

**PEMODELAN LAJU FOTOSINTESIS TANAMAN SELADA
(*Lactuca sativa* L.) DENGAN ALGORITMA *RANDOM FOREST*
PADA *INDOOR FARMING*
INTISARI**

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Fotosintesis merupakan proses fisiologis utama dalam pertumbuhan tanaman yang dapat diukur melalui laju asimilasi karbon dioksida (CO₂). Sistem *indoor farming*, seperti *Growth Chamber* (GC) dan *Plant Factory* (PF) dikendalikan secara presisi untuk mengoptimalkan faktor lingkungan seperti intensitas cahaya, suhu, kelembaban udara, dan konsentrasi CO₂ untuk meningkatkan efisiensi fotosintesis. Model prediksi laju fotosintesis berbasis *machine learning* diperlukan untuk mengoptimalkan kondisi lingkungan dalam sistem ini.

Penelitian ini bertujuan untuk mengembangkan model prediksi laju fotosintesis tanaman selada (*Lactuca sativa* L.) menggunakan algoritma *Random Forest* berdasarkan parameter lingkungan dan fisiologi tanaman dalam *Growth Chamber* dan *Plant Factory*. Tahapan penelitian mencakup pengumpulan dan *preprocessing* data (*Exploratory Data Analysis* dan *Feature Selection*), *processing* data (*Splitting Data*), pengembangan model (*Model Training & Hyperparameter Tuning*), evaluasi dan validasi model, serta visualisasi. Data pertukaran gas dan fluoresensi klorofil diukur menggunakan Portable Photosynthesis System LICOR LI-6800, sementara variabel lingkungan seperti suhu, kelembaban, dan intensitas cahaya dipantau menggunakan sensor Pulse Pro dan spektrometer LICOR LI-180. Model yang dikembangkan kemudian dievaluasi menggunakan koefisien determinasi (R²) dan *Root Mean Square Error* (RMSE). Hasil penelitian menunjukkan bahwa model *Random Forest* dengan 27 input utama yang mencakup 9 parameter *gas exchange* dan 18 parameter fluorometer menghasilkan nilai R² sebesar 0,9847 dan RMSE 2,134. Model ini dapat digunakan untuk mengoptimalkan strategi kontrol lingkungan di *Growth Chamber* dan *Plant Factory* sehingga mendukung peningkatan produktivitas tanaman dalam sistem *indoor farming* yang lebih efisien.

Kata kunci: *Growth Chamber*, *Plant Factory*, Pemodelan, Laju fotosintesis, *Random Forest*

**MODELING PHOTOSYNTHETIC RATE OF LETTUCE PLANTS
(*Lactuca sativa* L.) WITH RANDOM FOREST ALGORITHM
ON INDOOR FARMING**

ABSTRACT

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Photosynthesis is a key physiological process in plant growth that can be measured through the rate of carbon dioxide (CO₂) assimilation. Indoor farming systems, such as Growth Chamber (GC) and Plant Factory (PF) are precisely controlled to optimize environmental factors such as light intensity, temperature, humidity, and CO₂ concentration to increase photosynthetic efficiency. A machine learning-based photosynthesis rate prediction model is needed to optimize environmental conditions in this system.

This research aims to develop a prediction model of photosynthesis rate of lettuce plants (*Lactuca sativa* L.) using Random Forest algorithm based on environmental parameters and plant physiology in Growth Chamber and Plant Factory. The research stages include data collection and preprocessing (Exploratory Data Analysis and Feature Selection), data processing (Data Splitting), model development (Model Training & Hyperparameter Tuning), model evaluation and validation, and visualization. Gas exchange data and chlorophyll fluorescence were measured using Portable Photosynthesis System LICOR LI-6800, while environmental variables such as temperature, humidity, and light intensity were monitored using Pulse Pro sensor and LICOR LI-180 spectrometer. The developed model was then evaluated using the coefficient of determination (R²) and Root Mean Square Error (RMSE). The results showed that the Random Forest model with 27 main inputs that included 9 of gas exchange parameters and 18 of fluorometer parameters produced an R² value of 0,9847 and an RMSE of 2,134. This model can be used to optimize environmental control strategies in the Growth Chamber and Plant Factory so as to support increased plant productivity in a more efficient indoor farming system.

Keywords: Growth Chamber, Plant Factory, Modeling, Photosynthetic rate, Random Forest