International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2015): 6.391

Effect of Wateringon Tomato (*Solanum lycopersicum* L.) Plant Growth

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Abstract: ***Studies on the growth of tomato plants had been intensively conducted. However, the growth that is influenced by wateringon a soil where the plants are growing is still little studied. Therefore, this study aims to determine theamount of water given to the plants and how a potential capacity of a soil absorbs water for the growth of the tomato plants (Solanum lycopersicum L.). The study used Completely Randomized Design (CRD) consisting of 4 treatments ie100% (1200 mL), 75% (900 mL), 50% (600 mL) and of 25% (300 mL) of soil field capacities. The results showed that the 50% and 25% of the field capacity affected significantly on reduction of the of tomato plant growth, suggesting that watering with 600 mL per 8 kg soil. On ther word, it is less than75 mL water per kg soil used is the worstgrowth of the plants.***

Keywords: Tomato, water, field capacity, growth

1. Introduction

Tomato plants (*Solanum lycopersicum* L.) were included into Solanaceae that have a short life cycle, less than a year. The plants have green, yellow, and red fruits and of which are used as a vegetable, fresh fruit and processed drink(Astija, 2017). In Indonesia, the plants are widely grown in both highland and lowland areas. However, the productivity of tomatoes in the highlands is higher reaching 26.6 tons per ha compared to those in lowland areas reaching only about 6 tons per ha. One reason isthat of available water in the highlands (Etti Purwati and Khairunisa, 2007).

Several studies reported that tomato plants will experience death if the lack or excess water(Hasanuzzaman *et al.*, 2013). The water for plants is obtained from the soil by absorption through roots to be transported by a xylem vessel into entire cells including leaves. In the leaves, water with carbon dioxide is used to produce sugars through photosynthesis(De Storme and Geelen, 2014). In addition, water is required for osmotic pressure, solvent, pH regulator, temperature control, and other physiological processes.On the other hand, the water will be evaporated through transpiration through stomata to remove out water excess(Astija, 2017).Therefore, water plays an important rolein plants.

Deficiency of the water in plant cells can be overcome byadditing of water into the cells. However, this process needs to be considered so that water given is not excessive or lack. The amount of water supplied depends highly on the structure of the plant, the climate in which the plant grows, and the type of soil(Sato, Peet and Thomas, 2000; De Storme and Geelen, 2014). In particular, the type of the soil as a medium used in the growth of a plant is of great importance because the soil structure has the ability to absorb and store water(Wang, Vinocur and Altman, 2003; Little *et al.*, 2005; Campanoni and Blatt, 2007; Wahid *et al.*, 2007; Niassy *et al.*, 2010). Therefore, this ability is important to know in order to determine how much water is given or the water required by the plant.

Until now, studies focused on theabilityof soil in absorbing water have not been intensively investigated. Therefore, it is necessary to conduct a study to determine the ability of soil used for the growth of tomato plants in absorbing water so that it can know how much water is given to the plant when the amount of groundwater is not sufficient.

2. Methods

The study was conducted using a Completely Randomized Design (RAL) consisting of 4 treatments being 1200 mL (100%), 900 mL (75%), 600 mL (50%), and 30 mL (25 %) of field capacities. Each treatment was repeated 3 times. This study began with the determination of field capacity by taking the soil used in the study to be dried and weighed as much as 8 kg as an initial weight. The soil was then put into a polybag and placed in a bucket containing water. Further, the polybag was lifted and kept in a closed room for 4 days until the water no longer drips. Polybag was weighed to get a final weight. The difference between the final weight and the initial weight was called the field capacity value. Furthermore, the soilwas ready for use. Seedling plants were planted in the soil in polybags. The seedling plants were obtained from germinating seeds. Seeding was firstly conducted by soaking into thewater for 10-15 minutes. Good seeds were indicated by seeds submerged in water. The seeds were picked and sown into the soil. After germinating and growing for 2 weeks marked by the formation of two green leaves, the seedlings were planted into the soil. During its growth,the plantsweretreated by water according to the treatment types mentioned. Watering was done in the morning. The next step was anobservation to measure plant height in plants 20 and 40 days after planting (dap). Measurements were by placing a ruler from ground surface to the highest end of the stem. Other observations were a number of leaves and of branches with counter tools. Leavesarea wasmeasured using the Portable Laser Leaf Area Meter. The data obtained were then analyzed using analysis variance(ANOVA) one way assisted with XLSTAT 2017 Program.

