BIOLOGICAL SCIENCES

PHOTOSYNTHESIS RATE COMPARISON BETWEEN AGE CLASSES *Eucalyptus Sideroxylon A. Gunn*, PLANTS IN ABSHERON PENINSULA

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ABSTRACT

This study aimed to investigate the photosynthesis rates of *Eucalyptus sideroxylon A. Gunn*. leaves over a year using the Plant Photosynthesis Meter 3051C. The photosynthesis rates of juvenile, mature, and aged leaves were measured at least three times a month during mid-morning. The results showed that there was a significant difference in photosynthesis rates among the different age classes, with aged leaves exhibiting the highest photosynthesis rate and mature leaves exhibiting the lowest. The study found that there were seasonal patterns in photosynthesis rates, with the highest rates observed during summer and the lowest during winter. These findings suggest that environmental factors such as temperature and geography of area may play role in determining the photosynthesis rates of *Eucalyptus sideroxylon A. Gunn*. leaves. Overall, this study provides important insights into the factors that influence the photosynthesis rates of this species and could be useful in informing future research and management strategies.

Keywords: Photosynthesis, plant physiology, *Eucalyptus sideroxylon A. Gunn*., infrared gas analysis, age-class differences.

Introduction

Photosynthesis is a vital process that enables plants to convert sunlight into energy-rich organic compounds, providing the foundation for nearly all life on Earth [5,7]. Eucalyptus trees are among the most important sources of biomass and wood products in the world [8,10], and their ability to perform photosynthesis efficiently has significant ecological and economic implications. In this study, we measured the photosynthesis rates of *Eucalyptus sideroxylon A. Gunn*. leaves over the course of a year using a plant photosynthesis meter 3051C. Our goal was to better understand how the photosynthetic capacity of this species changes over time and to identify any seasonal patterns in photosynthesis rates. By gaining a more complete understanding of photosynthesis in *Eucalyptus sideroxylon A. Gunn*., we can develop strategies for improving their growth and productivity, which has important implications for forestry and carbon sequestration efforts.

Material and Methods

The Plant Photosynthesis Meter 3051C is a portable instrument used to measure the rate of photosynthesis in plants. [1] It operates on the principle of infrared gas analysis, which involves measuring the exchange of carbon dioxide and water vapor between the leaf and the surrounding atmosphere. The 3051C features a small, handheld chamber that is placed over a leaf to measure the exchange of gases in real-time. The instrument records the concentration of carbon dioxide and water vapor in the chamber and calculates the rate of photosynthesis based on the change in these concentrations over time [3,4].

In our study, we used the Plant Photosynthesis Meter 3051C to measure the photosynthesis rates of *Eucalyptus sideroxylon A. Gunn*. leaves over the course of a year. We selected one individual juvenile, mature and aged *Eucalyptus sideroxylon A. Gunn*. trees growing in the same area and measured the photosynthesis rates of one fully-expanded leaf from each tree at least three times a month over the course of a year. We took measurements at mid-morning, when photosynthesis rate is typically highest. To ensure consistency, we used the same instrument operator and followed a standardized protocol for placing the chamber over the leaf and collecting the data.

The data collected by the 3051C allowed us to quantify the rate of photosynthesis in *Eucalyptus sideoxylon A. Gunn*. leaves over time and to identify any seasonal patterns in photosynthesis rates. By using this instrument to track changes in photosynthesis rates over a year, we are able to gain a comprehensive understanding of how this species responds to variations in light, temperature, and other environmental factors.

The study was conducted in the Absheron Peninsula, where a population of *Eucalyptus sideroxylon A.*

