ELECTRONIC BOLLWORM PHEROMONE TRAPS: DO THEY "HARTSTACK" UP?

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Abstract

Z-traps, bucket-style pheromone traps equipped with electrically-charged tines to automatically record the capture of moths, were compared to traditional Hartstack pheromone traps for monitoring bollworm, *Helicoverpa zea*, during 2017 in Mississippi, North Carolina, South Carolina and Georgia. Four traps of each type were placed on a single farm in each state and averages per state were used for comparisons. The Z-trap bucket trap generally captured fewer moths than Hartstack traps. In Mississippi, differences in trapping efficiency were small, but few moths were captured in Z-traps in the other three states compared to Hartstack traps. The electronic sensors were poor at measuring moth capture in these traps, mostly underreporting trap catches, but sometimes reporting twice as many moths as actually captured. While electronic counting of moths could be beneficial for collecting data in a timely manner with minimal labor, the current trap and sensor are not reliable, and thereby not useful for bollworm. Further research should focus on other moth species that are traditionally monitored using bucket traps or develop a new trap design for bollworm monitoring.

Introduction

Bollworm, *Helicoverpa zea*, is a pest in numerous crops and is commonly monitored using pheromone traps developed by Hartstack et al (1979). This trap captures male moths attracted to a synthetic sex pheromone. Limitations of this trap are the cost and size of the trap. Furthermore, traps must be visited to make counts, so collecting daily data of trap captures is labor intensive if much travel to the trap is involved. Spensa Technologies Inc. (West Lafayette, IN) has developed an electronic pheromone trap (Z-trap). The trap is based on a standard plastic bucket trap fitted with battery-powered, electrified tines over the trap which are connected to software that counts the number of moths entering the trap (Fig. 1). The computer software in the trap communicates with the internet "cloud" so that the user can receive trap count data on a daily basis by opening an application on their computer or smart phone. The only time a person would actually need to go to the trap would be every two weeks to change the pheromone. This would allow improved data quality by knowing more precisely when the moths entered the trap and reduced labor for counting moths in the trap.

Because there are 30-40 years of bollworm data using Hartstack pheromone traps for many locations, it is necessary to compare this new pheromone trapping system with the standard Hartstack system so that data collected with one trapping method can be compared to data collected with the other method. Furthermore, it is necessary to evaluate the accuracy of the electronic sensor in counting moths as the sensor was developed with different insect species.

Materials and Methods

Four Hartstack pheromone traps (Hartstack et al. 1979) and four Z-traps (Spensa Technologies, Inc.) were placed at least 100 m apart within a single farm in Mississippi, North Carolina, South Carolina and Georgia. Individual pheromone trap captures can vary widely within a location, so the average of four traps at a location were used to reduce the variance of individual trap catches and provide a more reliable comparison of trapping systems. Trapping commenced at all locations during early May and continued through the end of September 2017. The same source of commercially available pheromones was used in both trapping systems at all locations, but the brand varied between states. Traps were physically visited once or twice per week and pheromones were replaced every two weeks. At each visit moths were counted in both trap types. Electronic data were downloaded from a website developed by Spensa Technologies and compared to the number of moths found in the Z-traps.

Correlations were made comparing average weekly Hartstack trap counts in each state with average weekly Z-trap counts based on actual moths found in the traps. Correlations were also made between the weekly electronic sensor data and the actual moth data from the same Z-traps.

Results and Discussion

Comparisons of moth counts in Hartstack traps and the bucket-style Z-traps varied by location. In Mississippi, both trapping systems caught a comparable number of insects (Fig. 2). However, in the other three states, moth captures in the bucket traps were very low in comparison to the Hartstack traps (Fig. 3). In all locations, the traps did not track each other closely, as the fit of the lines as measured by R^2 was less than 0.5. This variable response when comparing bucket and Hartstack traps has been found before (Guerrero et al. 2014).

The comparison of the counts measured by the electronic sensor and the actual counts in the same traps (Fig. 4) showed that the sensor was generally underestimating the number of moths in the trap. The best data for this were collected in Mississippi since this was the only location that caught many moths in the bucket trap. As shown in Fig. 5, the electronic counts and the actual counts (Z-trap) tracked well until mid-July, after which the sensor consistently underestimated moths in the trap.

Conclusions

Given the low catch rate in bucket traps compared to Hartstack traps and the inconsistent response of the electronic sensor to bollworms over the course of the season, the use of Z-traps for monitoring bollworms is not recommended at this time. The accuracy of the electronic counts compared to actual counts in the trap may be fixable with an adjustment of the sensors or the algorithm used to determine a moth catch, but collection of bollworm data that corresponds to historical Hartstack trap data will likely require a different trap design that better corresponds to bollworm flight behavior. The current Z-trap design is likely more appropriate for species that are efficiently monitored with bucket-style pheromone traps rather than Hartstack traps.

