HELICOVERPA ZEA AND *HELICOVERPA ARMIGERA* PHEROMONE LURES: MALE MOTH RESPONSE TO 'TEXAS TRAPS' AND GREEN 'BUCKET TRAPS'

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Abstract

An ongoing study has been conducted in the Texas High Plains to investigate the seasonal moth flight activity patterns of *Helicoverp*a spp. and to possibly detect the presence of the 'Old World' bollworm (OWB, *H. armigera*), if it has already been introduced into the Texas bollworm population. The primary objectives of the study were to: 1) investigate the effectiveness of species-specific pheromone lures obtained from two vendors, and 2) determine the efficiency of two different trap designs in capturing *Helicoverpa* spp. moths. Trap type x pheromone lure combination treatments were deployed in late July, followed by all traps being monitored and the captured moths counted approximately weekly through mid-November. All traps were re-baited with fresh lures approximately every two weeks. Sub-samples of up to 25 moths per trap per sample date are currently in the process of being dissected to determine if the Texas High Plains moth populations contained any *H. armigera*. Trap x lure efficiencies in capturing *Helicoverpa* spp. are discussed. Our current hypothesis is that *H. armigera*, Old World Bollworm (OWB), invasion has not occurred in Texas. During 2016, the traps baited with the USDA Cooperative Agricultural Pest Survey (CAPS) lures were observed to also capture tobacco budworms [*Heliothis virescens* (F.)], while the Trécé™ (*H. zea* and *H. armigera*) lure baited traps did not attract tobacco budworms.

Introduction

The Old World bollworm (OWB), *Helicoverpa armigera*, is a polyphagous pest, feeding on a wide range of crop and non-crop plant hosts. Its global distribution spans Europe, Asia, Africa, Oceania, and South America. During 2014, *H. armigera* was detected in Puerto Rico and Costa Rica, and then on 17 June 2015, one male moth was collected in a pheromone trap in Bradenton, FL. It is anticipated that this pest will invade the southern U.S. in the very near term and some entomologists have speculated that the invasion has already occurred. Ecological niche modeling indicates that the majority of the U.S. is a suitable habitat for the permanent establishment of reproductive OWB populations. Therefore, the current OWB issue in Texas is a rigorous anticipatory survey.

This continuing Texas High Plains study is being conducted to investigate the seasonal moth flight activity patterns of *Helicoverpa* spp. captured on two different trap designs (Fig. 1) and pheromone lures, obtained from two sources, specifically designed to trap *H. zea* or *H. armigera*. It should be noted that *H. zea* moths commonly respond to *H. armigera* pheromone baited traps and the two species are difficult to distinguish from each other without genetic testing or dissecting the adult males.

The study objectives were to: 1) investigate the effectiveness of *H. armigera* and *H. zea* pheromone lures obtained from two sources [Trécé™, Inc. (both species); USDA CAPS (*H. armigera* lures only)], 2) determine the efficiency of two different trap designs ('Texas Trap' vs. green 'Bucket Trap') in capturing *Helicoverpa* spp. moths, and 3) perform dissections of seasonal male adult sub-samples of *Helicoverpa* spp. moths captured on *H. armigera* pheromone baited traps in order to possibly detect 'Old World' bollworm sightings in Texas bollworm moth populations.

Materials and Methods

Survey area for the study included four trapping sites situated in a west-to-east orientation along Texas FM1294 in northern Lubbock County, TX (Fig. 2). Five selected experimental treatments included: 1) 'Texas Traps' baited with Trécé™ *H. zea* lure, 2) 'Texas Traps' with Trécé™ *H. armigera* lure, 3) 'Bucket Trap (green)' with Trécé™ *H. zea*

lure, 4) 'Bucket Trap' (green) with Trécé™ *H. armigera* lure, and 5) 'Bucket Trap' (green) with USDA CAPS *H. armigera* pheromone lure. Each treatment was represented at each trapping site, including five treatments and four sites (replications) deployed in a randomized block design.

Figure 2 also displays the yearly trapping periods for 2015 and 2016, typically deploying the traps during mid- to late July with monitoring extending until mid-November annually. Plans include an identical test to continue in 2017. Traps were inspected weekly and re-baited at two-week intervals. All captured moths were counted, placed into Zip-Loc™ bags, and then samples were placed into a freezer for species identification dissections at a later date.

