AUTOMATED MONITORING TRAPS FOR DETECTION OF WESTERN BEAN CUTWORM

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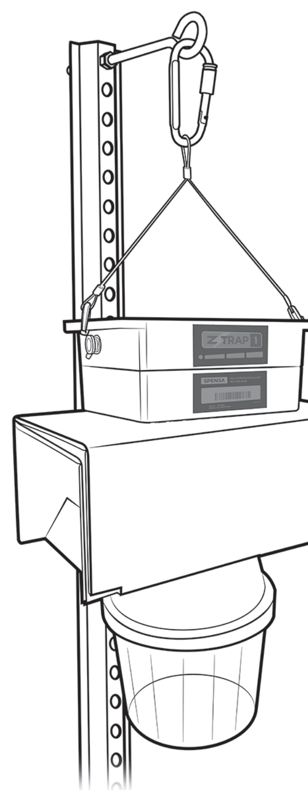
ABSTRACT

Western bean cutworm (*Striacosta albicosta*, Smith) has grown into a major pest of maize in the United States over the past ten years. Range expansion into the eastern corn-growing regions, the larvae's gregarious nature, and a resistance to engineered plant traits has made control difficult. Reliable monitoring technologies can make a significant difference in management of this pest.

Spensa Technologies' Z-trap is an automated monitoring trap that can provide real-time information about a target pest. It has not been field-tested against *S. albicosta* and so we sought to use the Z-trap to discover insights about *S. albicosta's* behavior.

S. albicosta accounted for 73% of all insects collected by the trap and the classifier correlated with trends in moth flight. Nightly flight data were normally-distributed, with flights peaking between 12 am and 1 am. The simple degree day model trailed behind the true flight progression by 5-12 days for the 2017 growing season. There was no relationship between trap count data and field infestation rates.



WESTERN BEAN CUTWORM

Western bean cutworm (*Stiracosta albicosta*, Smith) (WBC) has rapidly expanded its range into the eastern United States. Transgenic crop traits (i.e. Bt) fail to provide adequate control against it, requiring growers to fall back onto other methods. Foliar pesticide sprays provide adequate control, if timed properly. It is important, therefore, for growers to have accurate assessments of WBC populations in their area.

SPENSA Z-TRAPS

Reliable assessment of pest populations allow for responsive management decisions. New technologies can make these assessments faster, giving growers more time to adapt to changes in their fields. **Automated monitoring traps are part of a growing trend in precision agriculture, intended to streamline the flow of information and decrease the time between detection and activating a management plan.**

Spensa Technologies Inc.'s (West Lafayette, IN) Z-trap is an automated trap that functionally-replaces commercial pheromone bucket traps. Its detector uses electrical current to both capture a target pest and record its capture, with the information then uploaded wirelessly to a grower's device of choice. Growers can then review the data and make decisions based on the trends they observe.

OBJECTIVES

In this study, we aimed to discern the following objectives:

1. Accuracy of the Spensa Z-trap for detecting a target pest
2. Distribution of moth flight times over the course of the night
3. Accuracy of simple degree day model for predicting the 2017 WBC flight
4. Power of degree days, crop growth stage, moth flight factors for predicting field infestations

WBC: INDIANA

METHODS

Z-traps were deployed in eight cornfields in Indiana on May 11, 2017. Pheromone lures were replaced every four weeks and buckets were checked weekly starting on June 21, 2017 and terminating on July 31st, 2017. Contents of buckets were taken back to Spensa Technologies, where insects were photographed, identified, and counted.

All fields were scouted each week between June 21st and July 31st 2017. Five locations in each field were randomly selected and 20 plants per location were examined for *S. albicosta* egg masses. Growth stage of each plant and the number of egg masses per location were recorded.

