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Analisis Dinamika Konduktansi Stomata Tanaman Selada (Lactuca sativa L.) pada Fase Terang Fotoperiode Berdasarkan Pengukuran Pertukaran Gas Daun pada Sistem Plant Factory
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ANALISIS DINAMIKA KONDUKTANSI STOMATA TANAMAN SELADA (*Lactuca sativa* L.) PADA FASE TERANG FOTOPERIODE BERDASARKAN PENGUKURAN PERTUKARAN GAS DAUN PADA SISTEM *PLANT FACTORY*

INTISARI

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Konduktansi stomata (g_s) mengatur masuknya CO_2 untuk fotosintesis dan keluarnya uap air melalui transpirasi. Pada sistem *plant factory*, dinamika temporal g_s selama fase terang fotoperiode masih belum banyak dikaji secara kontinu. Penelitian ini bertujuan untuk menganalisis pola dinamika temporal g_s tanaman selada (*Lactuca sativa* L.), hubungannya dengan variabel pertukaran gas daun, serta membangun model prediksi g_s berbasis parameter mikroklimat. Penelitian dilakukan pada 20 Januari 2026 (28 HST), 21 Januari 2026 (29 HST), dan 24 Januari 2026 (32 HST) selama pukul 07.00–17.00 WIB dengan interval 10 menit. Data g_s, laju transpirasi (E), laju asimilasi CO_2 (A), konsentrasi CO_2 intraseluler (Ci) diukur menggunakan LI-6800, sedangkan data mikroklimat diamati menggunakan Pulse Pro. Analisis meliputi statistik deskriptif, korelasi Pearson, *Partial Least Squares Regression* (PLSR), dan regresi linier berganda.

Hasil menunjukkan bahwa g_s meningkat sejak pagi, mencapai puncak pada pertengahan fase terang, lalu stabil hingga sore. Tidak ditemukan gejala *midday depression* yang jelas yang berkaitan dengan kondisi VPD di dalam *plant factory* yang moderat dan stabil. Hubungan g_s dengan E sangat kuat ($r = +0{,}99$), sedangkan dengan A relatif lemah ($r = +0{,}42$), yang menunjukkan adanya diskoneksi temporal antara respons stomata dan laju fotosintesis. Variabel yang paling erat berkaitan dengan g_s adalah E_Leaf, VPD_Leaf, RH_mikro, dan Suhu_mikro. Model PLSR menunjukkan performa sangat baik dengan $R^2 = 0{,}996$ dan RMSE = 0,0049 mol $m^{-2}s^{-1}$. Model mikroklimat sederhana menghasilkan persamaan $g_s = -0{,}044(\text{Suhu\_mikro}) + 0{,}022(\text{RH\_mikro}) - 0{,}0003(CO_2\text{\_mikro}) - 0{,}329$, dengan $R^2 = 0{,}880$ dan RMSE = 0,0255 mol m^{-2} s^{-1}. Hasil ini menunjukkan bahwa g_s dapat diprediksi dengan cukup baik menggunakan sensor mikroklimat sederhana.

Kata kunci: konduktansi stomata, selada, *plant factory*, fase terang fotoperiode, pertukaran gas daun, mikroklimat

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ANALYSIS OF STOMATAL CONDUCTANCE DYNAMICS IN LETTUCE (*Lactuca sativa* L.) DURING THE LIGHT PHASE OF THE PHOTOPERIOD BASED ON LEAF GAS EXCHANGE MEASUREMENTS IN A PLANT FACTORY SYSTEM

ABSTRACT

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The conductance of the stomata (g_s) regulates the entry of CO_2 for photosynthesis and the release of water vapor through transpiration. In the plant factory system, the temporal dynamics of g_s during the bright phase of the photoperiod have not been continuously studied. This study aims to analyze the temporal dynamics of lettuce plants (*Lactuca sativa* L.) and their relationship with leaf gas exchange variables, and to build a gas exchange prediction model based on microclimate parameters. The research was conducted on January 20, 2026 (28 DAT), January 21, 2026 (29 DAT), and January 24, 2026 (32 DAT) from 07:00 to 17:00 WIB with an interval of 10 minutes. g_s data, transpiration rate (E), CO2 assimilation rate (A), and intercellular CO_2 concentration (Ci) were measured using LI-6800, while microclimate data were observed using Pulse Pro. Analysis included descriptive statistics, Pearson correlation, Partial Least Squares Regression (PLSR), and multiple linear regression.

The results showed that g_s increased from morning, peaking in the middle of the bright phase, then stabilizing until the afternoon. No obvious symptoms of midday depression were observed, likely due to the moderate and stable VPD conditions in the plant factory. g_s had a very strong relationship with E ($r = +0.99$), whereas its relationship with A was relatively weak ($r = +0.42$), suggesting a temporal disconnect between stomatal response and photosynthesis rate. The variables most closely related to g_s include E_Leaf, VPD_Leaf, RH_mikro, and Suhu_mikro. The PLSR model exhibits excellent performance, with an R^2 value of 0.996 and an RMSE of 0.0049 mol m^{-2} s^{-1}. A simple microclimate model yields the equation $g_s = -0.044(\text{Suhu\_mikro}) + 0.022(\text{RH\_mikro}) - 0.0003(CO_2\text{\_mikro}) - 0.329$, with $R^2 = 0.880$ and RMSE = 0.0255 mol m^{-2} s^{-1}. These results show that g_s can be predicted quite well using a simple microclimate sensor.

Keywords: conductance of stomata, lettuce, plant factory, photoperiod bright phase, foliar gas exchange, microclimate