

## ABSTRACT

Wheat ear detection and counting are essential for land management, yield estimation and crop phenotype analysis. Previous research shows that most wheat ear detection methods are based on superficial and color features extracted by machine learning methods. However, these methods cannot meet the detection and calculation of wheat ears in the field due to feature limitations. Various kinds of computer vision-based detectors have been made to deal with this problem, but they are still limited in the ability of detection accuracy and calculation accuracy. Based on this, a deep learning method for wheat ear detection and calculation with convolutional neural network using YOLOv8 model is proposed.

This research is designed using the anaconda platform with pytorch library and python 3.10.11 programming accompanied by google collaboratory which is used to detect, calculate and evaluate the performance of the YOLOv8 model on the GWHD (Global Wheat Head Detection) dataset. The modified YOLOv8 model uses increased channel depth and width values, SGD optimizer, improved layer structure and convolution module and tuning hyperparameters accompanied by transfer learning method.

The modified YOLOv8 results show better performance characterized by increased performance metric values such as precision of 99.90%, recall value of 99.50%, F1 score of 99.90% and mAP of 95.80% which outperforms the performance of the basic structure. In addition, the FPS value shown in the proposed model is 18.21. The wheat ear object calculation performance of the proposed model achieves accurate performance characterized by  $R^2$  value of 0.977, RMSE value of 2.765 and Bias value of 1.75.

**KEYWORDS:** Wheat Ear, Deep Learning, YOLOv8, Modification, mAP