dissolved nutrients in the soil. So from this process the process of photosynthesis occurs. The results of this photosynthesis will be used by plants for their growth process (Najiyati and Danarti, 1997).

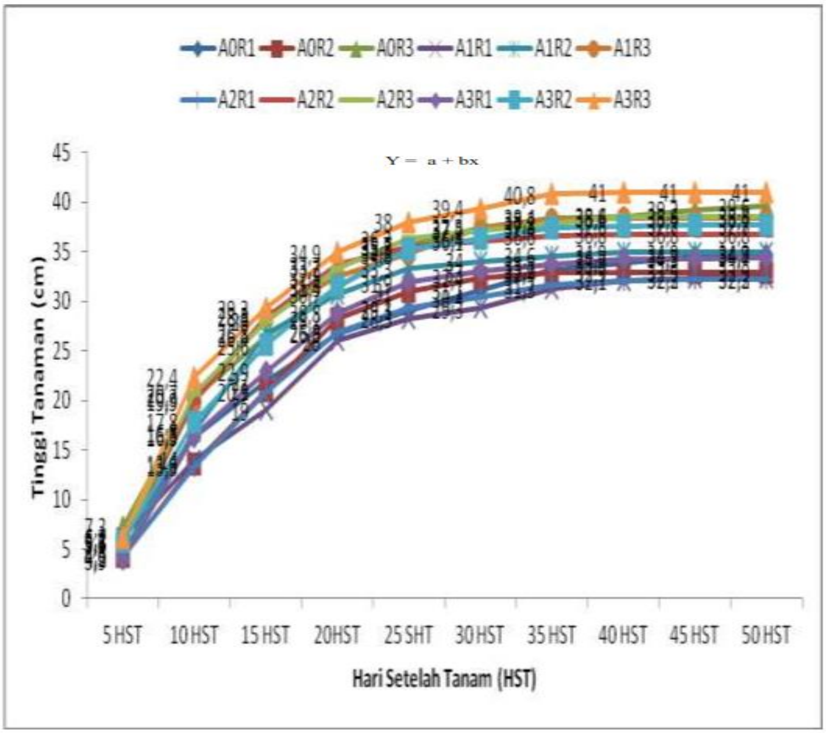

Figure 2. Graph of the Relationship between Shallot Plant Height (cm) and Treatment of Watering Volume (ml/pot)

The graph shows shallot plant height increased for each observation time, but at the age of 35-50 DAP the growth in plant height no longer increased significantly. This is in accordance with research which states that shallot plants begin to enter the vegetative phase after they are 11-35 DAP, and the generative phase occurs when the plants are 36 DAP. In the generative phase, there is what is called the tuber formation phase (36-50 DAP) and the tuber maturation phase (51-65 DAP).

The highest interaction between hydrogel administration and the volume of plant watering was obtained in the A_3R_2 treatment (3 g/pot and 500 ml/pot) namely 41.03 cm and the lowest in the A_2R_1 treatment (2 g/pot and 125 ml/pot) namely 32.23 cm.

Number of Leaves (strands)

The results of the analysis of variance showed that the treatment of hydrogel application and the volume of water sprinkling as well as the interaction of the two factors did not affect the number of shallot leaves at the age of 50 DAP. The average number of shallots at the age of 50 DAP is presented in Table 2.

Table 2. Average Number of Shallots (strands) in Hydrogel Treatment and Watering Volume at 50 DAP

Treatment	Water Flushing Volume		
	R_1 (125 ml)	R_2 (250 ml)	R_3 (500 ml)
Hydrogel			
A_0 (control)	30.00	26.67	30.33
A_1 (1 g)	27.00	26.00	34.67
A_2 (2 g)	28.67	31.33	37.67
A_3 (3 g)	28.33	34.33	39.33

Note: Notation is not carried out because it is not significantly different according to Duncan's test at the 5% level of significance

In general, it can be seen that the hydrogel treatment with the highest number of leaves was obtained in treatment A_3 (3 g/pot), namely 39.33 leaves, followed by treatment A_2 (2 g/pot), namely 37.67 leaves, treatment A_1 (1 g/pot). pot) namely 34.67 strands and treatment A_0 (0 g/pot) namely 30.33 strands.