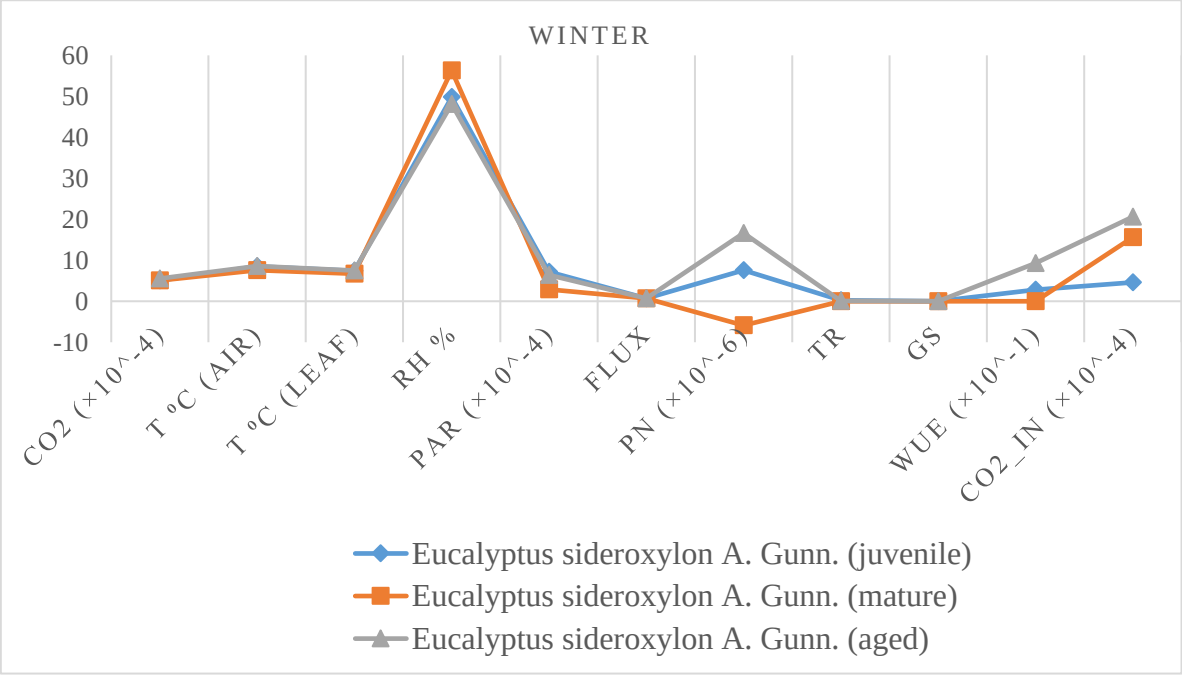
Gunn. plants was chosen as the focal species [12]. A suitable study site was selected based on the presence of a diverse range of age classes within the population. The site provided a representative sample of the species' growth and allowed for accurate classification of different age groups [12].

Height or size-based classification: To classify the *Eucalyptus sideroxylonn A. Gunn*. plants into different age classes, a height or size-based approach was adopted. This method leveraged the correlation between the plant's height or size and its age, considering that younger trees tend to be shorter or have smaller trunk diameters compared to older individuals. The height was recorded as the vertical distance from the ground level to the highest point of the tree, excluding any branches and foliage. In addition to height, the trunk diameter or circumference was measured using a measuring tape. The measurement was taken at a standardized height from the ground, typically 1.3 meters above the base of the tree.

Based on the height and size measurements, the *Eucalyptus sideroxlyon A. Gunn*. plants were categorized into three age classes: juvenile, mature, and aged. The specific criteria for each age class were established prior to data collection, considering the expected growth patterns and age ranges observed in previous studies or literature on the species [12,13].

