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Effect of light intensity on growth and chlorophyll content of Horenso (*Spinacia oleracea*) plants

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ABSTRACT

Horenso plant or Japanese spinach (*Spinacia oleracea*) is a vegetable plant that is often used for consumption because it contains precursor, vitamins and minerals that are beneficial to health. Plant productivity can be increased by environmental engineering through the use of shade because sunlight influences directly through photosynthesis and indirectly in plant growth and development due to direct metabolic responses. This study aims to determine the effect of light intensity on plant growth and plant chlorophyll content and to see the correlation between chlorophyll content and plant growth of *Spinacia oleracea*. The research was conducted by experimental method with 3 differences in light intensity namely A = 6000 lux, B = 3000 lux, and C = 2000 lux and 3 differences in shade namely A = clear plastic shade, B = opaque plastic shade and C = white plastic shade. Chlorophyll measurement is used by using the spectrophotometer method. Horenso plant growth is measured by the increase in plant height and the width of the leaf diameter. Data analysis used the ANOVA test to identify significant differences in each treatment. The experimental results showed the value of $P = 0.728$ while the value of $\alpha = 0.05$, that there is no effect of light intensity on the growth of Horenso plants and The results of the correlation test showed that the value of $P > \alpha$. The value of $P = 0.704$ while the value of $\alpha = 0.05$, there is no significant relationship between the growth of horenso plants and plant chlorophyll content.

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Introduction

Horenso or Japanese spinach (*Spinacia oleracea*) is a vegetable plant from the Amaranthaceae tribe which is used for its leaves and shoots, both consumed fresh and processed. Horenso is a proven source of important nutrients such as carotene (precursor of vitamin A), ascorbic acid (vitamin C), and several types of minerals. According to the Agricultural Research Agency of the US Department of Agriculture, it is estimated that 100 g of fresh Horenso provides at least 20% or more of the recommended dietary intake such as β -carotene (provitamin A), lutein, folate (vitamin B9), α -tocopherol (vitamin E), ascorbic acid (vitamin C) and contains flavonoids and phenolic acids¹.

Light is an important component in the process of photosynthesis, especially in the light reaction (Hill reaction). Increasing light intensity causes an increase in leaf temperature and respiration rate thereby inhibiting photosynthesis². The light coming from sunlight will be captured by chlorophyll and raise the energy level of the electrons which are the result of water oxidation in the process of photosynthesis. The energy is used for the synthesis of macromolecules and cell division for growth. The Light intensity can affect the number of stomata so the lower the light intensity, the lower the stomata level³.

Plant productivity can be increased by environmental engineering through the use of shade which will affect sun exposure. Sunlight influences directly through photosynthesis and indirectly in plant growth and development due to direct metabolic responses⁴. Based on the results of this study, this research was conducted with the aim of knowing the effect of light intensity on plant growth and plant chlorophyll content and to see the correlation between chlorophyll content and plant growth of Horenso (*Spinacia oleracea*).

Method

This research was conducted using the experimental method. Fraenkel, et al, suggests that the experimental method is a type of research that directly tries to influence certain variables⁵. The experimental method looks directly at the effect of at least one independent variable on one or more of the dependent variables. The main characteristic of this method is that the researcher manipulates the independent variables.

Data collection was carried out through trials on research subjects, with three light intensity treatments, namely A = 6000 lux, B = 3000 lux, and C = 2000 lux, and three different shades, namely A = clear plastic shade, B = opaque plastic shade and C = white plastic shade, using Horenso plant (*Spinacia oleracea*). Chlorophyll measurement is used by using the spectrophotometer method. Horenso plant growth is measured by the increase in plant height and the width of the leaf diameter.

Results and Discussion

The growth of the Horenso plant was not very good in the three shades, the sign of its growth was the increase in the width of the leaves. It can be seen that the difference in plant growth on the first and sixth days experienced little growth and did not even show a significant change (Table 1,2,3). Based on several previous studies, it is explained that shade will affect the intensity of light received by plants and affect the availability of light energy which will be converted into chemical energy and heat energy. If light energy is not released back into the environment, this energy will be converted into heat energy and will raise the temperature of the leaves, while light energy is converted into chemical energy, namely through the process of photosynthesis by producing carbohydrates that are used by plants in their growth process⁶.

Table 1. Average Horenso Plant Growth

Treatment	Plant Growth (%)
6000 Lux	14.5±0.69
3000 Lux	9,6±0.56
2000 Lux	5.7±0.67

Horenso plants are kept in three shelters. Plant A is in clear shade with a light intensity of 6000 lux, plant B is in opaque shade with a light intensity of 3000 lux and plant C is in white shade with a light intensity of 2000 lux. The growth of these three plants was not very significant even with different light intensities, only visible changes such as some leaves withered, fell, and grew with an increase in leaf width of only a few cm. Due to the slight growth, the results of the ANOVA test show that the null hypothesis is accepted because of the value of $P > \alpha$. The value of $P = 0.728$ while the value of $\alpha = 0.05$ so that there is no effect of light intensity on the growth of Horenso plants.

After the Horenso plants were treated for 6 days, we tested the chlorophyll content in the leaves of the plants. Test the chlorophyll content using a spectrophotometer, the chlorophyll levels measured are total chlorophyll, chlorophyll A, and chlorophyll B. Plants in the clear shade (A) are plants that have the highest chlorophyll content compared to plants in other shades. There was only a slight difference in chlorophyll content in the leaves of the Horenso plants in the three shades (Table 2).

Table 2. Chlorophyll Content

Treatment	Chlorophyll Content (ppm)		
	Chlorophyll A	Chlorophyll B	Total Chlorophyll
6000 Lux	4.56468	6.3288	10.91636
3000 Lux	3.86596	4.7272	8.609
2000 Lux	1.48588	4.42	5.92652

Based on the results of the ANOVA test using the SPSS application, it can be seen that there is no effect between light intensity or the treatment given to the chlorophyll content in the leaves of the Horenso plant. $P\text{-value} > \alpha$. The value of $P = 0.386$ while the value of $\alpha = 0.05$ so that zero H_0 is accepted or there is no effect of light intensity on the chlorophyll content of Horenso plants. The results of the correlation test showed that the value of $P > \alpha$. The value of $P = 0.704$ while the value of $\alpha = 0.05$ so that zero H_0 is accepted or there is no significant relationship between the growth of horenso plants and plant chlorophyll content.

Conclusion

Based on the experiments that have been carried out, it can be concluded that with three differences in light intensity and three differences in shade, the growth of the horenso (*Spinacia oleracea*) plant did not experience significant growth, only a few cm of leaf width increased. After the 6-day experiment, the chlorophyll content of the horenso plant was measured with a spectrophotometer, then the results were measured with SPSS and the result was that there was no effect of light intensity on the chlorophyll content of the horenso plant. Correlation results using SPSS showed that there was no relationship between horenso plant growth and plant chlorophyll content.

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