In the water irrigation volume treatment, the highest number of leaves was obtained in treatment R_3 (500 ml/pot), namely 39.33 leaves, followed by treatment R_2 (250 ml/pot) namely 34.33 leaves and treatment R_1 (125 ml/pot) namely 30.00 strands.

It can be seen that several treatment factors of hydrogel administration and the volume of water sprinkling did not affect the number of leaves, but in the treatment of the volume of watering of 500 ml/pot (R_3) the number of leaves tended to be more than the treatment of the volume of watering of 250 ml/pot and 125 ml/ pot. This is because the water needs that are met during the vegetative period will support plant growth. Al-Moshileh (2007) stated that increasing the soil moisture content would increase the growth of plant height, number of leaves and tuber diameter in the plants tested. Treatment of 500 ml/pot increased plant height and number of leaves. This is in accordance with Leskovar *et al*. (2012) which stated that watering 100% ETc increased the number of leaves and plant height compared to 75% ETc and 50% ETc.

The leaves are the most influential part in the process of plant growth, because photosynthesis occurs in the leaves which will then continue throughout all parts of the plant. At the beginning of planting, the leaf growth tends to be good because the need for sufficient water is caused by the hydrogel which is able to store and slowly release the water available in the soil, but in the middle of the planting period there is a puddle caused by the applied hydrogel being no longer able to bind the water that is stored in the soil. given because the water capacity is too excess. This condition causes abnormal plant growth and disease.

Higher plants strongly dislike wet (flooded) soils. The roots are exposed not only to very low oxygen and high levels of carbon dioxide, but also to inorganic toxicity (Fitter and Hay, 1994).

The interaction of Hydrogel administration and the volume of water sprinkling had no significant effect on the number of leaves. The highest number of leaves was obtained in the A_3R_3 treatment (3 g/pot and 500 ml/pot) namely 39.33 leaves and the lowest in the A_1R_2 treatment (1 g/pot and 250 ml/pot) namely 26.00 leaves.

Number of Tubers per Clump (fruit)

The results of the analysis showed that the hydrogel treatment and the volume of water sprinkling as well as the interaction of the two treatment factors did not affect the number of shallot bulbs per hill. The average number of shallot bulbs per hill can be seen in Table 3.

Table 3. Average Number of Shallot Bulbs per Clump (fruit) in Hydrogel Treatment and Watering Volume

Treatment	Water Flushing Volume		
	R_1 (125 ml)	R_2 (250 ml)	R_3 (500 ml)
Hydrogel			
A_0 (control)	6.67	6.67	7.33
A_1 (1 g)	6.67	6.67	8.00
A_2 (2 g)	6.33	7.33	9.67
A_3 (3 g)	7.67	8.00	8.00

Note: Notation is not carried out because it is not significantly different according to Duncan's test at the 5% level of significance.

In general it can be seen that the hydrogel treatment did not affect the number of tubers per clump. The highest number of tubers per clump was obtained in treatment A3 (3 g/pot) namely 8.00 fruit, treatment A_2 (2 g/pot) namely 9.67 fruit, treatment A_1 (1 g/pot) namely 8.00 fruit and treatment A_0 (0 g/pot) is 7.33 fruit.

Treatment of the volume of water sprinkling did not affect the number of tubers per clump. The highest number of tubers per clump was in treatment R_3 (500 ml/pot), namely 9.67 fruit, then treatment R_2 (250 ml/pot) namely 8.00 fruit and treatment R_1 (125 ml/pot) namely 7.67 fruit.

It can be seen that the hydrogel administration factor and the volume of water sprinkled did not affect the number of shallot bulbs, but in some treatments, such as the volume of watering 500 ml/pot, the number of tillers was slightly higher than the treatment with the volume of watering 250 ml/pot and 125 ml/pot. This is because generative growth is influenced by vegetative growth, if the leaf growth at the beginning of the plant is good, then the generative growth will also be good.

