Ohio Vegetable and Small Fruit Research and Development Program

6870 Licking Valley Road
Frazeysburg, Ohio 43822
www.opgma.org/ovsfrdp

January 8, 2024 – Final Research Report

Project Title: Automated Insect Trap Pilot Test

Principle Investigators: Jim Jasinski, Ashley Leach, Frank Becker, Bob Filbrun
Phone: 937-484-1526; Fax 937-484-1540
Email: Jasinski.4@osu.edu, leach.379@osu.edu, becker.587@osu.edu, filbrun.12@osu.edu
Cooperating Institution: Ohio State University, Depts. of Extension and Entomology
Address: 1512 S US 68, Suite B100, Urbana, OH 43078

Introduction

The first step in IPM requires pest population monitoring so that proper identification, thresholds and management actions can be determined if necessary. For decades OSU Extension and Entomology Department's have cooperatively set up statewide trapping networks to monitor up to 20 key pests in specialty crops so growers can use this information to make the best management decisions possible. While trapping is essential, it does take valuable grower time on a daily or weekly basis throughout the season to set up and service traps. Recent advances in automated trapping technology may facilitate grower adoption by adding reliability, cost effectiveness and convenience, ultimately increasing pest monitoring and leading to better pest management and produce quality. But the automated traps are designed differently than conventional traps and expensive to rent so before endorsing automated trap technology broadly, each trap type must first be validated against existing standard traps to ensure similarity in trap catch for each pest and crop complex.

The trap comparisons used in this study include delta sticky traps for Codling Moth (CM) and Hartstack and Heliothis traps for corn earworm (CEW). Originally, Grape berry moth was also a target pest to monitor but Trapview was unable to generate AI capable of identifying this pest, so it was dropped for the study. Trapview automated ID traps are solar cell powered, use a self cleaning sticky film rolling dispenser, and have a camera inside the trap facing the sticky film where every 24 hours an image of the insects captured was taken; in our studies, this image was taken at 11PM. Artificial intelligence software then identifies key pests on the film and places a green square around the "pest" and ignores other non-target insects. Sometime in the evening that information is transmitted via cellular connection to cloud software which generates updates on both a mobile phone app and website for users to access. The trap is designed to monitor for an entire season needing only to be visited to replace the pheromone lure or replace the sticky film if needed.

Research Objective 1: Compare trap catch **similarity** and **accuracy** of Trapview automated ID traps with conventional pheromone traps.

Trap Catch Similarity

Both Trapview AI and conventional traps were deployed near the target crop according to standard monitoring recommendations at four different locations across the state.

The CM comparisons were conducted at two apple orchards around Wooster, OH. The first orchard was OSU's Hort Unit 2 which deployed two conventional delta traps plus the Trapview trap. The traps were monitored from May 1 – August 21 (Fig. 1). The second site, Moreland farm, had three bucket traps deployed in the orchard plus the Trapview trap from May 1 – September 25 (Fig. 2). The CM conventional traps at both locations used Trece Pherocon L2-P lure and were inspected one day a week.

The CEW comparison to Trapview was also conducted at two sweet corn locations. The first site was OSU's Muck Crops Research Station in Willard, OH with traps being monitored from June 16 – September 28. The second site was OSU's Western Ag Research Station in South Charleston, OH with traps being monitored from June 14 – September 29. At each location both a Hartstack and Heliothis trap were set up using Hercon Luretape; all traps were inspected 2-3 days a week (Figs. 3-4).

The conventional and Trapview AI trap seasonal flight activity curves were compared for similarity using a standard t-Test. Delta and bucket trap captures at both CM locations were not significantly different than Trapview. Likewise, both seasonal flight activity curves for conventional CEW traps at Willard were not significantly different than Trapview catches, however the trap catch magnitude during peak flight in August was 5-6X higher than Trapview. Both CEW conventional traps at S. Charleston caught significantly more moths than Trapview captures (Table 1).

Table 1. t-Test statistic for conventional and Trapview seasonal flight activity curves.