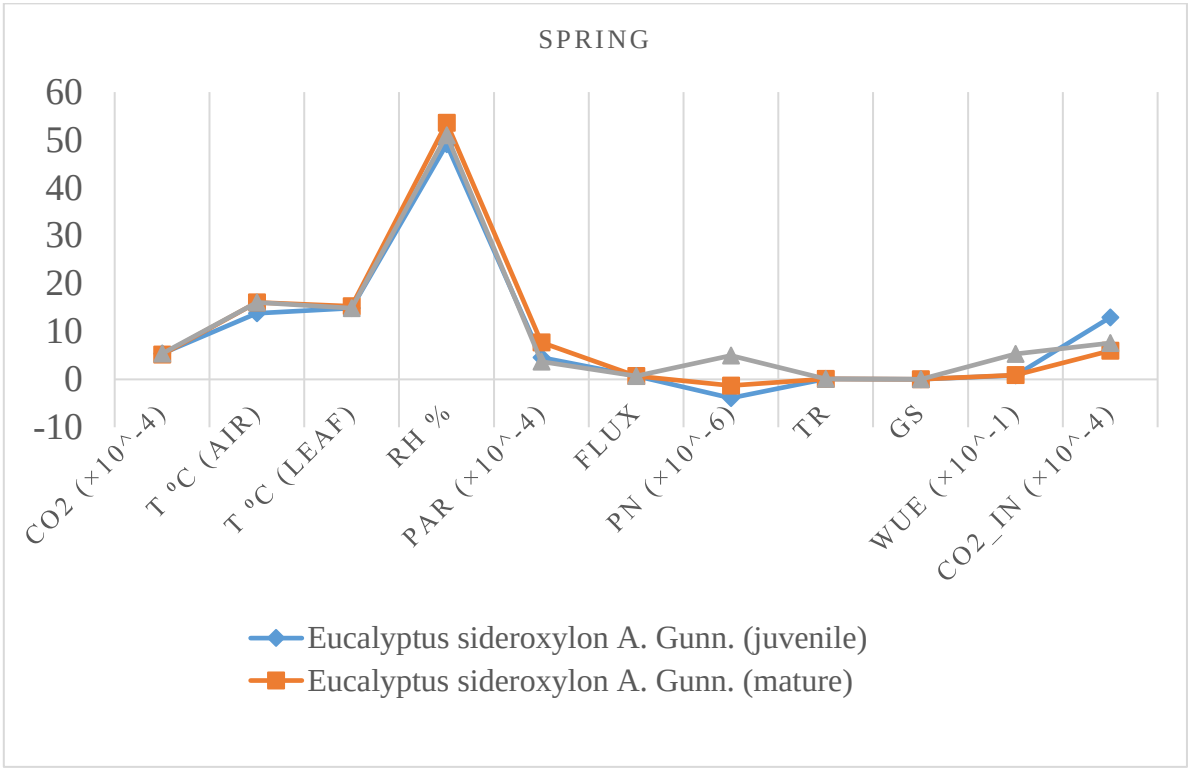
Results

Over the course of the year, we measured the photosynthesis rates of *Eucalyptus sideroxylon A. Gunn*. leaves using Plant Photosynthesis Meter 3051C. To examine potential differences in photosynthesis rates among different age classes of *Eucalyptus sideroxylon A. Gunn*., we measured photosynthesis rates in leaves from juvenile, mature, and aged trees. Our data revealed a wide range of photosynthesis rates.



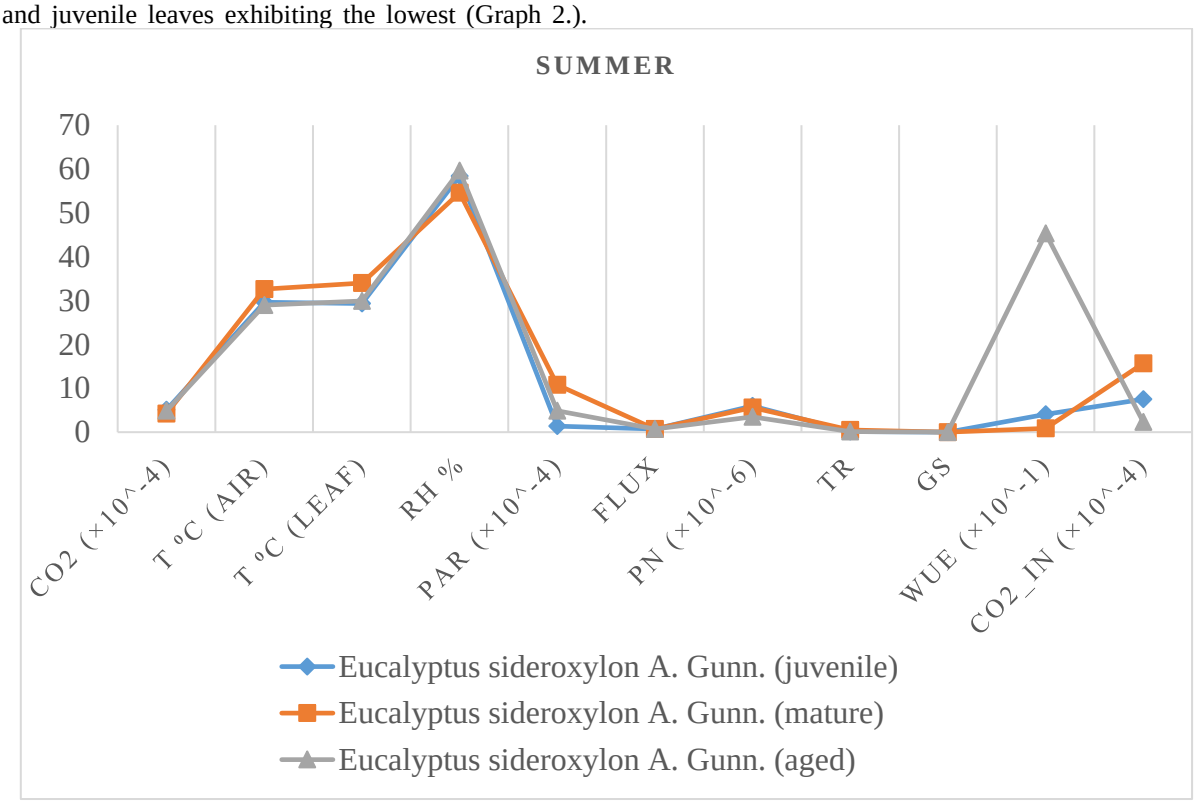
Graph 1: Mean photosynthesis dynamics for Eucalyptus sideroxylon A. Gunn. leaves in Winter

