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A Non-Destructive Estimation Method for Internal Time in Perilla Leaf Using Hyperspectral Data

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Abstract : Vegetables harvested early in the morning or late in the afternoon are valued in plant production, and so the time of harvest is important. The biological functions known as circadian clocks have a significant effect on this harvest timing. The purpose of this study was to non-destructively estimate the circadian clock and so construct a method for determining a suitable harvest time. We took eight samples of green busil (Perilla frutescens var. crispa) every 4 hours, six times for 1 day and analyzed all samples at the same time. A hyperspectral camera was used to collect spectrum intensities at 141 different wavelengths (350–1050 nm). Calculation of correlations between spectrum intensity of each wavelength and harvest time suggested the suitability of the hyperspectral camera for non-destructive estimation. However, even the highest correlated wavelength had a weak correlation, so we used machine learning to raise the accuracy of estimation and constructed a machine learning model to estimate the internal time of the circadian clock. Artificial neural networks (ANN) were used for machine learning because this is an effective analysis method for large amounts of data. Using the estimation model resulted in an error between estimated and real times of 3 min. The estimations were made in less than 2 hours. Thus, we successfully demonstrated this method of non-destructively estimating internal time.

Keywords : artificial neural network (ANN), circadian clock, green busil, hyperspectral camera, non-destructive evaluation
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