Early detection of Ganoderma basal stem rot of oil palms using artificial neural network spectral analysis

ABSTRACT

Ganoderma boninense is a causal agent of basal stem rot (BSR) and is responsible for a significant portion of oil palm (Elaeis guineensis) losses, which can reach US$500 million a year in Southeast Asia. At the early stage of this disease, infected palms are symptomless, which imposes difficulties in detecting the disease. In spite of the availability of tissue and DNA sampling techniques, there is a particular need for replacing costly field data collection methods for detecting Ganoderma in its early stage with a technique derived from spectroscopic and imagery data. Therefore, this study was carried out to apply the artificial neural network (ANN) analysis technique for discriminating and classifying fungal infections in oil palm trees at an early stage using raw, first, and second derivative spectroradiometer datasets. These were acquired from 1,016 spectral signatures of foliar samples in four disease levels (T1: healthy, T2: mildly-infected, T3: moderately infected, and T4: severely infected). Most of the satisfactory results occurred in the visible range, especially in the green wavelength. The healthy oil palms and those which were infected by Ganoderma at an early stage (T2) were classified satisfactorily with an accuracy of 83.3%, and 100.0% in 540 to 550 nm, respectively, by ANN using first derivative spectral data. The results further indicated that the sensitive frond number modeled by ANN provided the highest accuracy of 100.0% for frond number 9 compared with frond 17. This study showed evidence that employment of ANN can predict the early infection of BSR disease on oil palm with a high degree of accuracy.