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Comparison of optical sensing techniques for detecting citrus diseases

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Citrus diseases such as Huanglongbing (HLB) and citrus canker result in major production and economic losses in Florida. Therefore, there is an urgent need for a sensing technique that can be used to detect these diseases and apply suitable management practices. An ideal sensing technique should be rapid, accurate and reliable to provide economic, production and agricultural benefits. Optical sensing techniques such as visible-near infrared spectroscopy offer rapid sensing of plant diseases. Although optical sensing methods have few limitations, they offer unique benefits that can greatly aid in citrus disease detection. We have worked on several spectroscopic and imaging techniques to detect citrus diseases, especially HLB. This work presents the comparative performance of these techniques and discusses the benefits and limitations of each of these methods. The spectral techniques that will be discussed in this paper are: visible-near infrared spectroscopy, mid-infrared spectroscopy, fluorescence spectroscopy, multiband imaging, and thermal imaging. We collected spectral data representing healthy and diseased leaves from the citrus trees of different cultivar, followed by pre- and post-processing offsite using mathematical models. The classification studies using Naïve-Bayes classifier, Bagged Decision trees and Support Vector Machine were performed before or after principal component analysis, depending on the dataset. Our results indicated that most of these techniques showed a classification accuracy of about 90% and higher. However, the suitability of a technique would depend on its application. This paper summarizes the major findings from different spectroscopic techniques and compares their performance in relation to their applications.