

Detection of citrus black spot symptoms using spectral reflectance

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Abstract

Citrus black spot (CBS) disease can usually result in fruit blemish and yield loss on all citrus. Spectral reflectance was utilized to detect CBS symptoms in this study. Hyperspectral images of both healthy and diseased citrus were collected in the spectral region of 396–1010 nm. After raw image calibration, spectral reflectance of diseased (early hard spot, advanced hard spot, cracked spot, early virulent, and virulent) and healthy samples were extracted and used as independent variables for classification. Effective wavelengths were selected using regression coefficients based on partial least squares analysis. K-nearest neighbor models were established to classify the symptoms in each group (early hard spot vs. advanced hard spot, early virulent vs. virulent, hard spot vs. cracked spot, hard spot vs. virulent, cracked spot vs. virulent, diseased vs. healthy, and early stage vs. advanced stage). In diseased vs. healthy group, the models yielded the correct classification accuracies of 99.4 % (using full wavelengths) and 100.0 % (using selected wavelengths) for diseased samples. The correct classification accuracies were 92.5 % (using full wavelengths) and 93.8 % (using selected wavelengths) for early stage samples (early disease). Besides, the selected wavelengths were 549, 668, 706, and 790 nm for diseased vs. healthy group, and 675, 711, and 835 nm for early stage vs. advanced stage group. The overall results demonstrated that spectral reflectance information has the potential to classify different symptoms of CBS.