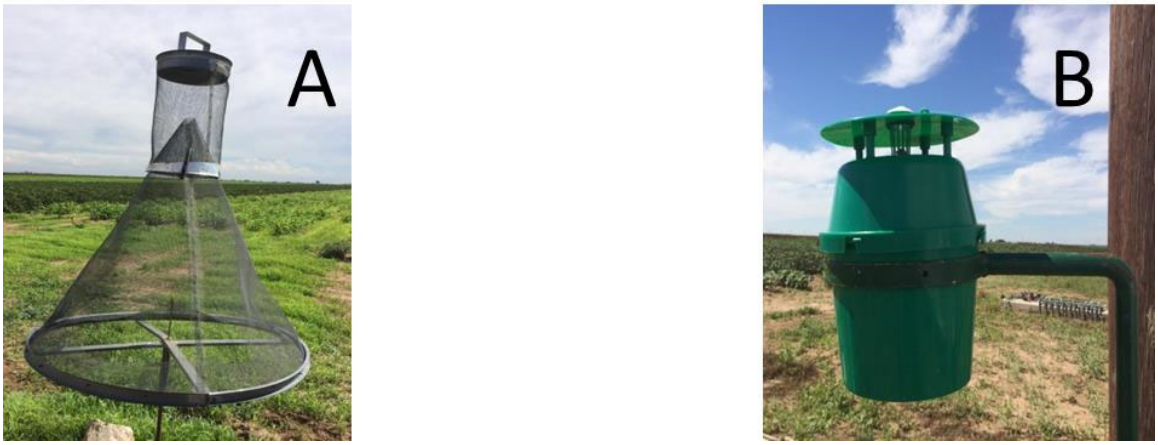

Figure 1. Two trap designs, 'Texas Trap' (A) and green 'Bucket Trap' (B), deployed at four Lubbock County sites.

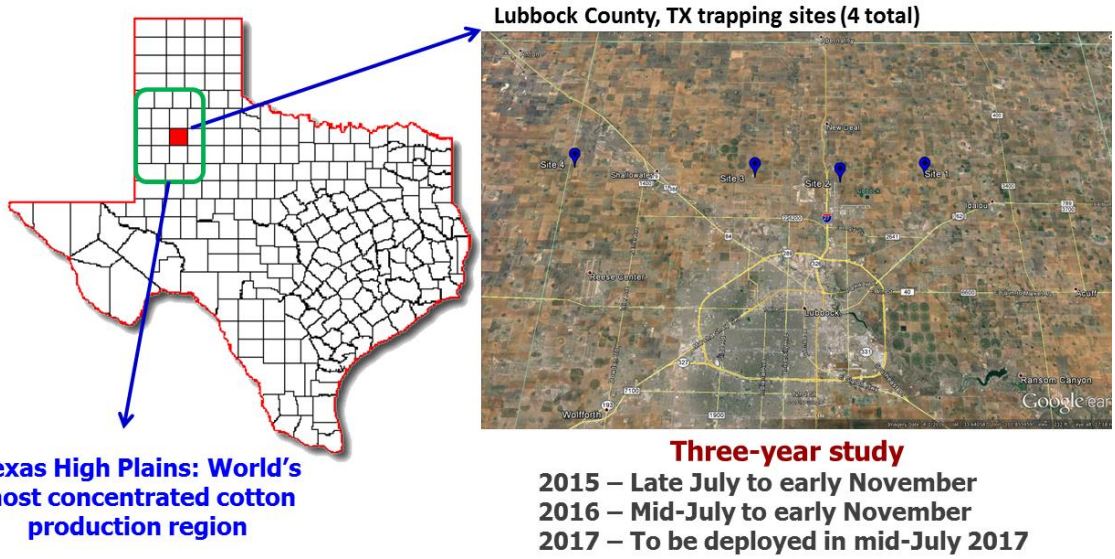

Figure 2. Trapping study sites utilizing two trap designs and two species-specific pheromone lures from two sources. Five traps (one per treatment as listed in section above) were deployed at each of the four Lubbock County sites.

Results and Discussion

'Texas Trap' with Two Associated Pheromone Lure Treatments

The Trécé™ *H. armigera* and Trécé™ *H. zea* lure baited Texas traps yielded 2015 seasonal weekly captures of 119 and 83 bollworms per trap, respectively; while during 2016, similar seasonal weekly moth capture averages of 110 and 80 were observed (Figs. 3 and 4). Overall, it should be noted that among the five study treatments, the Texas Traps baited with Trécé™ *H. armigera* lure captured the highest number of *Helicoverpa* spp. moths during both

2015 and 2016 (Figs. 3, 4 and 5). Because *H. zea* cross-responds to *H. armigera* lure, it appears that the Trécé™ lure that is designed for *H. armigera* is as much or more attractive to *H. zea* (Figs. 3, 4, and 5).