RESULTS

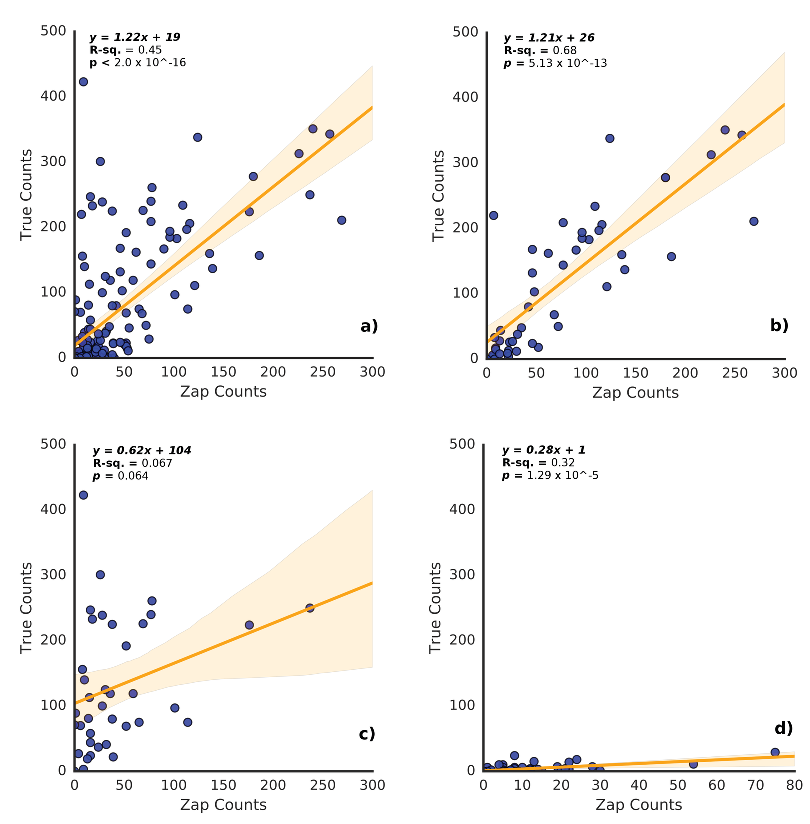


FIG. 1: Z-TRAP ACCURACY

WBC accounted for the majority of all trapped insect (73 ± 3%). Detection events (Zaps) were significantly correlated with the true rate of moth capture and accounted for 45% of all variation across the season (P < 2 x 10-16) (Fig 1a). The correlation was even higher in the first two weeks of the season (68%), when counts were greatest **(Fig 1b)**. The relationship between zaps and true counts declined as moth population levels declined with the season **(Fig 1c,d)**.

