Application of Rice Husk Silicate Extract to Increment Growth of Indoor Hydroponic Lettuce

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Abstract. The utilization of backyard or front yard for the cultivation of lettuce under hydroponics system is faced with a limited sunlight duration obtained by plants due to the shadow of buildings and other city infrastructure. This research aimed to overcome the limited sunlight by supporting various concentrations of rice husk extract. The experimental research method was used by a complete randomized design consisted of four treatments: A = without the application of silica extract, B = 10%, C = 20% and D = 30% silica extract of rice husk. Each treatment was repeated six times so that there were 24 experimental units obtained. The parameters measured were the main parameters (plant height, number of leaves, plant fresh weight) and secondary parameters (room temperature, room humidity, pH, electrical conductivity (EC), nutrient volume). The data were then analyzed by variance analysis at 5% significant level and Duncan multiple range test at 5% significant level. The results showed that the application of rice husk silica extract 10-30% concentration was not significantly different compared to without the application of rice husk silica extract. The application of rice husk silica extract has not been able to increase the growth of lettuce in conditions of light intensity lower than 4,500 lx.

1. Introduction
Shifting urban dietary patterns create new market opportunities to provide quality fresh vegetables. Lettuce is a vegetable that is consumed fresh in the form of salads or as additional filling material in sandwiches and hamburgers. The popularity of hydroponic technology in urban areas has encouraged urban community to have hydroponic installations as a system for growing vegetables, especially lettuce. The floating raft hydroponic system is one of the simplest hydroponic systems because it does not need a pump as a means to drain nutrients [1].

The most common hydroponic problem faced by urban communities is the availability spaces exposed to sunlight to place hydroponic installations. The availability of sufficient sunlight is an important factor for producing quality plants [2]. The addition of lights as a substitute for sunlight or to increase the intensity of the radiation requires additional costs. The element silica (Si) in hydroponic nutrients is rarely added to nutrient solutions except in rice plants, whereas the element Si has a role in increasing plant tolerance to biotic and abiotic stresses [3]. The abundant source of organic Si is the rice husks. Utilization of rice husk in agriculture generally used as a planting medium known as rice husk charcoal. Utilization of rice husk as a source of Si in hydroponic nutrition is carried out through the extraction process.

The application of rice husk extract to hydroponic plants is expected to be able to increase plant metabolism by making efficient use of water, nutrients, and sunlight [4]. This study aims to determine the effect of rice husk silica extract on the growth of lettuce plants and the concentration of rice husk silica extract which best supports the growth of lettuce plants.
2. Methods
This research was carried out from May-July 2019 in Cinunuk, Cileunyi Bandung District +689 m above sea level (asl). The experimental research method by using a completely randomized design of four treatments, namely A = without rice husk silica extract, B = 10%, C = 20% and D = 30% concentration of rice husk silica extract. As a control, lettuce was also planted outside the room to have full sunlight exposure. Each treatment was repeated six times to obtain 24 experimental units, each unit consisting of four plants. The research consisted of several stages, namely the process of making rice husk silica extract, seeding, making AB mix nutrition \[^5\], making a floating raft installation and growth lighting installation (growth lights consisted of 6 pcs red lights (660 nm), 12 pcs lights red (630 nm) and 6 pcs blue led (460 nm)) and two 18 watt-960 lumen (lm) compact fluorescent light (CFL) lamps. Transplanting is were done after two weeks of seedlings.

The application of rice husk silica extract was given by spraying it on the leaves at 7 and 14 day after transplanting (DAT) according to the treatment. Growth parameters observed were plant height, number of leaves, fresh weight, and dry weight of the plant. The observed environmental parameters are temperature, humidity, pH, electrical conductivity (EC), and crop water requirements. Data from observations of growth parameters were analyzed using analysis of variance at \(\alpha=5\%\) level, and followed by Duncan test at \(\alpha=5\%\) level if the results of the analysis of variance had a significant effect. Data from observations of environmental parameters were presented descriptively.

3. Result and Discussion
The average daily temperature and humidity in the room during the study were 24.5°C and humidity 60% respectively. The research took place in the dry season so that the humidity in the room was low while the temperature, due to limited exposure to sunlight, was only ranging between 23-26°C. The intensity of radiation during the day (07.00 am-05.00 pm) in the room during the study without the addition of lights is 53.5 lux. When added to the growing light, the intensity of the radiation is 440 lux, while the intensity of sunlight outdoors is more than 50,000 lux.

