

Near infrared imaging technology for detecting fruit fly eggs and larvae in intact mangoes

S. Saranwong,^{a,*} J. Anusornwongchai,^b A. Janhiran,^b
S. Kasemsumran,^b W. Thanapase^b and S. Kawano^a

^aNational Food Research Institute, 2-1-12 Kannondai Tsukuba 305-8642 Japan.

E-mail: sirinnap@affrc.go.jp

^bKasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI), Kasetsart University, Bangkok 10900 Thailand

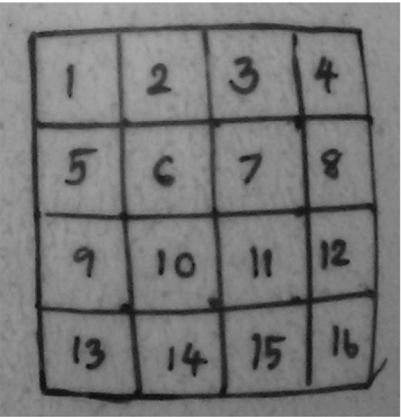
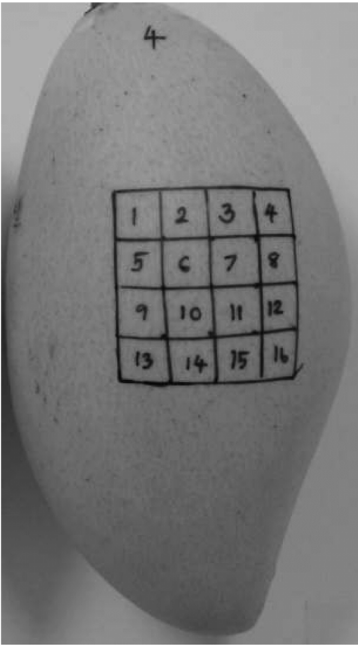
Introduction

From the data obtained in previous years for the possibility of using NIRS to detect fruit flies in intact mangoes, the ability of an NIR Imaging system for this purpose has been examined, using export grade green mangoes.

Materials and methods

Fifty unripe green Nam Dok Mai mango fruits were used. A grid of sixteen $1 \times 1 \text{ cm}^2$ blocks was drawn on the shoulder of mango samples [Figure 1(a)].

Then, for all samples, one pore of 2-mm depth was made on each block, giving a total of 16 pores for each sample. The forced infestation was performed by placing mangoes identified as the infested group in a fruit fly cage for 30 minutes. NIR measurements were performed using an NIR imaging system assembled by JFE Techno-Research Corporation (Chiba, Japan). The system consists of a computer-controlled 30-cm long sliding sample stage, light sources for visible and near infrared region, CCD camera, and NIR imaging spectrometer model "ImSpector V10E" (Spectral Imaging, Oulu, Finland) that was operated in the reflectance mode, and in the short wavelength region from 399.61 nm to 998.87 nm at 0.77 nm intervals [Figure 1(b)]. Spectra were taken at 0, 24 and 48 hours after infestation (HAI). Sample temperature was controlled by a 25°C water-bath as mentioned in previous works. After spectral acquisition at 48 HAI, the fruit shoulders were sampled and separated into 16 portions regarding to the block drawn earlier. Enumeration of fruit fly larvae was performed at 168 HAI. For the classification, the PLS-Discriminant Analysis system was used. NIR spectra used for calculation were the averages of those taken from each $1 \times 1 \text{ cm}^2$ block. All calculations were performed using The Unscrambler (CAMO, Oslo, Norway). Validation was performed using a separate test set.



a

Inspector

Illuminator

Sample

Sliding stage

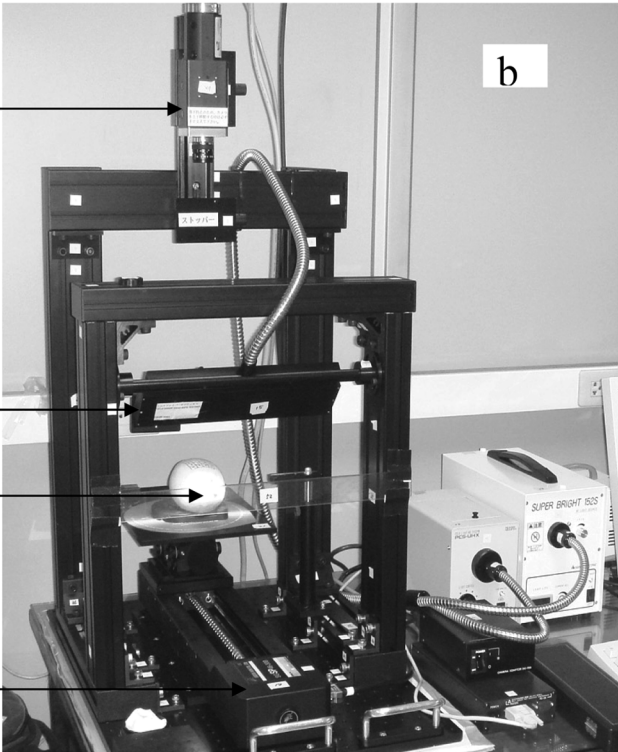


Figure 1. (a) The grid of sixteen 1-cm² blocks drawn on mango's shoulder; (b) The NIR imaging system used.

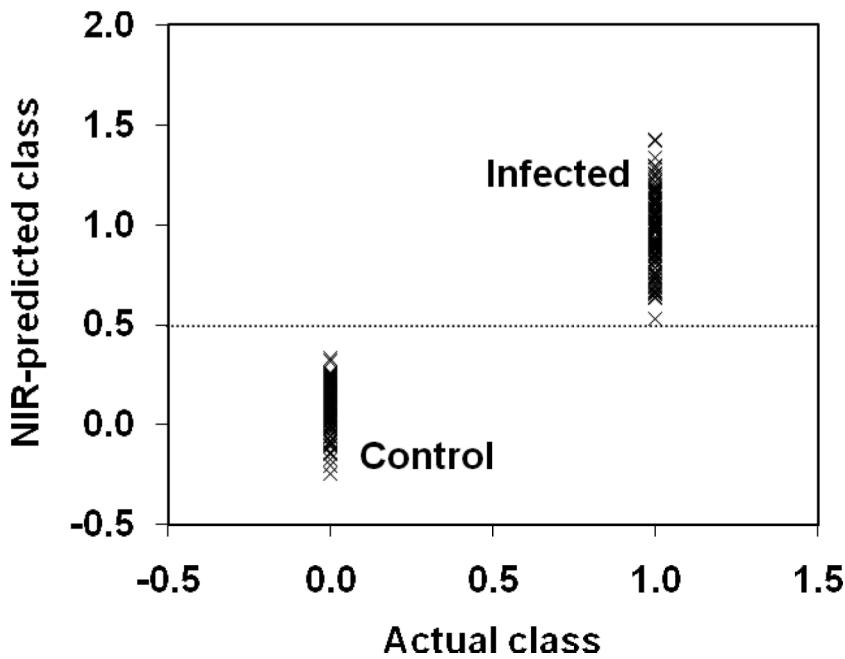


Figure 2. Classification results of control and infested mango portions using spectra of NIR imaging system measured at 48 hours after infestation.

Results and discussion

Figure 2 shows clear separation between control and infested blocks of mangoes.

Good classification results could be obtained from spectra taken at 48 HAI. Pin-point averaging at the area surrounding each pore might help improve the classification results. Further work is needed to improve sensitivity of the system to be able to detect fruit flies in a non-pored infested mango.