3. Results

Determination of field capacity by using as much as 8 kg of soil was 1.2 kg or 1.2 L water meaning that a value of the field capacity was 1200 mL for 100%. Furthermore, to determine 75% of the field capacity was obtained by multiplying 1200 mL ie 900 mL. The same way, for 50% and 25% of the field capacity were 600 mL and 300 mL, respectively. This result illustrates that the soil used for the growth of tomato plants has a maximal ability to absorb the water as much as 1200 ml per 8 kg of soil or an average of 150 mL per Kg of soil. The field capacity is used as a basic to determine a potential soil in absorbing the water and to determine an amount of the water given as wel as the water required by plants for the tomato plant growth. From the results, use of 100% (1200 mL), 75% (900 mL), 50% (600 mL) and 25% (300 Ml) influence significant differences on plant height, number of leaves, number of branches and leaf area of tomato plants.

The observed average of tomato plantheight at 20 dap (days after planting) and 40 dap treated by 100% or 1200 mL, 75% or 900 ml, 50% or 600 ml and 25% or 300 ml were completely shown in Figure 1.

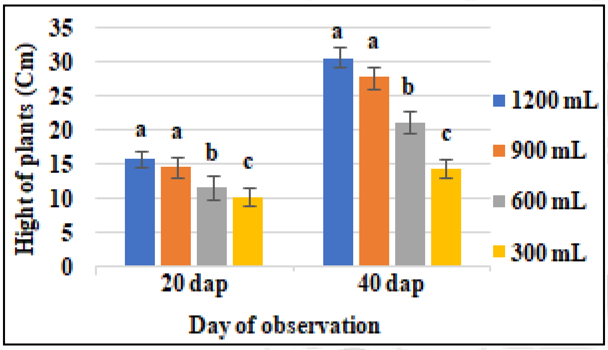

Figure 1: Tomato plant height at 20 dap (day after planting) and 40 dap treated with 100% (1200 mL), 75% (900 mL), 50% (600 mL) and 25% (300 mL). Hight of the plants at 20 and 40 dap was significantly reduced when the plants were watered with 600 mL and 300 mL.

Based on the Figure above shows that tomato plant growth varies depending on the amount of water provided. It seems that the less an amount of water supplied, the more inhibited. However, the amount of water 50% of the field capacity or 600 mL per 8 kg of soil significantly contributes to growth inhibition both at the age of 20 or 40 days of cultivation.

The amount of water also affects the average of leavesnumber from tomato plants at age 20 and 40 days after planting. As shown in Figure 2 showed that the number of leaves differed significantly between those treated with 100% or 1200 mL, 75% or 900 ml, 50% or 600 ml and 25% or 300 ml.

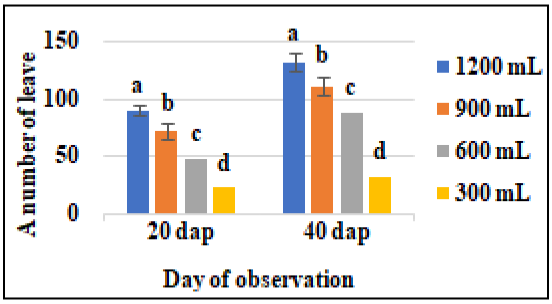

Figure 2: Number of leaves of tomato plants at age 20 dap and 40 dapdap treated with 100% (1200 mL), 75% (900 mL), 50% (600 mL) and 25% (300 mL). Reduction of the leaves number at 20 and 40 dap was a line with thereduction of the watering.

The amount of water seems to affect the growth of branches at 20 dap and 40 dap. Figure 3 showed that the reduction in the amount of water reduces the number of branches. Watering with 300 mL or 25% of field capacity reduced significantly to the number of branches.