3.1 Electrical Conductivity (EC-Value), Nutrient Solution Acidity, and Crop Water Requirement
The electrolyte concentration of the nutrient solution measured by the electrical conductivity meter during the study decreased from the initial application of 1.5 mS cm\(^{-1}\) to 0.80-0.87 mS cm\(^{-1}\). A decrease in EC value indicates that the nutrients provided were used for plant metabolic processes. The results of the analysis of variance (Table 1) shows that the addition of silicate extract did not significantly affect the absorption of plant nutrients. The final EC value of each treatment was not significantly different, showing that nutrient uptake was not influenced by the administration of rice husk silica extract. The response of lettuce growth to silica application is lower compared to silica application in rice plants [6], [7].

| Treatments | Initial EC | End of EC value | Initial pH | End of pH value | Initial Nutrient Volume (ml) | End of Nutrient Volume (ml) |
|------------|------------|----------------|------------|----------------|------------------------------|-----------------------------|
| A= 0 ml l\(^{-1}\) | 1.5 | 0.870 | 7.6 | 8.4 | 4,000 | 2,200 |
| B= 10 ml l\(^{-1}\) | 1.5 | 0.845 | 7.6 | 8.3 | 4,000 | 2,623 |
| C= 20 ml l\(^{-1}\) | 1.5 | 0.863 | 7.6 | 8.3 | 4,000 | 2,745 |
| D= 30 ml l\(^{-1}\) | 1.5 | 0.805 | 7.6 | 8.3 | 4,000 | 2,520 |
| Variance Analysis \(\alpha=5\%\) (p-value) | 0.59 | 0.31 | 0.065 | ns | ns | ns |

Remark: ns= not significantly different

The increase in pH of nutrient solution at final observation (Table 1) was found may caused by an increase in the number of cations that is higher than the number of anions in the nutrient solution [7].
Observation of lettuce water requirements during growth was not influenced by the application of rice husk silica extract. However, crop water requirements in the control treatment were higher than those in rice husk silica application. Silica on lettuce has a function to reduce the impact of environmental stress that can interfere with plant growth [8].

3.2. Plant Height
The application of rice husk silica extract did not significantly affect the plant height parameters. When compared with the treatment without the application of silica extract (A) the treatment of silica extract of rice husk 30 ml l\(^{-1}\) (D) showed an average plant height of more than 30 cm. Based on the description of lettuce plants, Kriebo varieties can reach 22-30 cm high.

The growth of lettuce plants that get full sunlight has an average plant height of 28.97 cm, and the average plant height in treatment D that exceeds 30 cm provides information that the etiolation symptoms occurred in that treatment. Low light intensity will affect vegetative growth (plant height) and reduce the quality of crop yields [9], [10].

| Treatments     | 49 Day After Transplanting |
|----------------|-----------------------------|
|                | Plant Height (cm) | Plant Fresh Weight (g) | Leaf Number | Dry Weight (g) |
| A= 0 ml l\(^{-1}\) | 29.30              | 3.00                    | 6.83        | 0.144          |
| B= 10 ml l\(^{-1}\) | 24.30              | 1.22                    | 4.83        | 0.059          |
| C= 20 ml l\(^{-1}\) | 18.08              | 0.95                    | 4.42        | 0.047          |
| D= 30 ml l\(^{-1}\) | 35.87              | 2.44                    | 6.67        | 0.123          |
| Variance Analysis 5% (p\_value) | 0.41              | 0.33                    | 0.22        | 0.34           |
| Control (full sunlight) | 28.97              | 96.80                    | 11.33       | 7.60           |

Remark: ns= not significantly different

3.3 Leaf Number
Lettuce plants that have symptoms of etiolation appear leaves on each elongated stem segment. The application of rice husk silica extract did not affect the number of leaves. The number of leaves in the plant without the application of rice husk silica extract produced a number of leaves that were not significantly different from the application of rice husk silica extract 10-30 ml l\(^{-1}\). Lettuce plants that get full sunlight have produced an average number of leaves of more than 11 strands. The low number of leaves in treatments A, B, C and D compared to the growth of lettuce plants which get sunlight is suspected due to disruption of N, P and Ca uptake so that the increase in the number of leaves is inhibited [11].

3.4 Plant Fresh Weight and Plant Dry Weight
The application of rice husk silica extract in this study did not affect the fresh weight gain and dry weight of the plant. Inhibition of the process of water absorption and plant metabolism causes the fresh and dry weight of plants to be lower than the yield of plants that get full sunlight. The role of Si elements to increase the absorption of elements N, P, and K and plant growth did not work optimally if the light intensity is below 4,500 lx (60 µmol m\(^{-2}\) s\(^{-1}\)). Plants will achieve maximum growth if the daily light intensity is more than 15,000 lux [12].

4. Conclusions
The application of rice husk silica extract by spraying on the top surface of the leaves did not significantly affect all growth parameters. The addition of organic Si element from rice husk silica
extract has not been able to increase the growth of lettuce in conditions of light intensity lower than 4,500 lx.

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