Conventional Trap vs. Trapview AI	**Location**	**p-value ($p=0.05$)**	**Interpretation**
Bucket CM	Wooster (Moreland)	0.084	Trap captures are not significantly different
Delta CM	Wooster (HU2)	0.448	Trap captures are not significantly different
Heliothis CEW	Willard (Muck)	0.084	Trap captures are not significantly different
Hartstack CEW	Willard (Muck)	0.066	Trap captures are not significantly different
Heliothis CEW	S. Charleston (WARS)	0.013	Trap captures are significantly different

Hartstack CEW	S. Charleston (WARS)	0.001	Trap captures are significantly different

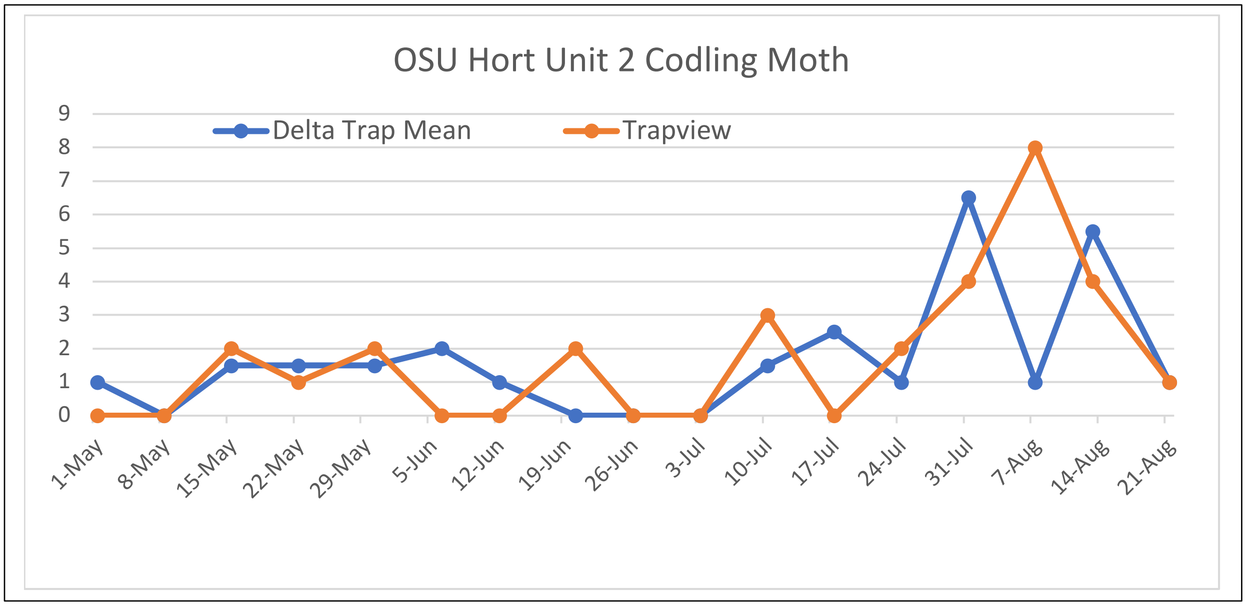

Figure 1. Codling moth flight curves at OSU’s Hort Unit 2 apple orchard.