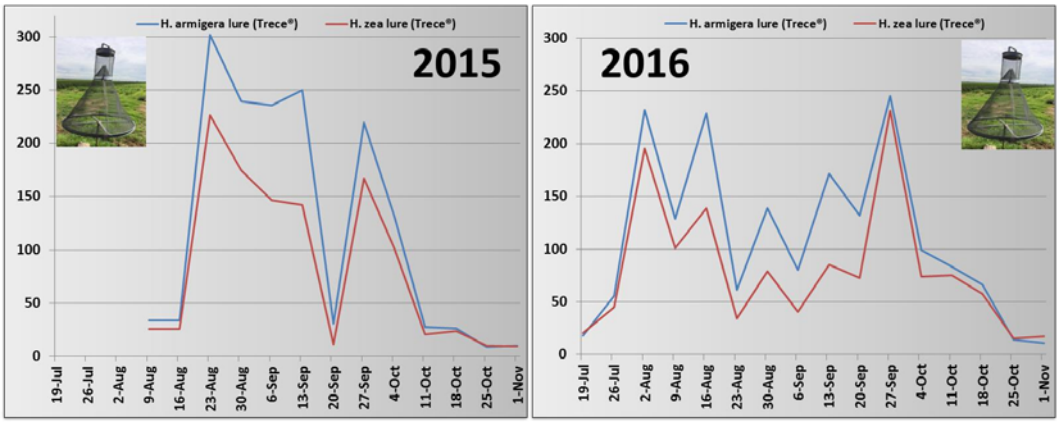

Figure 3. Texas Traps (Texas Pheromone Traps or TP Traps): Weekly *Helicoverpa* spp. male moth captures during 2015 (left) and 2016 (right) on 'Texas Traps' baited with *H. zea* or *H. armigera* Trécé™ pheromone lures.

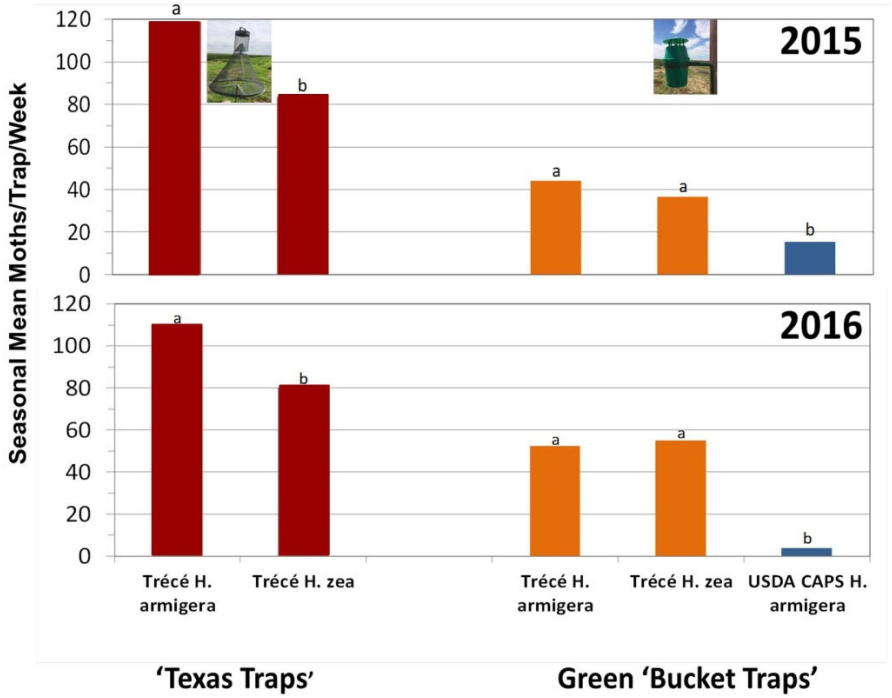

Figure 4. Seasonal mean number of *Helicoverpa* spp. male moths captured per week per trap on Texas Traps (red bars) baited with Trécé™ *H. armigera* and *H. zea* pheromone lures. Likewise, the two orange bars indicate weekly means for green Bucket Traps baited with Trécé™ *H. armigera* and *H. zea* lures. The blue bar illustrates the seasonal weekly means for green Bucket Traps baited with the USDA CAPS *H. armigera* lures. Seasonal means within each trap type indicated by different lowercase letters indicate statistical difference between these means.