Irrigation volume treatment did not affect the number of shallot bulbs. The process of forming and filling tubers is a growth stage that is very sensitive to water stress. The watering rate decreases, so transpiration also decreases and production decreases (Sulistyono and Yanuar, 2007). According to Russo (2008), the number of tubers planted is influenced by the density and variety of plants. According to Gough (2002), the number of leaves formed during vegetative growth greatly affects the number of tubers.

The interaction of Hydrogel application and the volume of water sprinkling had no significant effect on the number of tubers per clump. The highest number of tubers per clump was obtained in the A_2R_3 treatment (2 g/pot and 500 ml/pot) namely 9.67 fruit and the lowest in the A_2R_1 treatment (2 g/pot and 250 ml/pot) namely 6.33 fruit.

Plant Wet Weight (g)

The results of the analysis showed that the water volume treatment affected the wet weight of shallot plants, but the hydrogel treatment and the interaction of the two treatment factors did not affect the wet weight of shallot plants. The average wet weight of shallot plants can be seen in Table 4.

Table 4. Average Wet Weight of Shallot Plants (g) in Hydrogel Treatment and Watering Volume

Treatment	Water Flushing Volume		
	R_1 (125 ml)	R_2 (250 ml)	R_3 (500 ml)
Hydrogel			
A_0 (control)	15.67a	15.67a	26.00a
	A	A	A
A_1 (1 g)	13.33a	15.67a	28.67a
	A	AB	B
A_2 (2 g)	14.33a	17.00a	27.67a
	A	A	A
A_3 (3 g)	15.00a	25.33a	31.00a
	A	AB	B

Note: Numbers followed by the same letters are not significantly different according to Duncan's test at the 5% level of significance. Lowercase letters are read vertically (columns) and capital letters are read horizontally (rows).

In general it can be seen that the hydrogel treatment did not affect the wet weight of the plants. The wet weight of the heaviest plants in treatment A_3 (3 g/pot) was 31.00 g, treatment A_2 (2 g/pot) was 27.67 g, treatment A_1 (1 g/pot) was 28.67 g and treatment A_0 (0 g/pot) which is 26.00 g.

Treatment of the volume of watering affects the wet weight of the plant. The wet weight of the heaviest plants in treatment R_3 (500 ml/pot) was 31.00 g, treatment R_2 (250 ml/pot) was 25.33 g and treatment R_1 (125 ml/pot) was 15.67 g.

In general, there is a difference in the wet weight of the plants caused by differences in the volume of watering and hydrogel application. The higher the watering volume, the heavier the plant weight, as well as the hydrogel administration factor. The higher the hydrogel application, the heavier the plant weight. This is due to the plant's wet weight being affected by plant growth, the better the plant's growth in the vegetative and generative phases, the higher the plant's wet weight due to the lush leaves and large tubers. According to Suryana (2008), a plant will thrive and thrive if the nutrients provided can be absorbed by a plant and are in a form suitable for absorption by roots and in sufficient condition. In addition, the inability to produce tubers is related to yellowing of shallot plant leaves, yellowing of plant leaves causes reduced chlorophyll and reduced photosynthesis so that photosynthate production decreases.

The interaction of Hydrogel administration and the volume of water sprinkling had no significant effect on the wet weight of the plants. The highest plant wet weight was obtained in the A_3R_2 treatment (3 g/pot and 500 ml/pot) namely 31.00 g and the lowest in the A_1R_1 treatment (1 g/pot and 125 ml/pot) namely 13.33 g.

CLOSING

Conclusion

The results showed that water spray affected growth, namely on plant height and plant wet weight. The hydrogel did not affect growth, but the combination of water spray and hydrogel affected the growth of plant height, plant wet weight and efficiency of watering as much as 250 ml where plant height and plant wet weight of the 250 ml watering treatment and the 3g hydrogel were not significantly different from the 500 ml watering treatment and 3g hydrogel.

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