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Article

Physiological Aspects Identification of the Aloe Vera Grown at Sukoharjo and Wonogiri District, Central Java

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Abstract. The aloe vera is known as an ornamental plant that can survive almost all elevations and has a myriad of benefits for humans. This plant can plant at various altitudes, including in the districts of Sukoharjo and Wonogiri. This study aimed to identify the physiological and morphological aspects of aloe vera (Aloe vera) planted in Sukoharjo and Wonogiri districts. Parameters measured were ambient temperature, leaf length, number of stomata, and transpiration rate. Stomata number parameters were calculated using the leaf extension count method under a microscope, while for transpiration rate analysis, cobalt chloride paper was used. The results of this study showed no significant differences in the parameters of average temperature, leaf length, number of stomata, and transpiration rate. The results of this study can be used as a suggestion, especially for Sukoharjo district policy makers, that the aloe vera plant has the potential to become one of the leading agricultural commodities.

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1. Introduction

Aloe vera is known as an ornamental plant that can be included in the serophytic succulent plant and stores water in its leaves. One of the characteristics of aloe vera is thick parenchyma cells that can store water reserves in the form of viscous mucilage [1]. This is why the aloe vera plant can survive in hot areas. The uses of this plant are many, including as a curative and therapeutic ingredient with active ingredients in the pulp. One of the active ingredients contained in this plant is polysaccharides, which are reported to have various

benefits such as antibacterial [2], anti-tumor [3], antiviral [4], and antioxidants [5] so that polysaccharides can be used in various health purposes such as wound medicine [6].

One of the physiological aspects that can be used as information on a plant is the number of stomata. It can be understood that the existence of stomata is the key to the continuation of photosynthesis. Stomata are a gap between the two guard cells, while the stomata apparatus are the two guard cells [7]. The number of stomata of aloe vera plants treated with drought stress was 40% of field capacity, indicating that there was no significant difference between the aloe vera plants that received this stress and control plants [8].

Transpiration rate is also a limiting factor in plant growth and development. Transpiration can be defined as the release of water in the form of water vapor through the stomata, cuticle, or lenticels. The transpiration rate is proportional to the speed at which water and nutrients are transported, and vice versa.

Sukoharjo and Wonogiri Districts are examples of districts in the province of Central Java, which have areas with varying heights. This geographical aspect is one of the many potential probabilities for the growth of aloe vera plants. According to BPS Wonogiri data in 2019, aloe vera is one of the largest biopharmaceutical plants in this district, while the aloe vera plant is not one of the leading commodities in Sukoharjo district.

With several reasons as the background of this research and based on literature studies that until now research related to the physiological aspects of aloe vera plants grown in Sukoharjo and Wonogiri districts has not been reported, this research is deemed necessary. This study aims to identify the physiological aspects of the aloe vera plant in Sukoharjo and Wonogiri districts. The results of this study are expected to provide scientific information regarding the physiological aspects of the aloe vera plant, especially those related to the photosynthesis process so that it can be used as a reference in the development of aloe vera cultivation in Sukoharjo and Wonogiri districts.Introduce the reader to the pertinent literature.

2. Method

The research begun with a sample collection from several areas in the districts of Sukoharjo and Wonogiri which have relatively the same altitude, namely in areas with an altitude of about 100-200 masl. The sample that has been obtained was then analyzed for parameters in the form of the number of stomata and the speed of transpiration in the Biology Education Laboratory, Universitas Veteran Bangun Nusantara Sukoharjo. The temperature in the sampling area was also measured using a mobile phone application.

In general, the flow of this research consisted of four stages, i.e. , measurement of ambient temperature, leaf length, number of stomata, and transpiration rate, that will be carried out in general can be explained as follows:

a. Measurement the ambient temperature

The temperature measurement in the environment around the aloe vera plant which was used as the research sample was carried out using a temperature check application on a cellphone.

b. Leaf length

Leaf length analysis was done by measuring the length of the leaves from the base to the tip of the aloe vera leaf using a ruler.

c. Number of stomata

The lower leaf of aloe vera was thinly sliced for getting cross-section containing stomata. The calculation of the number of stomata begins with thinly rubbing the corrector sheet on the surface of the aloe vera leaf. After that, the corrector sheet was removed and the leaves are observed under a microscope. The number of stomata is then calculated one field of view and is repeated 3 times.

d. Shape of stomata

Shape of stomata was observed using microscope and be cohered with literature.

e. Transpiration rate

The transpiration rate was calculated using the cobalt chloride paper method. Cobalt chloride paper was affixed to the leaves and the color change was observed.

The research results were analyzed statistically and descriptively. The data obtained from research related to measurements of temperature, leaf length, number of stomata, and transpiration rate were statistically analyzed by means of analysis of variance (ANOVA) completely randomized design at the 95% confidence

level. If there is a significant difference between treatments, continue with the DMRT follow-up test. The data related to the shape of the stomata were analyzed descriptively.

3. Results and Discussion

In general, the temperature of the sampling sites in the two districts was relatively the same, namely around 32ºC (Table 1). This was likely correlated with the altitude of the sampling site in the two districts, which ranges from 100-200 masl. With the similarity in altitude, it can be seen that there were similarities and differences in the physiological aspects of the aloe vera plant grown in the two districts.

Aloe vera was also reported to live at almost all altitudes, including at the height of the two study sites. Zulfita [8] reported that aloe vera was one of the plants cultivated in West Kalimantan, which has temperatures around the equator. In addition, aloe vera can also survive in the tissue culture space that ranges from 25ºC [9]. Thus, once again, the temperatures in the two study areas were the optimal temperature range for aloe vera to survive.