Fig. 1. Side and end view of the Z-trap used in this study

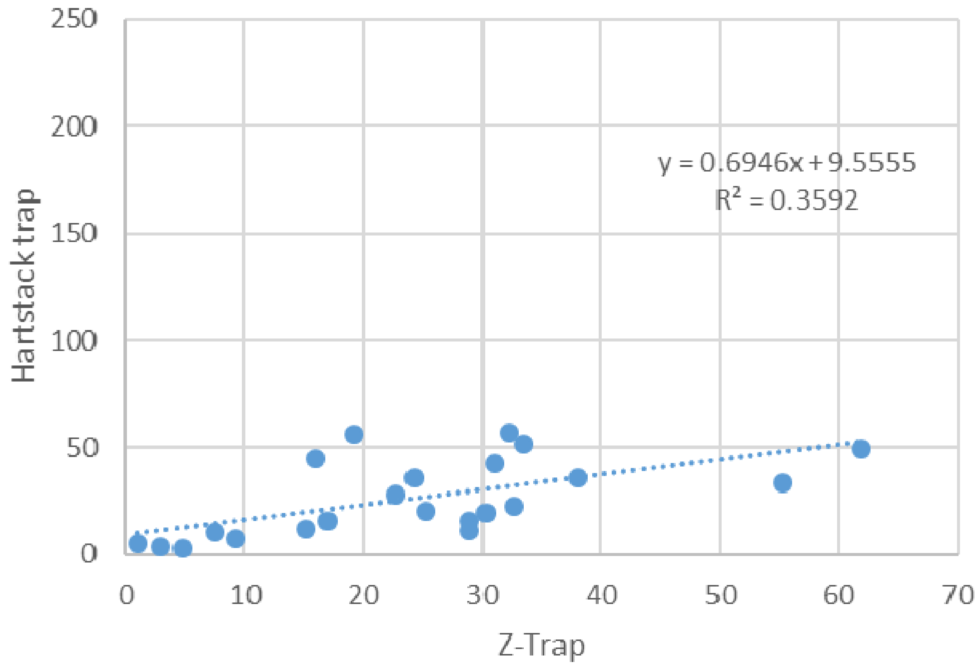

Fig. 2. Correlation of actual moths caught in Hartstack and Z-traps in Mississippi during 2017. Each point represents average weekly catch per trap from 4 traps of each type.

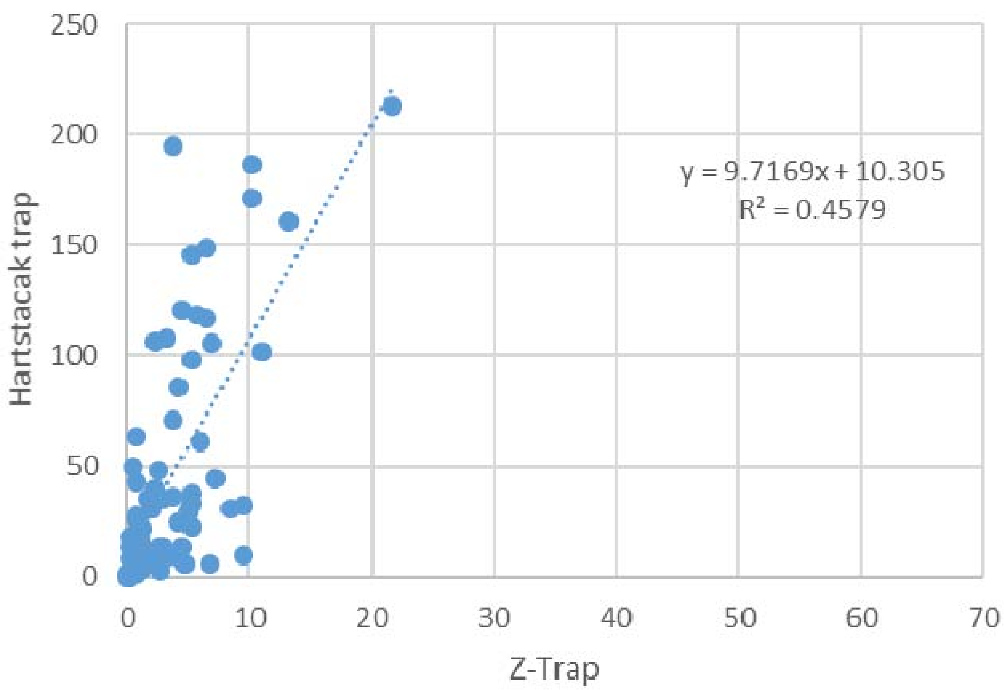

Fig. 3. Correlation of actual moths caught in Hartstack and Z-traps in Georgia, North Carolina and South Carolina during 2017. Each point represents average weekly catch per trap from 4 traps of each type at each location.

