A COMPARISON OF HARTSTACK AND BUCKET STYLE MOTH TRAPS FOR BOLLWORM

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Abstract

A comparison between Hartstack- and universal-style (bucket) moth traps was done for bollworm, *Helicoverpa zea*, during the summer of 2015 at a total of 24 locations in Arkansas, Louisiana and Tennessee. On average, Hartstack traps caught over four times as many moths as bucket traps, but bucket traps caught as many or more moths when moth catches were low. There was a weak correlation between the numbers of moths caught in Hartstack traps versus the numbers caught in bucket traps. However, there was a much stronger relationship between the average numbers caught in Hartstack and bucket traps when the data were first classified by defined ranges based on the number of moths caught. Baiting bucket traps with two pheromone lures increased the numbers of moths that were caught, particularly when moth catches were low. These data suggest that bucket traps may be suitable for monitoring invasive moths such as the old world bollworm, *Helicoverpa armigera*, that are expected to occur in low numbers. Unfortunately, average moth catches in bucket traps plateaued at about 20 moths/trap/week. Thus, Hartstack-style traps appear more suitable for estimating the size of moth flights for the purposes of making IPM decisions or if collecting moths for other purposes.

Introduction

The 'Hartstack' or 'Texas pheromone trap' was developed by the late Albert Hartstack (USDA ARS) and is the standard trap utilized for monitoring the size of moth flights for bollworm (*Helicoverpa zea*), tobacco budworm (*Heliothis virescens*), and other pests. They are also frequently used to collect live moths used in vial testing for resistance assays with pyrethroid insecticides. Bucket-style, universal moth traps are used for other pests and are also used by the USDA APHIS Cooperative Agricultural Pest Survey (CAPS) Program for the surveillance of several invasive moth pests including the old world bollworm. For several reasons, there would be considerable interest if bucket traps could accurately estimate the size of moth flights with similar efficiency as the Hartstack traps. Hartstack traps are approximately 25 times more expensive than bucket traps. They are also much larger and more difficult to transport, susceptible to theft or damage, and relatively cumbersome to place and run on a regular schedule. Finding a vendor for Hartstack traps is also difficult, and the quality of the traps can vary considerably. Other literature has indicated that Hartstack traps typically collect more *Helicoverpa* moths than other types of traps (Cantelo et al. 1982, Guerrero et al. 2014). However, the correlation between Hartstack and bucket traps is not well defined.

Materials and Methods

Traps at each of 24 locations were established in Arkansas (12), Louisiana (6) and Tennessee (6). Each location, included a Hartstack trap baited with one Hercon® pheromone lure, a bucket trap baited with one lure, and a bucket trap baited with two lures. Vapona® kill strips were used in bucket traps. The trapping period for at least some traps began in mid-May and extended through mid-September, but the primary trapping period was June through August. Traps were checked weekly, and the number of moths in each trap was recorded. Pheromone lures were replaced every second week.

For Hartstack versus bucket trap catches, the numbers of moths caught in bucket traps were categorized based on the numbers of moths caught in the Hartstack trap (Table 1). Similarly, moth trap catches in buckets baited with two lures

was classified by the numbers of moths caught in buckets baited with one lure (Table 1). The mean number of moths in each classification was then determined for both Hartstack and bucket traps. Linear and/or non-linear regression analyses (SAS Institute; Cary, NC) were done to determine the correlation in moth catches between Hartstack and bucket traps and also between bucket traps baited with one versus two lures. Regressions were done using raw and classified data.

Table 1. Classification scheme to determine average trap catches used in regression models.

Hartstack vs. bucket traps	Number of observations	Hartstack vs. bucket traps	Number of observations
0 – 3 moths	75	0 – 3 moths	150
4 – 10 moths	68	4 – 10 moths	85
11-20 moths	50	11-20 moths	67
21 – 40 moths	59	21 – 40 moths	41
41 – 70 moths	37		
71 – 100 moths	21		
101+ moths	33		

Results and Discussion

Across all 353 location*date observations, 22,724 moths were collected with average moth catches being highest in Louisiana, followed by Arkansas, and then Tennessee. In all states, peak trap catches occurred in July (LA) or August (AR, TN). Overall and similar to previous findings, Hartstack-style traps caught over many more moths than the bucket traps. Average catches were 45.1 ± 5.2, 9.22 ± 0.64, and 10.76 ± 0.72 moths/week for the Hartstack trap and bucket traps baited with one or two lures, respectively.