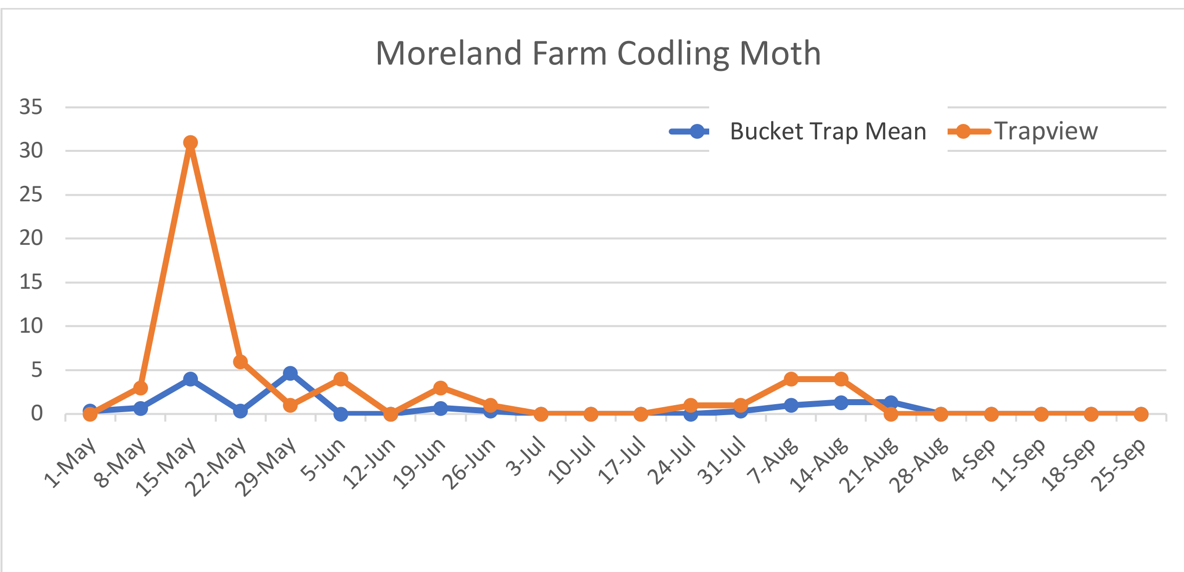

Figure 2. Codling moth flight curves at Moreland farm apple orchard.

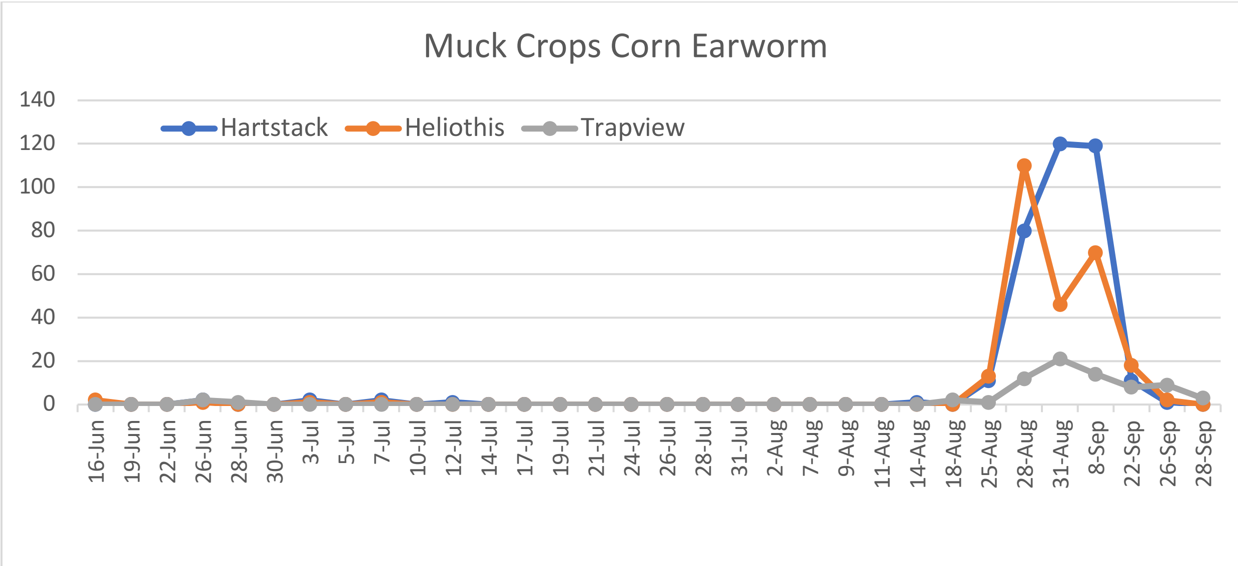

Figure 3. Corn earworm flight activity at Muck Crops research station in sweet corn.

