FY25 Final Report

Project Title: Development and Evaluation of a Computer Vision–Based Monitoring Tool for Cucumber Beetles

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Executive Summary

This project evaluated the feasibility of using computer vision–based artificial intelligence (AI) to support monitoring of cucumber beetles in watermelon fields. The work focused on assessing whether automated image analysis of yellow sticky cards can reflect insect activity patterns observed through traditional manual scouting, and was done in collaboration with David Owens (UD Extension Specialist) and Nichole Krambeck (Insight Ag Scouting LLC).

Across the 2025 growing season, a comprehensive dataset of sticky card images was collected from field deployments at UD's Carvel Research and Education Center, and at commercial fields scouted by Nichole Krambeck. At the time of reporting, preliminary quantitative analyses were completed using approximately 15% of the total dataset (≈100 of 625 images). These early analyses indicate that AI-assisted insect counting is feasible and broadly reflects observed levels of insect activity. However, full dataset processing and refinement are ongoing. This project has established an end-to-end pipeline for AI-assisted pest monitoring, encompassing field image capture, annotation, cloud-based model deployment, and quantitative comparison with human counts.

Project Objectives

1) Improve the performance of a pre-trained computer vision model for detecting cucumber beetles on yellow sticky cards.

2) Integrate the detection model into an accessible, user-friendly digital tool.

3) Conduct field-based evaluation of model performance under real-world conditions.

What was done in 2025

We deployed and retrieved ~625 sticky cards from watermelon fields, captured images using smartphone cameras, annotated images to train the AI model, processed images through AI detection models, and conducted manual insect counting of cucumber beetles for comparison with our AI approach. Object detection models were trained using annotated sticky card images and deployed

through a Gradio interface, which can run locally or via a cloud-based processing pipeline. Model outputs were compared with manual human counts to generate initial performance metrics.

Preliminary Results

These preliminary results are based on approximately 15% of the sticky card data collected to date. At this stage, the model's insect counts differ from human counts by an average of ~ 4 insects per card. This indicates that the model is broadly capturing the level of insect activity observed on the cards, although non-trivial differences remain (Figure 1).

Figure 1. *An example of an AI-processed sticky card image, depicting striped cucumber beetles. Note how three beetles were missed by the computer model.*

Because the analysis is based on a partial dataset, the results reflect early patterns rather than final performance benchmarks. As data capture and analysis continue, and as data from additional seasons are incorporated, these patterns will be further refined and used to establish more robust benchmarks.

At this stage, a functional prototype has been deployed using the Gradio. The prototype has been bench-tested using field-collected images and supports both single-image and batch processing workflows. The system can be run on a local

server or cloud-based environment, allowing flexibility for future deployment and testing scenarios. For the purposes of this report, the prototype is maintained in a controlled testing environment. Access for demonstration and evaluation can be provided upon request. Access to the prototype can be shared upon request.

Next Steps

The next steps planned include completion of full dataset processing, expansion of training data through incorporation of additional seasons, and refinement of performance metrics. This work demonstrates the feasibility of AI-assisted monitoring as a complementary tool to traditional scouting. While human expertise remains essential, automated image analysis has the potential to reduce repetitive counting tasks and support more consistent monitoring of pest activity.