During the winter season, the mean photosynthesis rate of juvenile *Eucalyptus sideroxylon A. Gunn*. leaves was 7.6 µmol $CO_2/m^2/s$, while for mature leaves it was -5.9 µmol $CO_2/m^2/s$, and for aged leaves it was 16.6 µmol $CO_2/m^2/s$. This indicates that there is a significant difference in photosynthesis rates among the different age classes, with aged leaves exhibiting the highest photosynthesis rate and mature leaves exhibiting the lowest. (Graph 1.). These results are not consistent with previous studies that have found that juvenile leaves generally have higher photosynthesis rates than mature and aged leaves. The lower photosynthesis rate in mature and juvenile leaves could be due to a range of factors, including temperature, geography of area and etc.



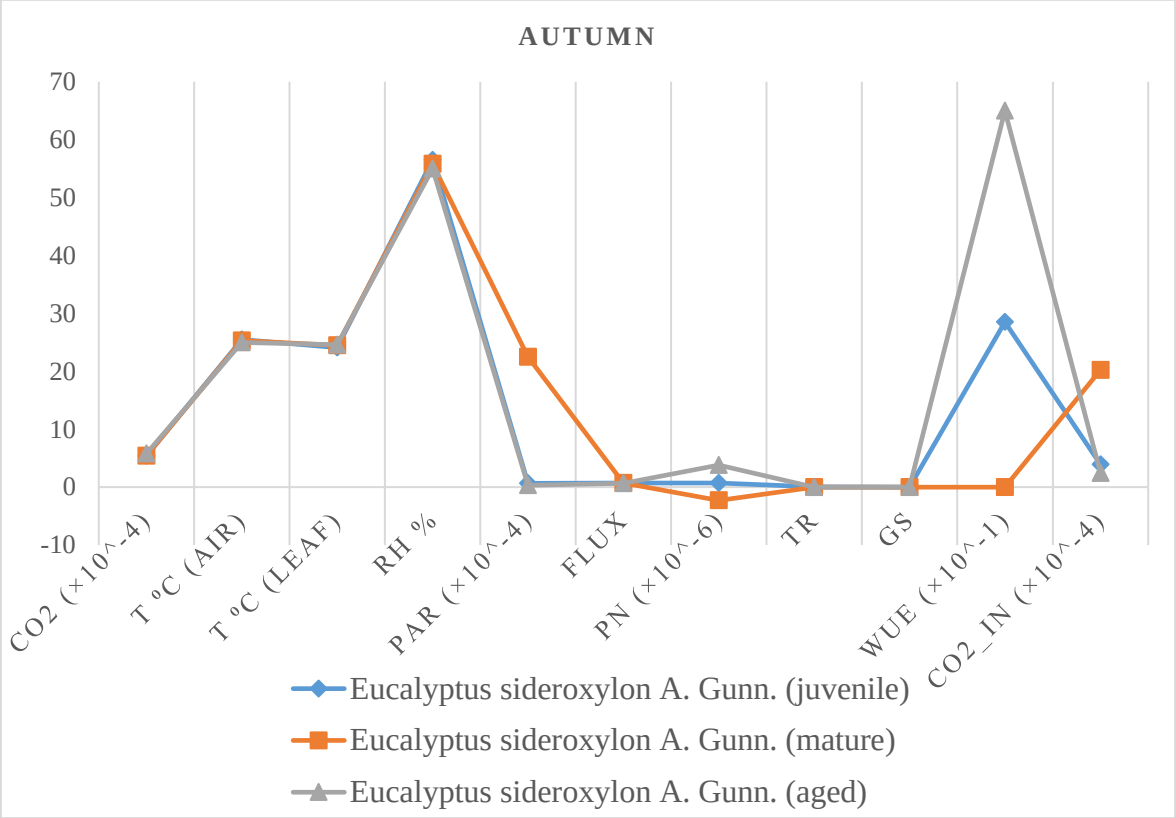
Graph 2: Mean photosynthesis dynamics for Eucalyptus sideroxylon A. Gunn. leaves in spring.