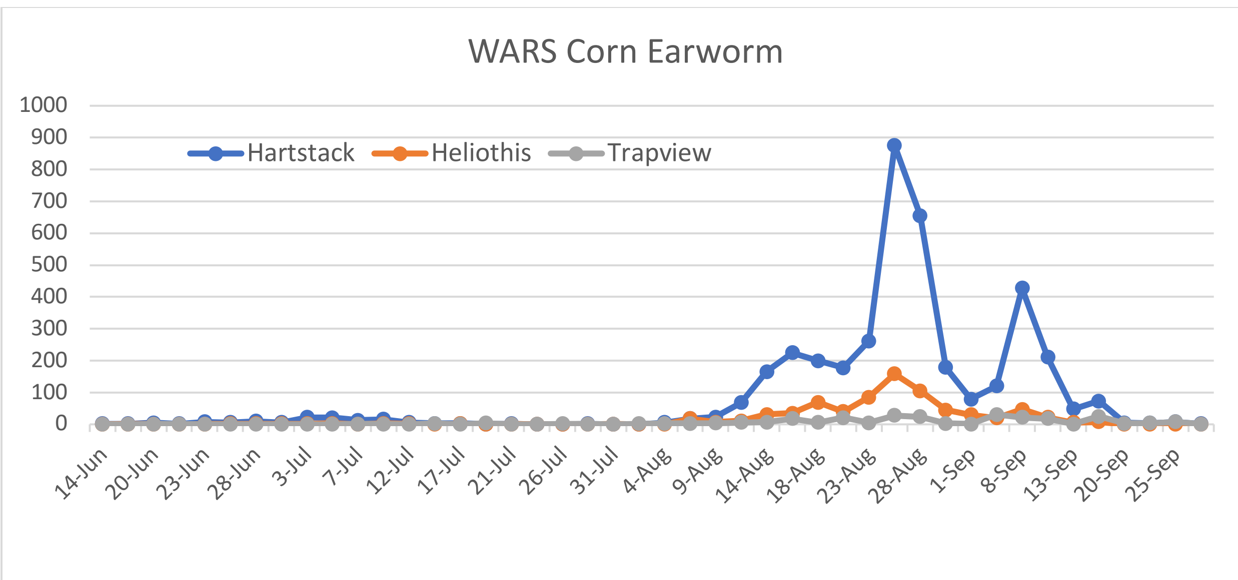

Figure 4. Corn earworm flight activity at Western Ag Research Station in sweet corn.

Trap Catch Accuracy

The other aspect of using Trapview AI traps is determining the accuracy of the automated identification of pests versus non-target captures. To accomplish this, each image captured by the Trapview camera was reviewed for identification accuracy.

The Moreland Trapview trap captured 148 images (one per day) with 59 CM adults reported over the season; 56 were positively confirmed as CM leading to a 94.9% accuracy rate. The Hort Unit 2 Trapview trap captured 113 images (one per day) with 29 CM adults reported over the season; 27 were positively confirmed as CM leading to a 93.1% accuracy rate. The Muck Crops station Trapview trap captured 104 images (one per day) with 128 CEW moths reported over the season; 124 were positively confirmed as CEW leading to 96.8 % accuracy rate. The Western Ag Research Station Trapview trap captured 106 images (one per day) with 254 CEW moths reported over the season; 253 were positively confirmed as CEW leading to 99.6% accuracy rate. There was a camera malfunction on July 30th so no image was captured that night and on at least 5 nights CEW moths climbed off the sticky tape.

Below are some screen shots of images taken by the Trapview AI camera showing basic positive identification and various forms of misidentification, missing moths and other counting errors (Figure 5).