When linear regressions were done using raw data, the correlations between trap catches in Hartstack and bucket trap catches were highly significant ($P < 0.0001$) but very weak, explaining less than 5% of the variation, regardless of whether bucket traps were baited with one or two lures (not shown). The linear relationship between buckets baited with one versus two lures was stronger ($P < 0.0001$; $df = 1,341$; $R^2 = 0.40$)

To improve regression fits and better understand the relationship between trapping regimes, non-linear polynomial regressions were done comparing the numbers of moths caught in Hartstack and bucket traps using mean values for data classified as previously described. Regressions using the mean values of classified data greatly improved fit. Results indicated a nearly linear relationship between Hartstack and bucket traps when average moth catches in the Hartstack traps was less than 100 moths/trap/week. However, although catches in individual bucket traps peaked at 75-80 moths/trap/week, average catches in bucket traps plateaued at approximately 20 moths/trap/week (Fig. 1). On average, bucket traps caught slightly more moths than Hartstack traps when average trap catches in the Hartstack traps were less than 10 moths/trap/week (data not shown).

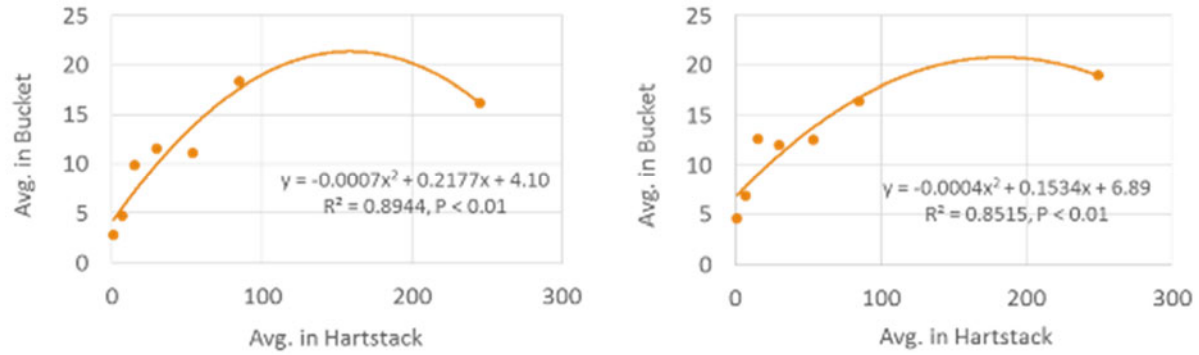

Figure 1. Regression fit for the average number of *H. zea* moths caught in bucket traps baited with one (left) or two (right) pheromone lures versus the number of moths caught in Hartstack traps.

Using the classified data, there was a near perfect linear relationship between the numbers of moths caught in buckets baited with either one or two pheromone lures (Fig. 2). Buckets baited with two lures caught over twice as many moths (6.05 moths/trap/week) versus those baited with only one lure (2.91 moths/trap/week) when average catches were low (i.e., ≤ than 10 moths/trap in buckets baited with one lure).

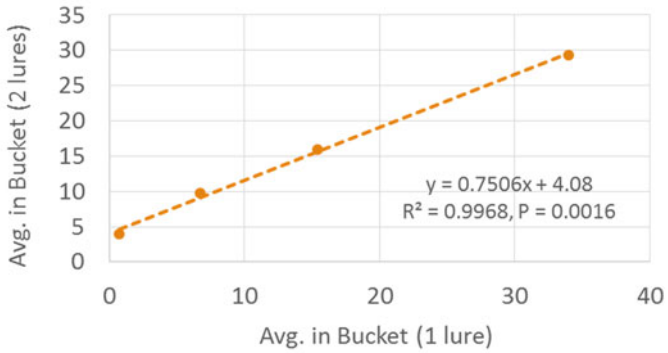

Figure 2. Regression fit for the average number of *H. zea* moths caught in bucket traps baited with one versus two pheromone lures.

Summary

These data suggest that bucket traps may be suitable or perhaps better when monitoring invasive moths such as the old world bollworm that are expected to occur in low numbers, and two lures would increase the numbers of moths caught. Because average catches in bucket traps plateaued at about 20 moths/trap/week, it appears Hartstack-style traps are more suitable for estimating the size of moth flights for the purposes of making IPM decisions or for collecting moths for other purposes.

References

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