

APLIKASI *THERMAL IMAGING* UNTUK ESTIMASI *CROP WATER STRESS INDEX* PADA TANAMAN DALAM *GREENHOUSE*

INTISARI

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Greenhouse merupakan salah satu teknologi yang dilengkapi dengan *monitoring* kondisi lingkungan untuk mengoptimalkan pertumbuhan. *Monitoring* kondisi lingkungan seperti adanya suhu lingkungan, kelembapan lingkungan, intensitas cahaya, dan kelembapan tanah. Perkembangan teknologi menciptakan sebuah alat seperti kamera *thermal* yang mampu mengetahui kondisi tanaman secara visual dan terukur. Kondisi tanaman ini termasuk dalam menentukan *deficit* air di dalam tubuh tanaman yaitu berbasis *CWSI* (*Crop Water Stress Index*). *CWSI* (*Crop Water Stress Index*) merupakan indeks stress tanaman yang dipengaruhi oleh ada dan tidaknya air di dalam tubuh tanaman dengan menyatakan suhu tanaman. Tujuan dari penelitian ini yaitu merancang sistem *thermal imaging* untuk pengamatan kondisi tanaman di dalam *greenhouse* dan mengevaluasinya kondisi tanaman dengan *CWSI*. Sistem *thermal imaging* dirancang agar dengan beberapa modul seperti *monitoring* suhu tanaman, *monitoring* kondisi lingkungan, dan *monitoring* pengambilan gambar *thermal* konsisten. Dilakukan uji validitas yaitu berupa uji regresi linier, *RMSE* (*Root Mean Square Error*), *MAPE* (*Mean Absolute Percentage Error*). Uji validitas sistem *thermal imaging* dengan tanaman diperoleh nilai R^2 sebesar 0,9807, *RMSE* sebesar 1,01, dan *MAPE* sebesar 3,80%. Implementasi sistem dilakukan di dalam *greenhouse*, tanaman dengan perlakuan yang diberi air sebanyak 300 mL (tanaman normal), 100 mL (tanaman stress medium), dan tanpa diberi air (tanaman stress maksimum). Suhu tanaman tertinggi sebesar 41,82°C pada pukul 12.37 WIB hari ketujuh dan terendah sebesar 25,81°C pada pukul 17.06 WIB hari keenam. Hasil analisis *CWSI* rerata selama tujuh hari pada tanaman normal, tanaman stress medium, dan tanaman stress maksimum masing-masing 0,315, 0,322, dan 0,397. Tanaman pakcoy yang menghasilkan nilai $CWSI \geq 0,4$ terindikasi bahwa tanaman tersebut perlu diberi irigasi. Tanaman stress maksimum menghasilkan nilai *CWSI* yang mendekati 0,4 yaitu sebesar 0,397, berarti bahwa tanaman stress maksimum perlu diberi irigasi.

Kata kunci: *CWSI*, sistem *monitoring*, *thermal Imaging*

Application of Thermal Imaging for Crop Water Stress Index Estimation to Plant in Greenhouse

ABSTRACT

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Greenhouse is a one of the technologies equipped with *monitoring* environmental conditions to optimize growth. *Monitoring* environmental conditions includes factors such as temperature, humidity, light intensity, and soil moisture. The development of technology has created tools, such as thermal cameras, that can visually and quantifiably determine the condition of plants. This plant condition is used to determine water deficit in the plant's body, specifically using the Crop Water Stress Index (CWSI). CWSI is an index that measures plant stress, which is influenced by the presence or absence of water in the plant's body, as indicated by the plant's temperature. The purpose of this research is to design a thermal imaging system for observing plant conditions in the *greenhouse* and evaluating plant conditions using CWSI. The thermal imaging system is designed with several modules, including *monitoring* plant temperature, *monitoring* environmental conditions, and consistently capturing thermal images. Validity tests are carried out, including linear regression tests, Root Mean Square Error (RMSE), and Mean Absolute Percentage Error (MAPE). The validity test of the thermal imaging system with plants resulted in an R^2 value of 0.9807, an RMSE of 1.01, and a MAPE of 3.80%. Implementation of the system is carried out in the *greenhouse*, with plants given different treatments: 300 mL of water for normal plants, 100 mL for medium stress plants, and no water for maximum stress plants. The highest recorded plant temperature was 41.82°C at 12:37 pm on the seventh day, and the lowest was 25.81°C at 17:06 pm on the sixth day. The average CWSI analysis results for seven days in normal plants, medium stress plants, and maximum stress plants were 0.315, 0.322, and 0.397, respectively. Pakcoy plants that produce CWSI values ≥ 0.4 indicate that the plants need to be irrigated. Maximum stress plants produce CWSI values close to 0.4, at 0.397, indicating that they need to be irrigated.

Keywords: CWSI, *monitoring* system, thermal imaging