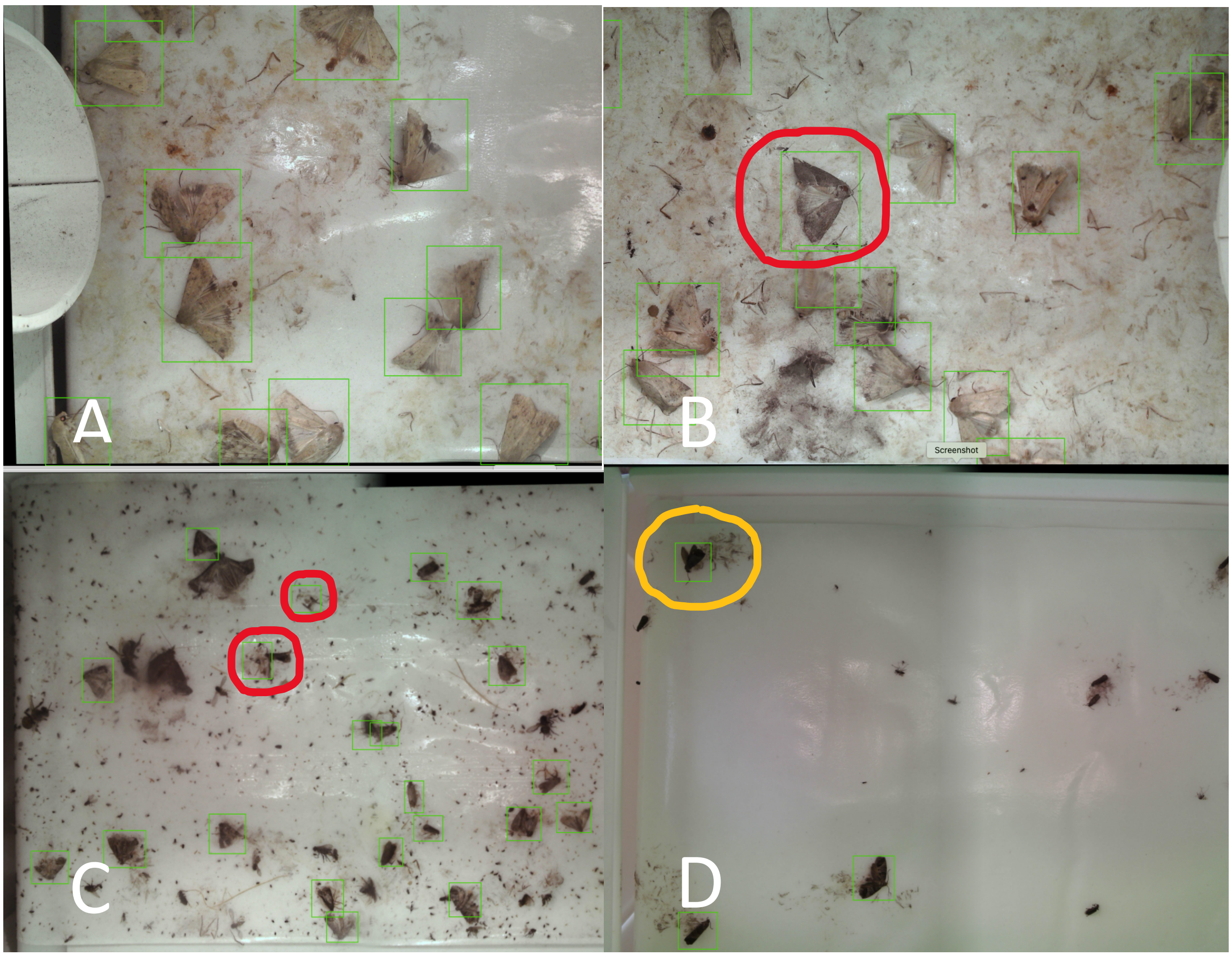

Figure 5. Trapview AI images; (A) green box = positive ID, (B) red circle misidentified CEW, (C) red circles highlighting missing / not insects, (D) circled image too dark to confirm ID.

Research Objective 2: Determine cost effectiveness and economics of deploying automated traps for specific pest and crops in Ohio.

