

Assessment of kernel presence in winter wheat ears using Near-Infrared Hyperspectral Imaging

Damien Vincke ^{1,2}, Benoît Mercatoris ², Damien Eylenbosch ¹, Vincent Baeten ¹ and Philippe Vermeulen ¹

¹Walloon Agricultural Research Centre (CRA-W), Gembloux, Belgium

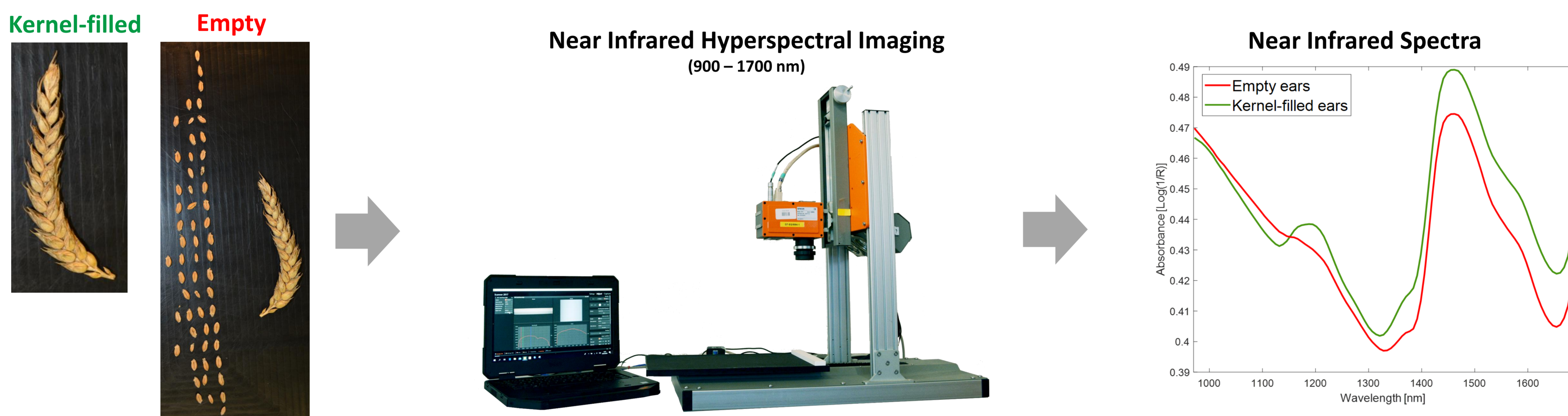
²University of Liège, Gembloux Agro-Bio Tech, Biosystems Dynamics and Exchanges, Gembloux, Belgium

Introduction

Obtaining varieties with higher yield is one of the aims of crop breeding. For winter wheat (*Triticum aestivum* L.), yield is the result of three components which are the number of ears per unit area, the number of kernels per ear and the kernel weight. The occurrence of stresses during crop growth can have a negative impact on the yield components. For example, abiotic stresses such as drought or frost, if they occur at sensitive stages of the crop can cause a decrease in the number of kernels per ear. On the other hand, biotic stresses induced by a disease such as *Fusarium Head Blight* (FHB) can also cause a decrease in the number and weight of kernels per ear. Assessing the physiology behind the number of kernels and the impact of stresses is a complex process requiring observations at specific critical periods of the crop cycle. The scope of this study is to propose an innovative method based on Near Infrared Hyperspectral Imaging (NIR-HSI) to evaluate the presence of kernels in winter wheat ears.

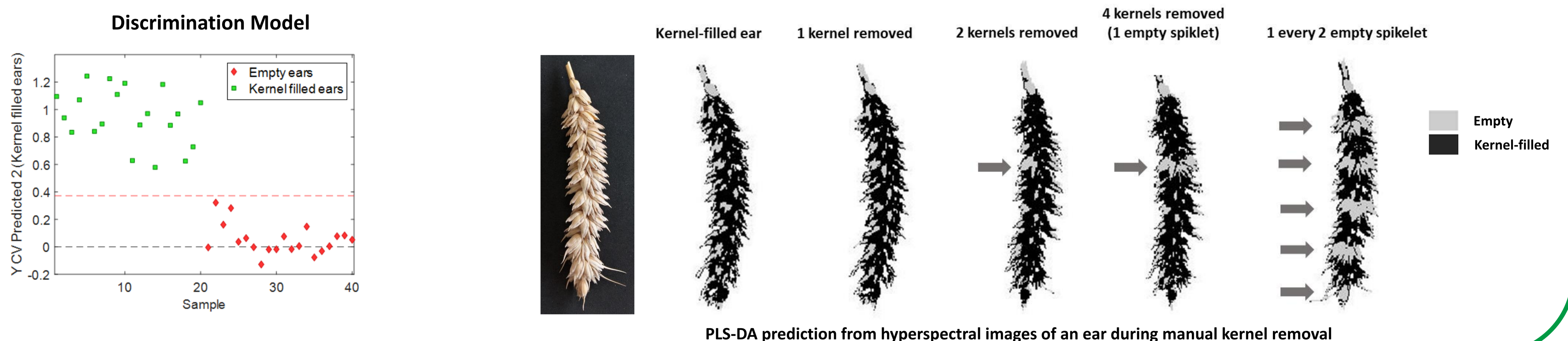
Material and methods

Twenty ears were picked at full ripeness from five different winter wheat varieties in a field trial in Gembloux, Belgium. The ears were firstly scanned in the lab using a NIR-HSI camera. Then, using tweezers, the kernels were manually removed from the ears while preserving the integrity and structure of the ear organs (rachis and spikelets). Finally, the empty ears were also scanned using the same NIR-HSI device. After image acquisition spectral libraries have been created in order to design a Partial Least Squares Discriminant Analysis (PLS-DA) model for the discrimination between empty and kernel-filled ears.



Results

The obtained spectral signatures indicated several wavelengths of interest for the discrimination between empty and kernel-filled ears. In addition, the application of the PLS-DA model on hyperspectral images indicated the possibility of detecting empty spikelets in ears.



Conclusion & prospects

The overall objective of this work was to propose an innovative method using NIR-HSI for the evaluation of kernel presence or absence in winter wheat ears. This preliminary study has enabled evaluating the potential of the method using ears samples where kernels were manually removed. NIR-HSI combined with chemometric tools enabled the assessment of spectral bands characteristic of the presence of the kernels in the ears. In addition, a PLS-DA model has been designed in order to assess the presence or absence of kernels in winter wheat ears. The development of such method may help to better understand one of the yield components. In addition, further works are planned to transfer the findings of this research to a field platform.

Acknowledgements

This work was performed in the framework of the PhenWheat project funded by the Walloon Region, Service Public de Wallonie (SPW), Direction Générale Agriculture Ressources Naturelles Environnement (DGO3 - DGARNE), Direction Recherche et Développement, project number D31-1385/S1. The authors are grateful to Guillaume Jacquemin and his team, from the Crop Production Unit, for managing the field trials. We are also grateful to Pauline Van Den Broucke, François Godechal, Lisa Plasman, Benoît Scaut, Nicaise Kayoka Mukendi and all technical staffs of all CRA-W research teams involved.