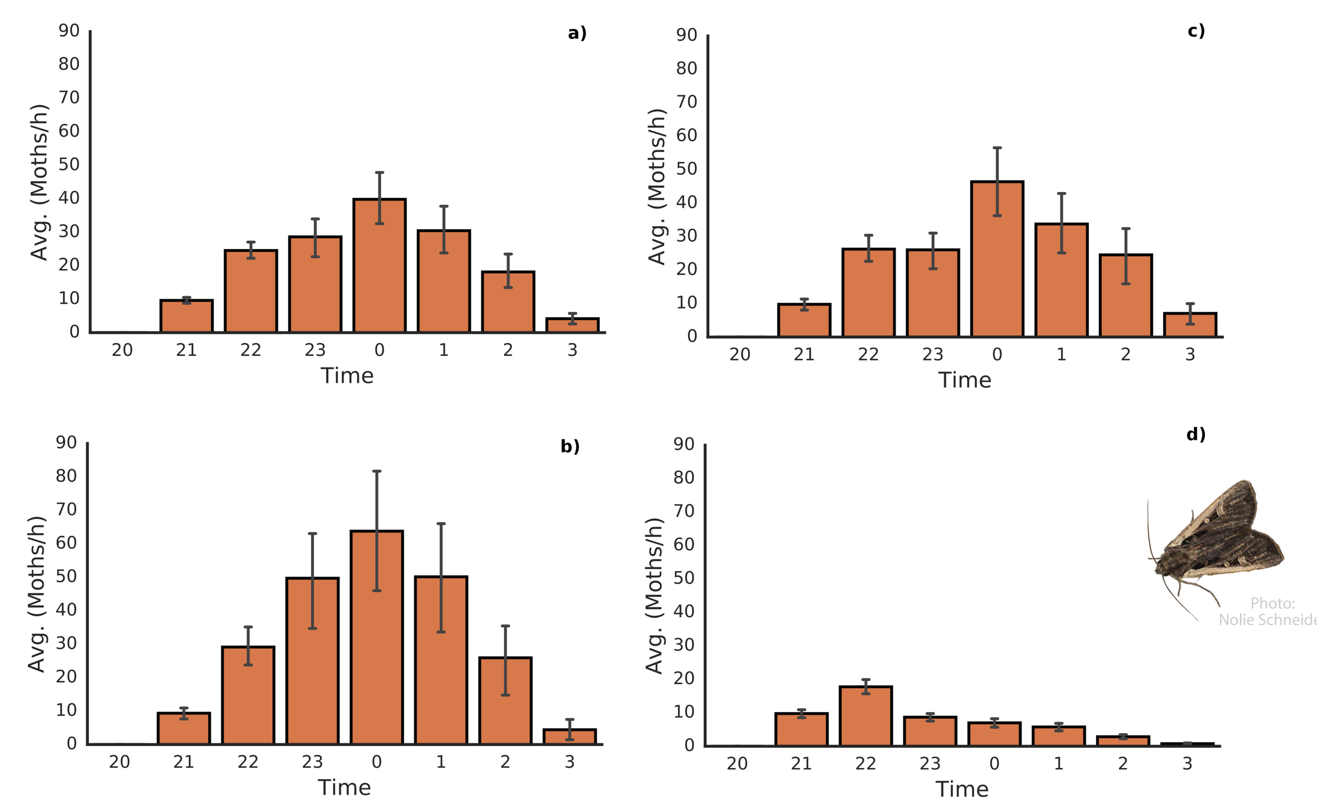


FIG. 2: FLIGHT DISTRIBUTION

Moth flight distribution was normally-distributed (P = 0.82), with moth activity significantly influenced by the time of night (F = 17.56, df = 2, 284, P = 6.43 x 10-8) **(Fig 2a)**. Peak flight occurred between 12 and 1 am, roughly 3-4 hours after sunset in the study region. This distribution remained largely consistent until late in the season, when the peak appeared to shift, occurring between 10 and 11 pm **(Fig 2b-d)**.

ASSESSMENT

All statistical tests were performed in R (R Core Team, 2015).
Regression analysis was used to evaluate:

1) Accuracy of z-trap for detecting WBC
2) Effect of time of night (two-week interval) on nightly moth flights
3) Predictive power of the WBC simple degree-day model in Indiana
4) Utility of degree-day, plant growth stage, and moth flight factors for determining field infestation rates

ANOVA was used to compare moth counts between fields identified with significant infestation rates (> 5%) and those that did not (< 5%).