During spring season, the mean photosynthesis rate of juvenile *Eucalyptus sideroxylon A. Gunn*. leaves was -3.9 $CO_2/m^2/s$, while for mature leaves it was -1.3 $CO_2/m^2/s$, and for aged leaves it was 5 $CO_2/m^2/s$. This indicates that there is a significant difference in photosynthesis rates among the different age classes, with aged leaves exhibiting the highest photosynthesis rate and juvenile leaves exhibiting the lowest (Graph 2.). These results are not consistent with previous studies that have found that juvenile leaves generally have higher photosynthesis rates than mature and aged leaves. The lower photosynthesis rate in mature and juvenile leaves could be due to a range of factors, including temperature, geography of area and etc.



Graph 3: Mean photosynthesis dynamics for Eucalyptus sideroxylon A. Gunn. leaves in Summer

During the summer season, the mean photosynthesis rate of juvenile *Eucalyptus sideroxylon A. Gunn*. leaves was 6 $CO_2/m^2/s$, while for mature leaves it was 5.6 $CO_2/m^2/s$, and for aged leaves it was 3.5 $CO_2/m^2/s$. This indicates that there is a significant difference in photosynthesis rates among the different age classes, with juvenile leaves exhibiting the highest photosynthesis rate and aged leaves exhibiting the lowest. These results are consistent with previous studies that have found that juvenile leaves generally have higher photosynthesis rates than mature and aged leaves. The higher photosynthesis rates in juvenile leaves could be due to a number of factors, including higher chlorophyll content, increased leaf surface area and etc.



Graph 4: Mean photosynthesis dynamics for Eucalyptus sideroxylon A. Gunn. leaves in Autumn

During the autumn season, the mean photosynthesis rate of juvenile *Eucalyptus sideroxylon A. Gunn*. leaves was 0,7 $CO_2/m^2/s$, while for mature leaves it was -2.3 $CO_2/m^2/s$, and for aged leaves it was 3.8 $CO_2/m^2/s$. This indicates that there is a significant difference in photosynthesis rate among the different age classes, with aged leaves exhibiting the highest photosynthesis rate and mature leaves exhibiting the lowest. These results are not consistent with previous studies that have found that juvenile leaves generally have higher photosynthesis rates than mature and aged leaves. The lower photosynthesis rates in juvenile and mature leaves could be due to a range of factors, including temperature, geography of area and etc.

Discussion

Photosynthesis is the process by which plants use light energy to convert carbon dioxide and water into glucose and oxygen [5]. It is a vital process for all plants, as it provides the energy they need to grow and survive. *Eucalyptus sideroxylon A. Gunn*., commonly known as mugga ironbark, is a species of eucalyptus tree that is native to Australia [1]. Like all plants, *Eucalyptus sideoxylon A. Gunn*. relies on photosynthesis to produce the energy it needs to survive and grow. Numerous studies have investigated the photosynthesis rates of *Eucalyptus sideoxylon A. Gunn*. leaves, and have found that they are influenced by variety of factors, including temperature, light intensity, and leaf age [1, 2, 3, 5]. In particular, leaf age has been shown to be a significant factor in determining photosynthesis rates, with juvenile leaves generally exhibiting higher rates than mature and aged leaves.

