BOOK OF ABSTRACTS

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Abstract
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Understanding the effects of bacterial leaf blight disease on rice spectral signature

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Keywords (3): Canopy hyperspectral, Rice disease, Bacterial leaf blight

Challenge (800 - 1000 characters incl. spaces)

Rice is one of the main staple food for nearly half of the global population, rice production is closely associated with global food security. Rice bacterial leaf blight (BLB) caused by *Xanthomonas oryzae* pv *oryzae* is considered one of the most widely occurring diseases in tropical and temperate rice-growing areas, causing yield losses of around 2.72% globally. To prevent damage and yield loss caused by BLB infection, it is imperative to detect BLB-infected rice timely. Hyperspectral data containing thousands of narrow bands shows great potential to detect BLB in a rapid and accurate manner. Previous studies have revealed several spectral changes at the canopy scale but only focused on post-heading growth phases, which limits the use of hyperspectral data for early disease detection. To address this knowledge gap, this study aims to examine the feasibility of detecting BLB infection from canopy reflectance spectra at the pre-heading stage.

Methodology (1200 – 1500 characters incl. spaces)

A field experiment was conducted at the rice stem elongation phase at the Zeigler Experiment Station at the International Rice Research Institute (IRRI), Los Baños, Philippines. A highly susceptible rice variety (IR24), was grown in the wet season of 2023 when conditions are favourable to BLB. Rice leaves were inoculated at the tillering phase by cutting leaf tips and dipping in the suspension with the BLB pathogen. In non-inoculated plants, leaves were cut and dipped in distilled water only. Canopy hyperspectral reflectance and crop biophysical and biochemical parameters (e.g. SPAD, Leaf area index (LAI), canopy height, fresh biomass, dry biomass, canopy water content) were measured in inoculated (n=45) and non-inoculated (n=45) plots. The spectral reflectance of rice canopies was then pre-processed by removing the noisy bands and averaging. Linear discriminate analysis was conducted on each spectral wavelength to examine the separability of spectral bands, and 5-fold cross-validation was used to evaluate the accuracy. Furthermore, the significance of differences in biophysical and biochemical parameters between the two classes (healthy vs. infected) was assessed using the Student t-test or the Mann-Whitney U test after the normality test through the Shapiro-Wilk test.

Expected results (1200 – 1500 characters incl. spaces)

Comparison of the mean spectra from the infected and healthy rice showed higher reflectance in visible, near-infrared and short-wave infrared regions for infected rice than that of healthy rice at the rice stem elongation phase. The separability of each spectral band assessed by linear discriminate analysis demonstrated higher accuracy in the visible and shortwave infrared regions than in the near-infrared region (Figure A). The most sensitive spectral bands are 623nm, 634nm, 657nm, 664nm, 2206nm, 2236nm, and 2238nm, which are in red and shortwave infrared regions. Regarding the assessment of biophysical and biochemical responses, SPAD, LAI, fresh biomass and canopy water content data were tested to be normally distributed, while canopy height and dry biomass were not. Figure B displays the results of the significance test for these biophysical and biochemical parameters. Specifically, student t-test results of SPAD, LAI, fresh biomass and canopy water content showed above parameters significantly decreased after BLB infection which was explained by the selected sensitive spectral bands. The result of the Mann-Whitney U test showed that canopy height significantly decreased and dry biomass did not.

Outlook for the future (800 - 1000 characters incl. spaces)

This study examined the spectral variation of BLB infection at the rice pre-heading phase using canopy hyperspectral measurements, the potential of red and SWIR regions on BLB detection has been determined using LDA. Although this study was conducted through non-imaging hyperspectral data at canopy level, these findings from the inoculation experiment under control conditions provide a fundamental basis for upscaling to the regional scale using hyperspectral imagery. In addition, some of the sensitive spectral bands selected in this study have similar wavelengths to Sentinel-2 imagery (band 4 and band 12), which demonstrates the applicability of existing multispectral images in BLB detection. The mechanism of detecting BLB using spectral variations has been clarified by assessing the changes in biophysical and biochemical properties. Particularly, the changes in leaf chlorophyll content have great potential to be used for BLB detection using remote sensing, which has been detected by the red region.

Please upload 1-2 figures or graphical abstract (min 300 dpi. jpeg/png)

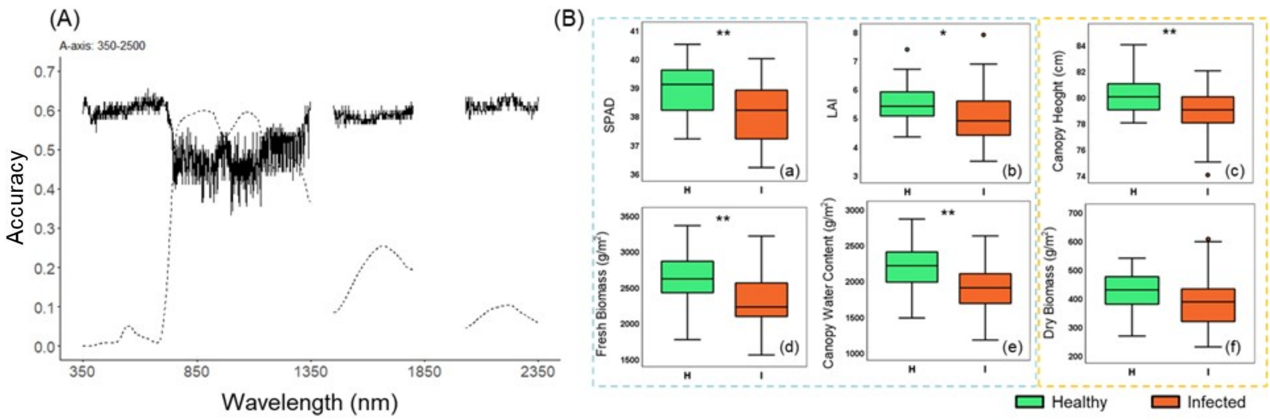

Figure (A) The overall accuracy (OA) of classification per wavelength (B) Comparison of leaf/canopy biochemical and biochemical parameters between the infected and healthy rice, the parameters in the blue frame are normally distributed, while the parameters in the orange frame are not normally distributed

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