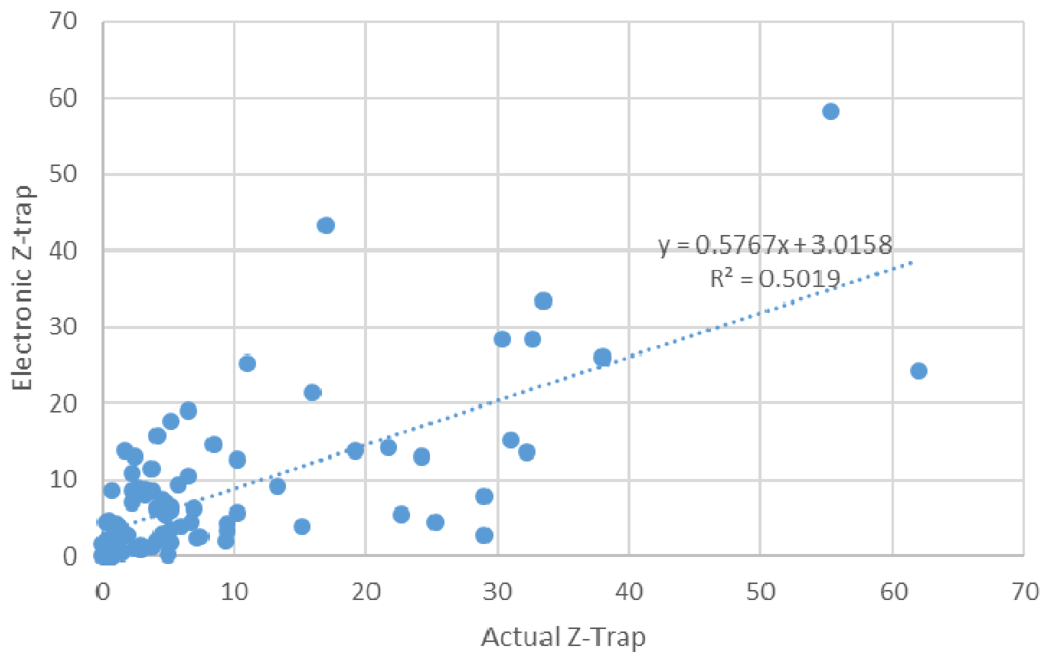

Fig. 4. Correlation of actual moths caught in Z-traps with counts recorded electronically from the same traps in Georgia, Mississippi, North Carolina and South Carolina during 2017. Each point represents average weekly catch per trap from 4 traps at each location.

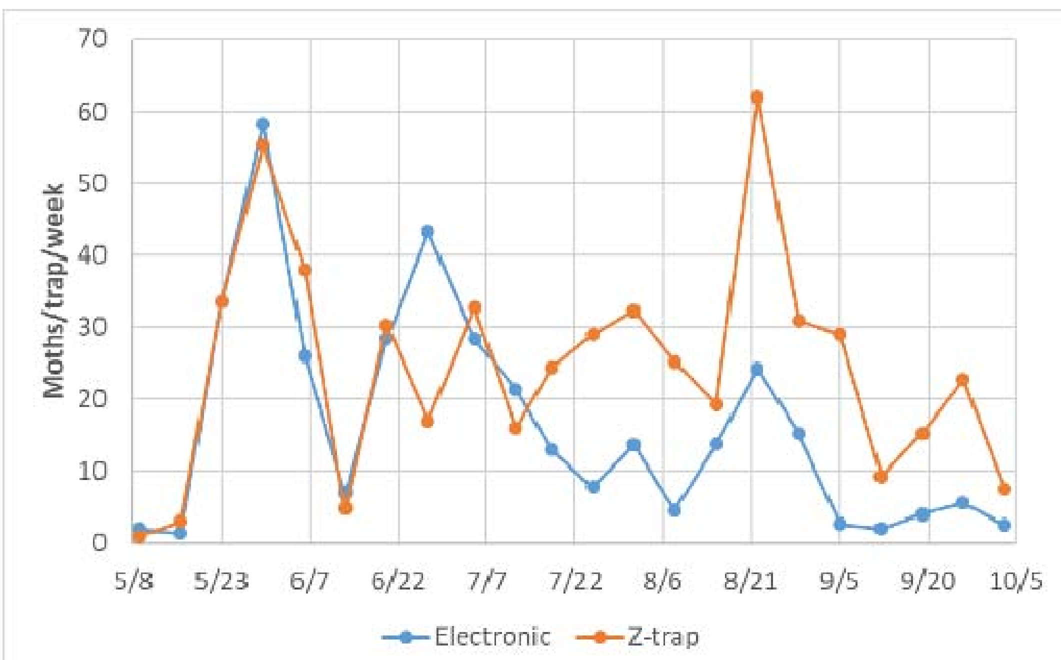

Fig. 5. Weekly catch of moths as determined with an electronic sensor (Electronic) and physical count (Z-trap) in the same Z-traps in Mississippi during 2017. Each point represents the average catch per trap from 4 traps.

Acknowledgements

The authors thank Spensa Technologies, Inc. for providing the Z-traps and computer interface, Monsanto for initiating and coordinating the project, and Mississippi State University, North Carolina State University, Clemson University and University of Georgia for providing funding for this project.

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