Table 1 Analysis of parameters of average temperature, leaf length, number of stomata, and transpiration rate of aloe vera plants grown in Sukoharjo and Wonogiri districts.

No	District origin	Avarage temperature (ºC)	Leaf lenght (cm)	Number of stomata (piece)	Cobalt chlorida discoloration (second)
1	Sukoharjo	31.8667[a]	32.133[a]	19.133[a]	60.467[a]
2	Wonogiri	31.8667[a]	34.467[a]	20.00[a]	59.200[a]

Note: different letters indicate a difference based on the DMRT test with a 95% confidence level.

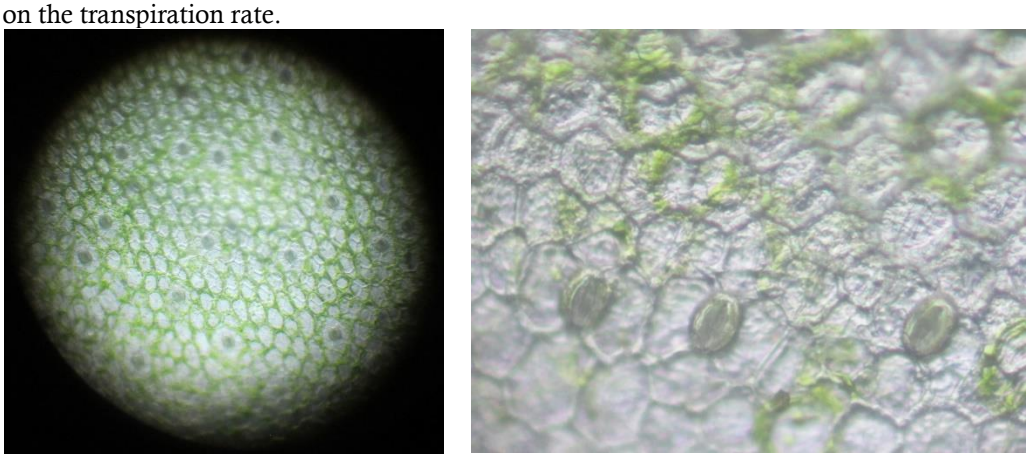
Apart from external factors, temperature, internal factors also play an important role in physiological aspects of the aloe vera plant, such as leaf length. From the observation of leaf length, the range of leaf lengths sampled was 25-45 cm (Table 1), both samples of aloe vera from Sukoharjo and Wonogiri districts. The length of aloe vera leaves in these two districts was included in the range of normal aloe vera leaves, which is around 40-90 cm [10].

Observations related to other aspects of physiology were the number of stomata. The results showed the range of stomatal numbers from 15 to 25 stomata when the sample was viewed under a microscope using a magnification of the objective and ocular lenses, each 10x (Table 1). This showed an equation in the number of stomata of the aloe vera plant; that is one of the plants belonging to the CAM type, which was grown in Sukoharjo and Wonogiri. [11] stated that CAM type plants had a smaller number of stomata compared to C3 and C4 types. The number of aloe vera stomata treated by cutting the tip of the midrib and those that did not turned out to be not significantly different was around 9 pieces per area mm2 [8].

With the characteristics of the number of stomata that was around 20 per area of the observation area using microscope, the stomata shape of the aloe vera plant sample turned out to have almost similar characteristics, namely in the form of “cryptophores” (Figure 1). The stomatal shape of "cryptophores" is a typical form of thick-leafed plants, which is characterized by the position of the cover cells lower than the location of the epidermal cells [12]. This is an added value for the aloe vera plant in an effort to efficiently use water for its survival.

Transpiration rate can be said to have a relationship with the number of stomata. This is based on the fact that stomata are the entrance and exit of gases and water vapor in plants. The transpiration rate can be easily determined using cobalt chloride paper, by calculating the amount of time it takes to change the color of the paper from blue to its original color (pink). The results of observations in the field during the day showed that the average time needed to change the color of cobalt chloride paper was around 60 seconds (Table 1). This result is in stark contrast to the report of [8] which reported that the average transpiration rate of aloe vera which was cut off its midrib was only around 18 seconds, and which was also given drought stress treatment of

40%, field capacity was only around 31 seconds, but measured at night day. This indicated the possibility of other environmental factors, such as soil type or measurement time (day vs night), which in turn have an influence on the transpiration rate.



A B

Figure 1 Cross-section of an aloe vera leaf. Stomata with characteristic black circles (A); the image was enlarged three times (B).

4. Conclusion

Aloe vera plants grown in several places at Sukoharjo and Wonogiri districts have physiological similarities. The average temperature of several places analyzed the samples was relatively the same, which was around 31°C. Leaf length parameters of the aloe vera plant samples grown in the two districts were relatively the same, i.e around of 32-34 cm. The parameters of the number of stomata and the transpiration rate of the aloe vera plant samples grown in the two districts were also not significantly different, with a range of 19-20 stomata per field of microscope observation with a magnification of 100x, and a time range of 60 seconds for the change in color of cobalt chloride paper associated with transpiration rate.

The suggestion from this research was the need for socialization in the Sukoharjo environment that the aloe vera plant is easily cultivated in the Sukoharjo area so that it is hoped that the aloe vera plant can become one of the leading agricultural commodities in Sukoharjo district, as happened in Wonogiri district.

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