Title Detection of grain weevils inside single wheat darnels by a very near infrared two-wavelength model

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Citation J. Near Infrared Spectrosc. 7, 213-221 (1999)

Keywords wheat; grain weevil; internal infestation; rapid insect detection; near infrared spectroscopy (NIR); near infrared imaging

Abstract

Near infrared reflectance spectroscopy in the very near infrared region (700 nm to 1100 nm) has been investigated for the detection of grain weevil larvae and pupae inside single wheat kernels. Using a total of 80 samples, simple, two-wavelength classification models have been identified, based on either log 1/*R* (982 nm) 1/*R* (1014 nm) or log 1/*R* (972 nm)-log 1/*R* (1032 nm). Both models correctly classified over 96% of samples as uninfested or infested. Detection performance equaled that obtained using the full-spectrum approach of principal components analysis. In a separate experiment, repeatedly scanning samples over time demonstrated detection of younger larvae as well as later developmental stages. This experiment confirmed that the observed spectral differences arise from the actions of the developing insect, rather than from any feature specific to kernels selected by adult females for egg-laying. The origins of he spectral differences are almost certainly decreasing grain starch, for log 1/*R* (982 nm)-log 1/*R* (1014 nm), or increasing grain moisture, for log 1/*R* (972 nm)-log 1/*R* (1032 nm), with infestation. These results indicate that the future incorporation of the wavelength pair, 982 nm and 1014 nm, as camera lens filters in a very near infrared imaging system, could lead to an inexpensive, reliable machine-vision method for detecting internal insects in grain.