An Eco-Friendly Deep Learning Tool for Disrupting Insect Mating Behavior of Diaphorina citri Supporting the Mitigation of Unwarranted Pesticide Usage in Citrus Greening Control

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Asian citrus psyllid (ACP) is an insect vector of Huanglongbing (HLB), an incurable citrus disease with devastating economic and production impacts worldwide. Since the first detection of HLB in 2005, citrus production in Florida has decreased by 74%, causing tremendous losses and resulting in the entire citrus industry downsizing. Current laboratory techniques to detect HLB on citrus plants are often time-consuming, resulting in delayed treatment that does not effectively target the pest. The primary method of treatment for ACP recommended are pesticides and foliar sprays, which when applied in excess can negatively impact non-target organisms and are not sustainable long term. Alternative methods of intervention have been proposed to disrupt the mating of ACP, which duet vibrationally through twig surfaces. This project proposes a deep learning-based predictive modeling approach to remotely identify ACP mating calls. Generative adversarial networks were used to augment the original dataset of 1-2 second long male calls and female responses. Static and learnable frontend architectures were compared for feature extraction, based on various neural network backends. The learnable frontend paired with the EfficientNetB0 neural network architecture achieved an F1 score of 98.8% accuracy, achieving the engineering goal. When exported to a microcontroller platform this modeling approach can create an end-to-end tool for extension entomologists and farmers to limit the spread of ACP, through interference signals and a better knowledge of one's crop.

Awards Won:

Fourth Award of $500

Association for Computing Machinery: First Award of $4,000

American Statistical Association: In-Kind membership to ASA for all winners, including honorable mentions

American Statistical Association: Honorable Mention