A Novel Dataset and Deep Learning Object Detection Benchmark for Grapevine Pest Surveillance

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Abstract

Flavescence dorée (FD) stands out as a significant grapevine disease with severe implications for vineyards. The American grapevine leafhopper (*Scaphoideus titanus*) serves as the primary vector, transmitting the pathogen that causes yield losses and elevated costs linked to uprooting and replanting. Another potential vector of FD is the mosaic leafhopper, *Orientus ishidae*, commonly found in agroecosystems. The current monitoring approach involves periodic human identification of chromotropic traps, a labor-intensive and time-consuming process.

Therefore, there is a compelling need to develop an automatic pest detection system, leveraging the recent progress in computer vision and deep learning techniques. However, the current progress in developing such a system is hindered by the lack of effective datasets to serve as ground-truth data for the training process.

To fill this gap, our study contributes a fully annotated dataset of *S. titanus* and *Or. ishidae* from yellow sticky traps. The dataset comprises more than 400 images, with 1000 identification per class. Guided by entomologists, the annotation task involved defining bounding boxes around relevant insects with corresponding class labels.

We trained and compared the performance of state-of-the-art object detection algorithms (YOLOv8 and Faster R-CNN). Pre-processing included automatic cropping to eliminate irrelevant background information and image enhancements to improve overall quality. Additionally, we tested the impact of altering image resolution, data augmentation, and single-class detection. Preliminary results achieved a high detection accuracy, with mAP@50 and F1-score above 90%, and mAP@50-95 around 70%, allowing a first deployment as an automatic annotation support tool.

Keywords: insect detection, deep learning, smart pest monitoring, flavescence dorée, insect traps.