Given that the annual rental fee of each Trapview trap unit far exceeds the cost of the conventionally recommended trap, cost factors such as number of trips to the field per season, scout hourly wage, mileage to the site, time spent traveling to the site and time spent servicing the traps were calculated to justify the expense of deploying automated ID traps. A cost benefit table was generated for each crop and pest in the study (Tables 2-5).

There is no one consistent scenario that clearly shows an economic advantage of when to use the Trapview trap. The most significant interactions to consider are the frequency of pheromone lure changes requiring more trips to the field (CEW @ 2wks vs CM @ 8-12 wks), distance traveled, length of monitoring season and hourly scouting rate. It is interesting to note there are up to two scenarios that seem to indicate a savings by adopting the Trapview trap except for Table 2. The "Break Even" scenario for each table was created to determine the minimum conditions for growers to neither lose nor make money by adopting the trap.

Table 2. Cost benefit analysis of using Trapview traps in Moreland farm apple orchard over a 22 week season monitoring codling moth. Scout cost was $22.35/hr.

	No. trips to traps (22 wks)	Round Trip Mileage	Time / trip (hr)	Mileage + Service Cost ($)	Trapview Rental ($)	Seasonal Cost Benefit ($)	Interpretation
From Home Loop - 1 Trapview Trap	22	15.4	1.5	$ 870.70	$650.00	$ 220.70	Grower saves
From Home Loop - 1 Trapview trap per block (4 total)	22	88	8.0	$ 4,720.00	$2,600.00	$ 2,120.00	Grower saves
From Home Loop - Realistic Scenario - 22 wks & 3 Traps per block (12 total)	22	88	8.0	$ 4,720.00	$7,800.00	$(3,080.00)	Grower loses
Breakeven Scenario From Home Loop - 22 wks & 2 Traps per block (8 total)	22	107	8.5	$ 5,190.50	$5,200.00	$ (9.50)	Break even

Table 3. Cost benefit analysis of using Trapview traps in Hort Unit 2 in apples over a 17 week season monitoring codling moth. Scout cost was $20.00/hr.

	No. trips to traps (17 wks)	Round Trip Mileage	Time / trip (hr)	Mileage + Service Cost ($)	Trapview Rental ($)	Seasonal Cost Benefit ($)	Interpretation
From Office Loop - 1X/wk, 1 Trap	17	8.2	1.0	$ 379.95	$ 650.00	$ (270.05)	Grower loses
Realistic from Office RT 1X/wk, 2 Traps	17	8.2	1.0	$ 379.95	$1,300.00	$ (920.05)	Grower loses

Breakeven Scenario From Office - 17 wks & 2 Traps per block	17	59	1.8	$ 1,301.25	$1,300.00	$ 1.25	Break even

Table 4. Cost benefit analysis of using Trapview traps in sweet corn at the Muck Crop Station over a 14 week season monitoring corn earworm. Scout cost was $15.00/hr.

	No. trips to traps (14-16 wks)	Round Trip Mileage	Time / trip (hr)	Mileage + Service Cost ($)	Trapview Rental ($)	Seasonal Cost Benefit ($)	Interpretation
From Station Loop	34	0	0.3	$ 135.00	$ 650.00	$ (515.00)	Grower loses
From Home Loop	34	74	1.7	$ 1,973.70	$ 650.00	$ 1,323.70	Grower saves
Realistic Scenario - 14 weeks of monitoring (10wks 1X + 4wks 3X)	22	74	1.7	$ 1,096.50	$ 650.00	$ 446.50	Grower saves
Breakeven Scenario - 14 weeks of monitoring (10wks 1X + 4wks 3X)	22	40	1.2	$ 651.00	$ 650.00	$ 1.00	Break even

Table 5. Cost benefit analysis of using Trapview traps in sweet corn at the Western Ag Research Station over a 14 week season monitoring corn earworm. Scout cost was $21.00/hr.