In this study, we utilized the Plant Photosynthesis Meter 3051C to measure the photosynthesis rates of *Eucalyptus sideroxylon A. Gunn*. leaves over the course of a year. Our measurements included one individual juvenile, mature and aged tree from the same area, with photosynthesis rates of one fully-expanded leaf from each tree being taken at least three times a month. Our data was collected at mid-morning to ensure consistency, and we followed a standardized protocol for placing the chamber over the leaf and collecting the data [1,8,11].

Using the data collected by the 3051C, we were able to identify any seasonal patterns in photosynthesis rates for *Eucalyptus sideroxylon A. Gunn*. By tracking changes in photosynthesis rates over a year, we gained a comprehensive understanding of how this species responds to variations in light, temperature, and other environmental factors. Our results indicated a wide range of photosynthesis rates among different age classes, with aged leaves exhibiting the highest photosynthesis rates and mature leaves exhibiting lowest.

During the winter season, there was a significant difference in photosynthesis rates among the different age classes, with aged leaves exhibiting the highest

photosynthesis rate and mature leaves exhibiting the lowest. These results are not consistent with previous studies that have found that juvenile leaves generally have higher photosynthesis rates than mature and aged leaves. The lower photosynthesis rates in mature and juvenile leaves could be due to a range of factors, including temperature and geography of the area.

In the spring season, there was also a significant difference in photosynthesis rates among the different age classes, with aged leaves exhibiting the highest photosynthesis rate and juvenile leaves exhibiting the lowest. These results are not consistent with previous studies that have found that juvenile leaves generally have higher photosynthesis rates than mature and aged leaves. The lower photosynthesis rates in mature and juvenile leaves could be due to a range of factors, including temperature and geography of the area.

During the summer season, the results were consistent with previous studies that have found that juvenile leaves generally have higher photosynthesis rate than mature and aged leaves., with juvenile leaves exhibiting the highest photosynthesis rate and aged leaves exhibiting the lowest. The higher photosynthesis rates in juvenile leaves could be due to a number of factors, including higher chlorophyll content and increased leaf surface area.

Finally, during the autumn season, there was a significant difference in photosynthesis rates among the different age classes, with aged leaves exhibiting the highest photosynthesis rate and mature leaves exhibiting the lowest. These results are not consistent with previous studies that have found that juvenile leaves generally have higher photosynthesis rates in juvenile and mature leaves could be due to a range of factors, including temperature and geography of the area.

Negative Pn in Plant Photosynthesis Meter 3051C refers to the decrease or consumption of CO_2 during plant respiration, which results in a reduction in the net rate of photosynthesis [9]. The negative value of Pn indicates that the rate of CO_2 uptake by the plant is less than the rate of CO_2 release through respiration. This phenomenon can be observed in conditions where the rate of respiration in the plant exceeds the rate of photosynthesis or in situations where environmental factors such as low light intensity or high temperature negatively impact photosynthesis. Accurate measurements of Pn are critical for evaluating the photosynthetic performance of plants and understanding their response to changing environmental conditions [9].

Overall, our study provides valuable insights into the photosynthesis rates of *Eucalyptus sideroxylon A. Gunn*. and their response to seasonal variations in environmental factors. These findings could potentially inform future studies on plant physiology and could have implications for ecosystem management and conservation efforts.

Conclusion

In conclusion. The Plant Photosynthesis Meter 3051C is a useful tool for measuring the rate of photosynthesis in plants, allowing researchers to quantify changes in photosynthesis rates over time and identify seasonal patterns. In this study, the 3051C was used to measure the photosynthesis rates of *Eucalyptus sideroxylon A. Gunn*. leaves from different age classes over the course of a year. The results showed that there were significant differences in photosynthesis rates among the age classes, with juvenile leaves exhibiting the highest photosynthesis rates during summer and aged leaves exhibiting the highest rates during winter and autumn. These findings provide valuable insights into the physiological responses of *Eucalyptus sideroxylon A. Gunn*. to environmental variations and may have implications for forest management and conservation efforts.

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