Detection and counting of coffee berry borer (*Hypothenemus hampei*) Using computer vision algorithm

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Introduction

Counting coffee berry borer (CBB) from field traps is a tedious process due to the number of traps (BROCAP®) that may be operating, the great number of individuals that can be captured in each trap, and the litter remains (moss, insects, leaves, etc.) found within the traps (Figure 1). We propose to train an object detection pipeline to detect and count CBB using of photographs.

Figure 1. Photographs of CBB samples. a) traps (BROCAP®), b) CBB and moss, c) a lots of CBB.

Methods

We trained Corigan, an image analysis pipeline, developed for small object detection using high resolution images and based on the Yolov3 and Yolov5 core (Figure 2).
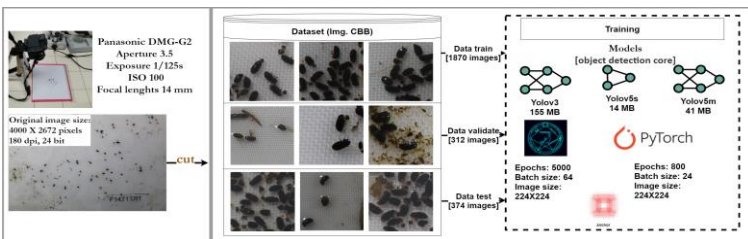

Figure 2. Steps for training the models.

Results

The Yolov5 model showed good performance in CBB detection. Precision, recall and F1 (harmonic mean of both) metrics were above 90%, ensuring a low false negative and false positive rate (Figure 3).

The confidence threshold of Intersection over Unión (IoU) to maximize the mean Average Precision (mAP = 0.97) of the Yolov5s model for detection was 0.58, while the IoU confidence threshold of the Yolov5m model was 0.73 (mAP = 0.96).
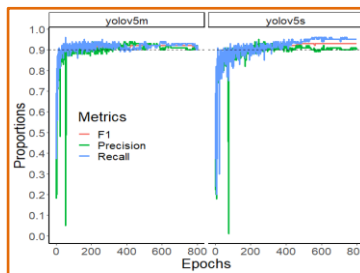
Figure 3. Training performance of CBB detection and counting models.

Figure 4. Detection of CBB. In this picture the yolov5m algorithm detected 1234 CBB.

Figure 5. Detection of CBB. In this picture the yolov5s algorithm detected 1297 CBB.

Conclusion

The use of pipeline detection reduces processing time considerably. We suggest the using at least three different photographs of the same sample, each one taken after stirring the sampling material, and the use of the average detected CBB from these three counts for subsequent analysis. Otherwise, the maximum detection can be used.

We hope to develop an app for cell phones so that farmers and researchers can easily use it, and we will work to improve the pipeline to detect CBB in its different stages (egg, larva, pupa, adult).

Project in: https://github.com/SVMendoza/Detection-and-count-CBB

References:

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