Automated detection of Fusarium Head blight symptoms on wheat spikes using Deep Learning on field RGB imaging

S. Ousmane Kone[1], V. Cadot[1], D. Vincke[2], S. Treier[3], N. Mascher[1], J. P. Maigniel[1], J. Herrera[3] and P. Vermeulen[2]

Valérie.cadot@geves.fr

GEVES
Expertise & Performance

Context & objectives

- **Fusarium Head Blight (FHB)** is a major fungal disease of wheat, leading to significant yield losses and the production of mycotoxin, harmful to human and animal feed worldwide. Currently, as part of the breeding or registration process of varieties in the European Catalogue, dedicated field trials are inoculated with *Fusarium graminearum and Fusarium culmorum* to assess variety resistance to FHB.
- To phenotype resistant cultivars against Fusarium head blight, visual assessment of symptoms is the method used currently, but it requires a high expertise, can be subjective and is time-consuming to score the percentage of scabbed spikelets on hundreds of genotypes in several trials.
- In the frame of the EU Phenet project, the aim of this study is to replace visual assessment of FHB symptoms by robust artificial intelligence models, based on RGB imaging.

Methodology for prediction of FHB symptoms

1. Acquisition protocol → 2. Roboflow annotation → 3. FHB prediction method

- In 2 years
- 2 sites in France (GEVES) & Belgium (CRA-W)
- 2398 RGB images in perspective views
  - 2023 : 812 images
  - 2024: 1586 images

2 classes: Healthy & Fusarium

- 1113 annotated images (239 CRA-W + 409 GEVES + 465 Data Augm.)
- Manual, SAM, & development of automatic model

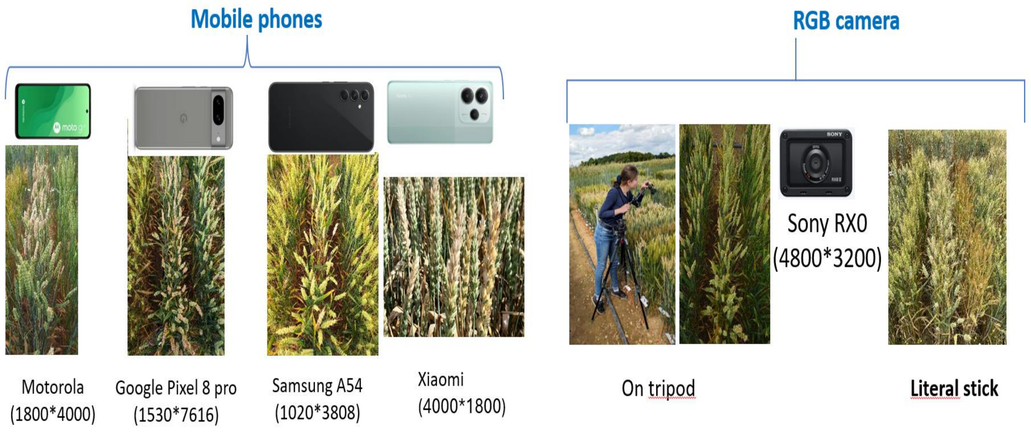
2 tested processes:

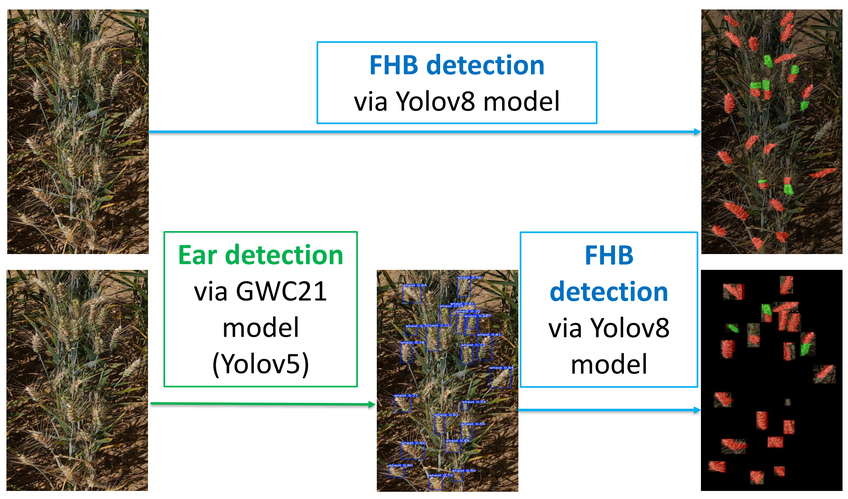
1. Without ear detection
2. With ear detection

Data set:
-Train: 930 images (83 %)
-Validation: 130 images (12 %)
-Test: 53 images (5 %)

Instance segmentation: Yolo V8 **by Deep Learning**

Sensors used:





Results

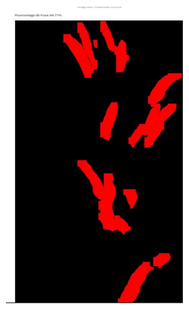
FHB model detection

Among 17 Deep Learning models, developed by GEVES, the best YOLOv8 model gave fairly high precision, recall and F1-score

Classes	Bounding box[1]			Segmentation[2]			F1 score
	Precision	Rappel	mAP50	Precision	Rappel	mAP50	
All classes	0.78	0.73	0.80	0.79	0.73	0.81	0.76
FHB	0.81	0.72	0.80	0.82	0.72	0.81	
Healthy	0.75	0.74	0.80	0.77	0.74	0.80	

1

2

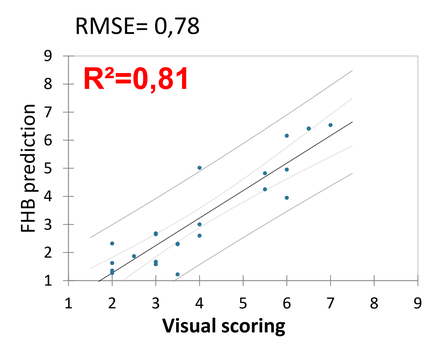


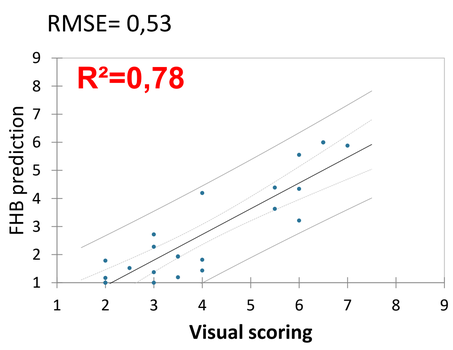
Correlation: FHB prediction/visual scorings

Fairly high correlations were obtained with or without ear detection and for all sensors.

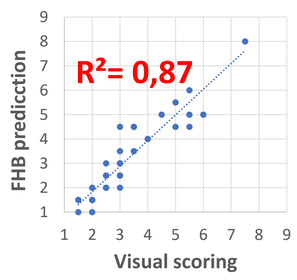
1 **Without ear detection** 2 **With ear detection**

with Sony RX0

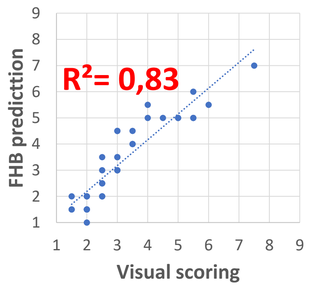




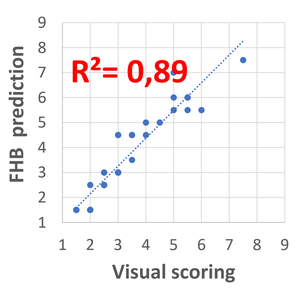
Camera Sony RX0



Smartphone Samsung



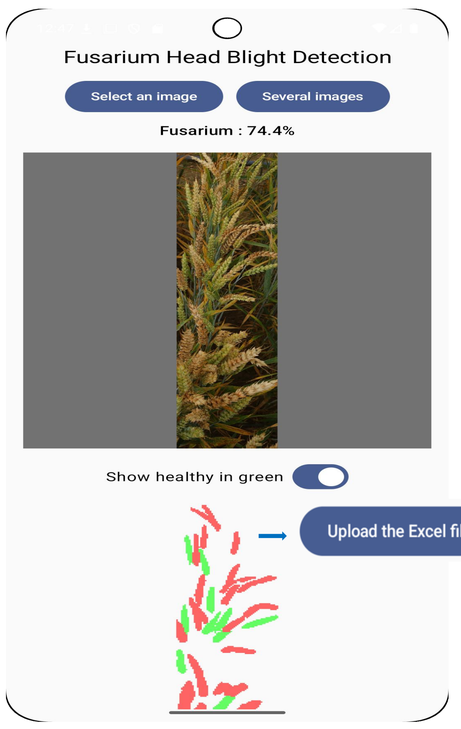
Smartphone Google P8



User interface

GEVES developed 2 user interfaces:

1. **Web application: Streamlit**
2. **Application: android**



Conclusion & outcomes

This work demonstrates that RGB images combined with Deep Learning can effectively replace visual scoring for classifying FHB resistance in wheat varieties in EU breeding and registration trials. It enables automated, objective monotoring, accelerating selection and easing expert workload.

For the future, we plan to improve ear detection, perhaps with the next Global Wheat Challenge and extend the FHB RGB images dataset by integrating the Agroscope's dataset and by adding images from different sites in 2025 to improve the FHB model's robustness.

PHENET
PHENOTYPING & ENVIROTYPING SOLUTIONS FOR AGROECOLOGY

1 GEVES Expertise & Performance

2 Wallonie recherche CRA-W

3 Agroscope

©GEVES – Septembre 2025– Tous droits réservés