	No. trips to traps (14-16 wks)	Round Trip Mileage	Time / trip (hr)	Mileage + Service Cost ($)	Trapview Rental ($)	Seasonal Cost Benefit	Interpretation
From Station	44	0	0.50	$ 378.00	$ 650.00	$ (272.00)	Grower loses
From Home Loop	44	52	1.50	$ 2,350.80	$ 650.00	$ 1,700.80	Grower saves
Realistic Scenario - 14 weeks of monitoring (10wks 1X + 4wks 3X)	22	52	1.50	$ 979.50	$ 650.00	$ 329.50	Grower saves
Breakeven Scenario - 14 weeks of monitoring (10wks 1X + 4wks 3X)	22	33	1.05	$ 652.50	$ 650.00	$ 2.50	Break even

To interface and interact with Trapview there is both a website and smart phone app where users can login and view dozens of functions related to the technology in addition to seeing the standard trap catches and sticky film images. Our research was mainly focused assessing the Trapview AI technology to confirm positive identification of the pest, therefore these other advanced features such as life stage modeling were not tested or reviewed. These features are touted by Trapview as value added and desirable for growers.

Both the website and app could be used to tweak the sticky roll once it was sufficiently covered with insects if not done timely enough by the AI, which was typically weekly. Sometimes the automated roller advancement feature worked well, moving the tape every seven days or when the tape was covered with insects but sometimes it did not move the roll over for a period of weeks or months, leading to difficulty sorting out new and existing insect captures.

Project Summary

This study was to evaluate how compatible an automated trap system such as Trapview would be in monitoring two specific pests in two different crops. Based on four comparisons, accuracy does not seem to be an issue but trap attractiveness and daily insect captures can vary widely compared to the conventional trap, therefore established trap thresholds should be cautiously applied and will require a “calibration” phase that should last several seasons.

Generally speaking, the seasonal flight activity curves produced by Trapview traps compared favorably to the recommended delta sticky and bucket style trap for codling moth, suggesting these traps may be potentially substituted after a few more years of validation. The codling moth identification accuracy ranged from 93-95%. Yet to be evaluated would be how well or easily these traps determine the biofix for egg hatch treatment later in the season.

The Trapview trap seasonal flight curves were statistically similar to both the Heliothis and Harstack traps in sweet corn at the Muck Station despite the trap catch being substantially lower than both traps. The Trapview trap seasonal flight curves were statistically lower than both Heliothis and Hartstack traps at the Western Ag Research Station. The lower Trapview trap catches could lead growers to lengthen their insecticide spray intervals based on existing thresholds per night, under estimating egg laying, larval infestation and crop loss during actual higher moth activity flights. While the first year at this site did not compare well per se, some modifications of the Trapview trap design or threshold table may make it more compatible with current management guidelines in future years.

In the face of agricultural labor shortages and diminishing skilled crop scouts, these AI based camera traps may be part of the insect monitoring landscape within a few years for certain crops and pests despite their high cost if thresholds can be successfully modified. Below are some specific areas to address and highlight regarding this project.

-Trapview trap moth captures at both apple locations compared favorably to the recommended delta sticky trap for codling moth, suggesting these traps may be potentially substituted after a few more years of validation.

-Codling moth identification accuracy was 93-95%. Yet to be evaluated would be how well these traps determine the biofix for egg hatch treatments.

-Trapview trap seasonal moth captures were statistically not different from both Heliothis and Hartstack traps in sweet corn at the Muck Station despite moth captures being numerically much lower.

-Trapview trap seasonal moth captures were significantly lower than both conventional Heliothis and Hartstack traps at the Western Ag Research Station.

-Low Trapview trap catches of CEW due to trap design could lead growers to lengthen their insecticide spray intervals exposing ears to larval infestation, crop damage and economic loss.

-While CEW identification accuracy was 97-99%, modifying the Trapview trap design may make trap catch similar to conventional traps so that current management guidelines for specific pests can be used.

-There were some technical issues with the traps such as a minor camera malfunction, several nights where CEW moths climbed off the sticky tape, moths not landing on sticky tape, misidentified insects in trap, etc. but overall product support was fairly good.