New computer vision tools help to assess wheat ear diseases: UC1 - Plant health

The objective of this use case on plant health is to validate sensors and methodology dedicated to the assessment of wheat ear diseases. Two applications concerning major pests of wheat crops were developed using deep learning methods. The 1st called “FUSASEYD” is dedicated to the assessment of Fusarium Head Blight (FHB) caused by *Fusarium* section *Discolor*, from RGB images acquired in the field. The second called “COYL” is dedicated to count automatically the orange wheat blossom midge, *Sitodiplosis mosellana*, and the yellow wheat blossom midge, *Contarinia tritici* from RGB images acquired on petri dishes containing larvae collected by washing infected wheat ears.

FUSASEYD (Assessment of FHB) is an application dedicated to the assessment, on RGB images, of ears showing FHB symptoms. The breeding process leading to the creation of disease-resistant cereals requires characterizing and assessing many genotypes. Up to now, only an expert eye can assess the disease susceptibility of cereal varieties in field trials. In this framework, developing automated assessment methods based on imaging techniques could provide useful information, helping the experts in their task of identifying disease-resistant varieties. This study highlights the potential of RGB imaging associated with an instance segmentation model based on the Yolov11 model to detect and quantify FHB on winter wheat ears. This study led to a proof of concept for the use of RGB images and deep learning instead of visual counting to classify the varietal resistance against FHB for the purposes of plant breeding and registration in the catalog.

GEVES has developed a PC user interface and a smartphone application, called “FUSASEYD”, to visualize on the Web the symptoms predicted by the model. This application design still needs improvement and will be validated during the next campaign 2026 in the trials for registration in France.

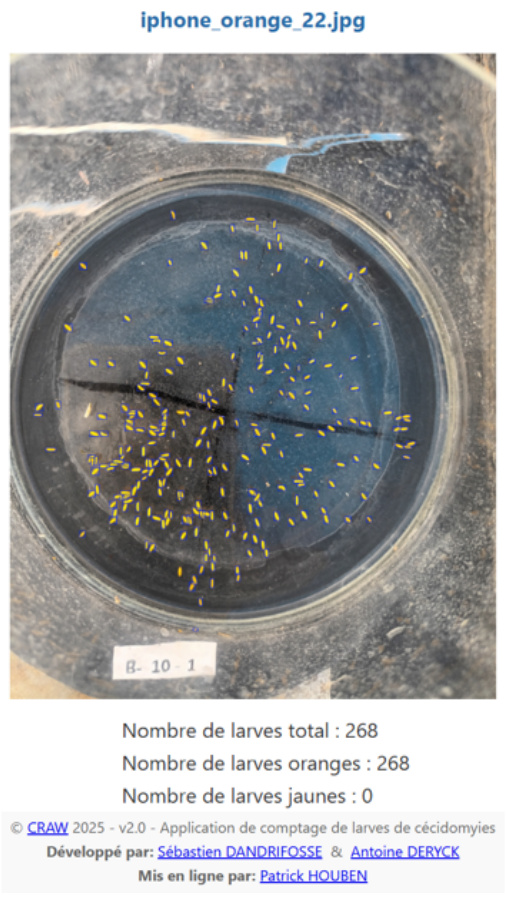
For the next step, it is planned to contribute to the Global Wheat datasets (Hund, 2020) to improve precision phenotyping under field conditions by assembling large, diverse and well annotated image data and by updating models.

The full study is described in

Companion journal article (under review at Journal of Experimental Botany: “Plant Phenomics & Enviromics Across Scales" special issue):

V. Cadot et al. Resistance assessment of wheat varieties against fusarium head blight using artificial intelligence on RGB images

COYL (Counting Orange and Yellow Larvae) is an application dedicated to count automatically on RGB images, the orange wheat blossom midge, *Sitodiplosis mosellana*, and the yellow wheat blossom midge, *Contarinia tritici* which are major pests of wheat crops. This study originated from a practical problem encountered by the breeders: the need to increase the throughput of larvae counting to characterize the susceptibility of numerous wheat varieties. This problem was solved using a deep learning method applied to RGB images acquired using smartphones. Several YOLO-based object detection architectures were evaluated through a coarse-to-fine strategy to identify the most effective configuration. The best-performing model (YOLOv26m) achieved high detection performance. The model successfully distinguished between the two visually similar species, although slightly better performance was observed for *S. mosellana*. The output for the breeders was an online application to count the larvae. It necessitated inputs from agronomists, data scientists, and web-development specialists. At the time of writing these lines, the online application is only available for the members of the Walloon Agricultural Research Centre, but further web developments could be made to secure the connection and open it to the web.



The complete process, from the problem to the practical solution, including all stages of research is described in Companion journal article (under submission at Plant Phenomics Journal):

Antoine Deryck et al. “Automatic detection and counting of *Contarinia tritici and Sitodiplosis mosellana* larvae using smartphone images and deep learning”

A concrete output for the community is the release of the labeled dataset. This dataset is available at https://doi.org/10.5281/zenodo.19402333. It has been named the COYL-1 (Counting Orange and Yellow Larvae) dataset. It can be used to train wheat blossom midge detection models, or it can be included in a more generic dataset, for example to count larvae for any insect species. Final model and code will be available at the same location.