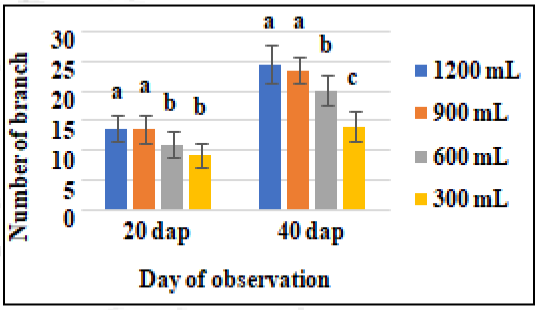

Figure 3: Number of branches of tomato plants at age 20 dap and 40 daptreated with 100% (1200 mL), 75% (900 mL), 50% (600 mL) and 25% (300 mL). The number of branches of the plants at 20 and 40 dap was significantly reduced when the plants were watered with 600 mL and 300 mL.

Meanwhile, the leaf widthwas to be reduced when the amount of the water was less than 50% of its field capacity that were 600 mL and 300 mL (Figure 4).

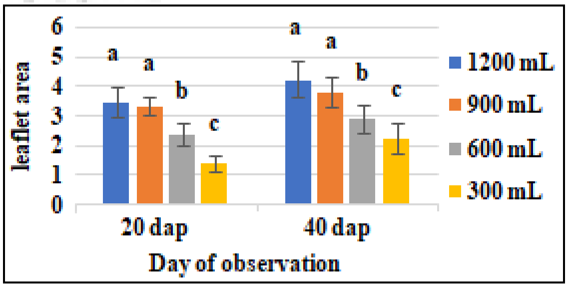

Figure 4: Leaves width at age 20 dap and 40 dapdap treated with 50% (600 mL) and 25% (300 mL) were reduced, compared to those with 100% (1200 mL), 75% (900 mL).

4. Discussion

The results showed that growth of tomato plants decreased at 50% and 25% of field capacity of the soil used for the tomato plants. However, the growth of the tomato plants increased at 75% and 100% of field capacity (Figure 1). This study is similar to a studyreported by Evita (2012)that peanut plants responded to several water levels in that water intake of 75%, 100%, and 125% of the field capacity provided for growth and yield of the peanut weremuch better, compared to 25% and 50% of field capacity conditions. This study suggests that tomato plant has the same water requirement as the peanut plant. This study is also line with areport proposed by Islami and Utomo (1995)that plants undergoing water stress would have a smaller size compared to plants growing normally with adequate watering. In addition, Arifin (2002)stated that plants that suffer from water shortage would experience a disruption to plant growth. Moreover, Whigham and Minor (2008)also reported that the lack of water resulted in the vegetative phase such asreduction of stemdiameter and crop.The results of this study differ slightly from previous studies as reported by Mapegau (2006) that water stress at 60% of KATT (soil water level available) of soybean Willis Cultivar decreased significantly in hight of the plant.

The amount of groundwater can affect the number of tomato plant leaves. This can be shown from the results of the study conducted (Figure 2). The study observed that the number of leaves of tomato plants decreased at the water stress level of 50% and 25% of the field capacity. However, the number of leaves of tomato plants increased at the water stress level of 75% and 100% of the field capacity. This is an important informationbecauseif tomato plants that experience water shortage of 50% of field capacity,those will affect the number of leaves that are reducing the number of leaves of the plant.

Another interesting point of the study is that the results illustrated that the number of branches and leaves of the tomato plants also decreased at the water stress level of 50% and 25% of the field capacity. However, the increasing number of branches increased at the water stress level of 75% and 100% of the field capacity (Figure 3 and 4). This result also suggests that lack of water up to 50% of the field capacity, it will result in areduction of the branches and leaves of tomato plants.The results of this study are parallel with the results of a study reported by Mapegau (2006)that at 40% the level showed asignificant decrease in the leaves of Willis and TidarCultivar. of the soybean.

5. Conclusion

Based on the research results, it can be concluded that 25% and 50% of the field capacity of the soil used by growing tomato plants have a significant effect on the decrease of the plant height, the number of leaves, the number of branches, and the leaf area.

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