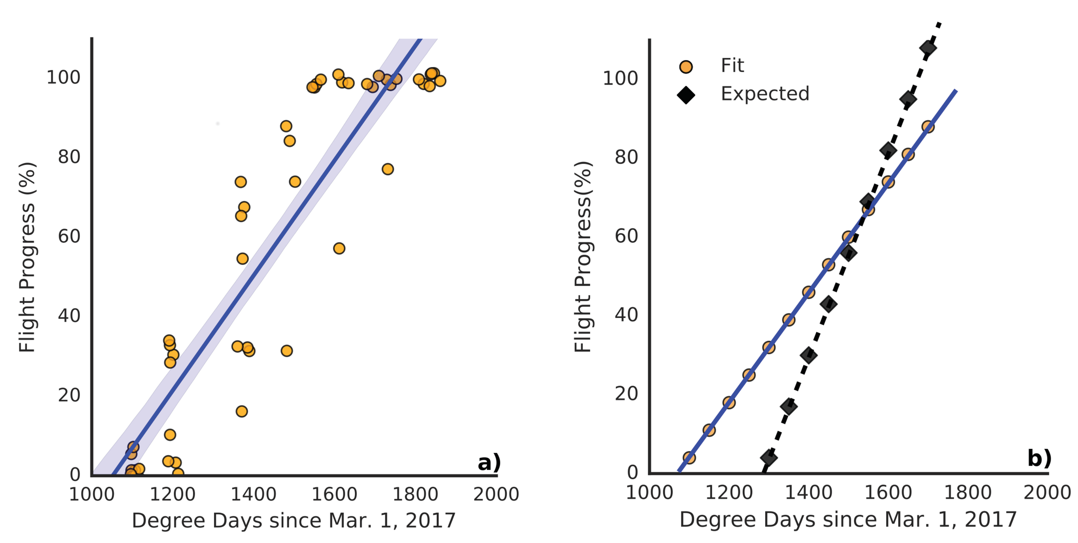


FIG. 3: PHENOLOGY

WBC's 2017 seasonal flight could be tracked using degree-day data, accounting for 80% of the variation (F = 210.2; d.f. = 1, 50; P < 2 x 10-16) **(Fig 3a)**. Spensa Z-traps detected moth flights ahead of the degree-day model, which trailed behind actual moth flight by 5-12 days **(Fig 3b)**. While model predictions still had a significant relationship with observations (F = 10.43; d.f. = 1, 18; P = 0.0047), they were a poor fit (R-sq. = 0.33).

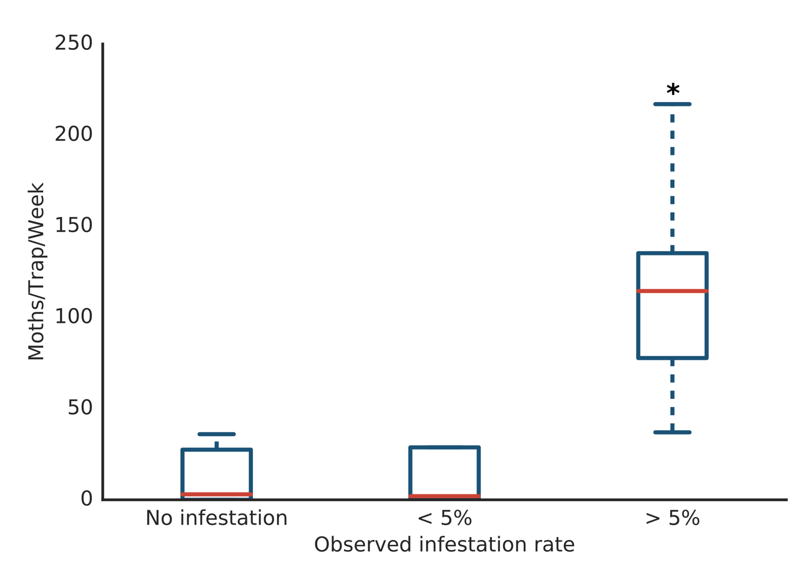


FIG. 4: FIELD INFESTATIONS

Degree days, crop growth stage, and moth flight progress were predictive of field infestation levels, but only weakly (Table 1). However, ANOVA revealed significant differences in weekly moths counts between fields with above threshold levels and those below, during the same 1-week period (ANOVA: F = 11.04, d.f. = 1, 32, p-value = 0.0022) **(Fig 4)**. Fields with significant infestation levels caught an average of 156 ± 61 moths/trap/week, while fields below threshold levels averaged between 48-66 moths/trap/week.

CONCLUSIONS

SPENSA TECHNOLOGIES' Z-TRAP CAPTURED THE GENERAL TRENDS IN SEASONAL WBC FLIGHT AND NIGHTLY ACTIVITY.

Traps detected the start and rise of the 2017 flight ahead of the simple degree-day model. This early detection could give growers more time to activate management plans to control WBC effectively.

Z-TRAPS COULD NOT PREDICT INFESTATION LEVELS IN THE FIELD, USING THE AVAILABLE DATA.

They were able to characterize differences in moth counts between fields with different relative levels of infestation. These differences could be used to identify fields with greater risk of damage for further scrutiny. Overall, the Z-trap proves to be a useful tool that complements other pest management practices.