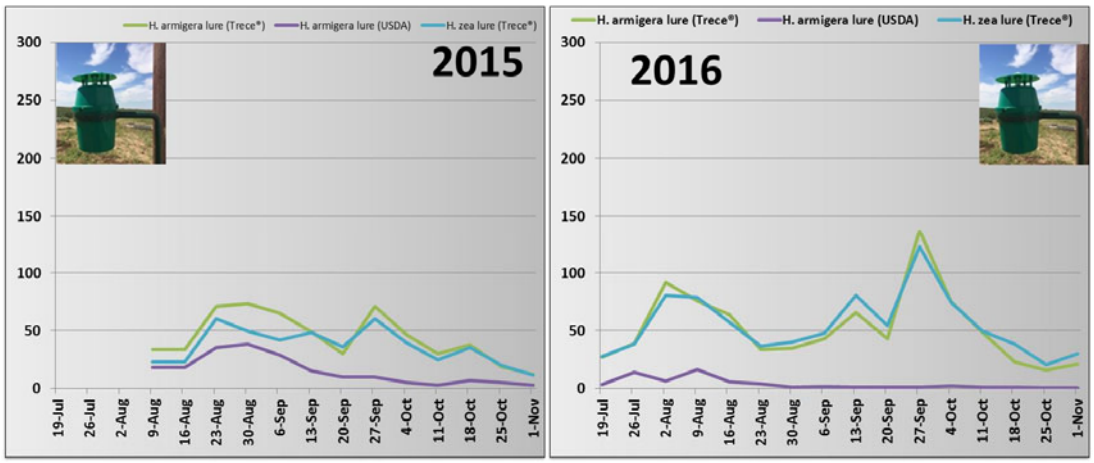

Figure 5. Green 'Bucket Traps': Weekly *Helicoverpa* spp. male moth captures during 2015 (left) and 2016 (right). Traps were baited with *H. zea* or *H. armigera* Trécé™ pheromone lures, and *H. armigera* USDA CAPS lure.

Green 'Bucket Traps' with Three Associated Pheromone Lure Treatments

Overall, green bucket traps baited with the Trécé™ *H. armigera* and *H. zea* lures yielded lower numbers of bollworm moths than the Texas Traps, yet overall peak trap response periods were observed on both trap designs similarly (Figs. 3, 4 and 5). The Trécé™ *H. armigera* and Trécé™ *H. zea* lure baited green bucket traps yielded 2015 seasonal weekly moth captures of 44 and 36 bollworm moths per trap, respectively, reflecting the same general moth activity trend as observed from the Texas traps (Figs. 3 and 4).

During 2016, a slightly different numerical trend was observed whereas the Trécé™ *H. zea* lure baited traps captured a seasonal mean of 55 moths per trap, whereas the Trécé™ *H. armigera* lure captured slightly lower moth numbers (although not statistically different) at 52 moths per trap (Fig. 5).

What should be noted is that the moth captures on the USDA CAPS baited green bucket traps did not reflect the same moth trap response activity patterns of the other four treatments which utilized lures obtained from Trécé™, Inc. Figures 4 and 5 clearly illustrate that the moth numbers were much lower and only the early season peak trap responses were slightly reflected by USDA CAPS lure as compared to the other pheromone lure treatments. While *H. armigera* lure is expected to cross-capture *H. zea*, USDA CAPS lures were designed to be more sensitive toward *H. armigera* compared to commercially available *H. armigera* lure. At the present time, *H. armigera* does not appear to be in the Texas High Plains bollworm population (see below in *Identification* section), therefore it is impossible to determine which lure type (lure supplier) has the best pheromone lure for attracting *H. armigera*.

During 2016, the traps baited with the USDA CAPS lures were observed to also capture tobacco budworm [*Heliothis virescens* (F.)] moths, while the Trécé™ (*H. zea* and *H. armigera*) lure baited traps did not attract tobacco budworm moths. For example, during the eleven week period of 18 August to 4 November, the four USDA CAPS lure baited traps captured a total of 170 tobacco budworm moths, while during the same time period these traps captured only 58 *Helicoverpa* spp. moths.

Dissections to Determine *Helicoverpa* spp. Identifications

A total of 1,252 moths from Trécé™ and USDA CAPS *H. armigera* lure baited traps have been dissected to date. Based upon these initial dissections, we do not believe that the 'Old World' bollworm' (*H. armigera*) has been introduced to the Texas High Plains. All dissected male moths appeared to be *H. zea* specimens. More Texas High Plains specimens are yet to be dissected, along with some samples from South Texas (Hidalgo County location). We plan to repeat this survey in 2017 with two locations from South Texas added to the 2016 study.

Acknowledgements

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Reference

U.S. Department of Agriculture, Animal Plant Health Inspection Service, Plant Protection and Quarantine. 2014. New Pest Response Guidelines: *Helicoverpa armigera* (Hübner) (Old World Bollworm). Washington, D.C.: Government Printing Office. http://www.aphis.usda.gov/import_export/plants/manuals/online_manuals.shtml