EVALUATION OF PHEROMNE LURES AND TRAP TYPES FOR MONITORING *HELICOVERPA ARMIGERA* IN TEXAS

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Abstract

A four-year (2015-2018) survey study was 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. Surveys were conducted approximately at weekly intervals from mid- to late July to mid-November each year. Our hypothesis was that OWB invasion had not occurred in Texas. In the absence of *H. armigera*, it was therefore, impossible to determine which lure type and/or lure vendor had the best pheromone lure formulation for attracting *H. armigera*. Among the five selected experimental treatments, the Texas Traps baited with Trécé™ *H. armigera* lure captured the highest number of *Helicoverpa* spp. moths during all four years of the study. The *H. armigera* baited traps with the USDA Cooperative Agricultural Pest Survey (CAPS) lures captured significantly fewer moths compared to that in 2015. The Trécé™ (*H. zea* and *H. armigera*) lure baited traps captured numerous *H. zea* specimens. Improvement in the CAPS lure since 2016 has discriminated *Helicoverpa* moth species significantly and the moth capture by CAPS lure has been greatly reduced, indicating the greater sensitivity of the USDA lure in possible monitoring of OWB moths. However, the 2018 CAPS lure failed to discriminate *H. zea* moths compared to that in both 2016 or 2017 CAPS lure formulations. On the other hand, Trécé™ *H. armigera* lure is totally ineffective in discriminating the *Helicoverpa* moth species. Sample dissections of 2016 resulted in no positive identification of OWB samples from Texas populations. Similarly, the molecular examination of 2017 samples resulted in no positive identification of OWB while the 2018 samples are being processed. Based on current data, we do not believe that OWB has been introduced to Texas at this time.

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 was anticipated that this pest would invade the southern U.S. in the very near term while some entomologists speculated that the invasion might have already been occurred. Ecological niche modeling indicates that most regions of the U.S. possess suitable habitats for the permanent establishment of reproductive OWB populations. Therefore, the current OWB issue in Texas is a rigorous anticipatory survey.

This study was 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. armiger*a 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. 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. Five selected experimental treatments included: 1) 'Texas Trap' baited with Trécé™

H. zea lure, 2) 'Texas Trap' 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 deployed in a randomized block design. Trapping periods for all four study years included typically deploying the traps during mid- to late July with monitoring extending until mid-November annually. 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 and/or sent to USDA Lab in Fort Collins, CO for molecular identification.

Results and Discussion

The Trécé™ *H. armigera* and Trécé™ *H. zea* lure baited Texas traps yielded 2015 seasonal weekly mean captures of 119 and 83 bollworm moths per trap, respectively; while during 2016, similar seasonal weekly moth capture averages of 116 and 84 were observed (Fig. 1). Moth captures in 2017 were higher than that in the previous two years. The 2018 moth captures were similar to 2015-2016. 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 three of the four years of the study. Because *H. zea* cross-responds to *H. armigera* lure and the Trécé™ *H. armigera* lure is not sufficiently sensitive to species specificity, it appears that the Trécé™ lure that is designed for *H. armigera* is as much or more attractive to *H. zea*. Therefore, the Trécé™ *H. armigera* lure is not a viable monitoring tool in OWB survey.

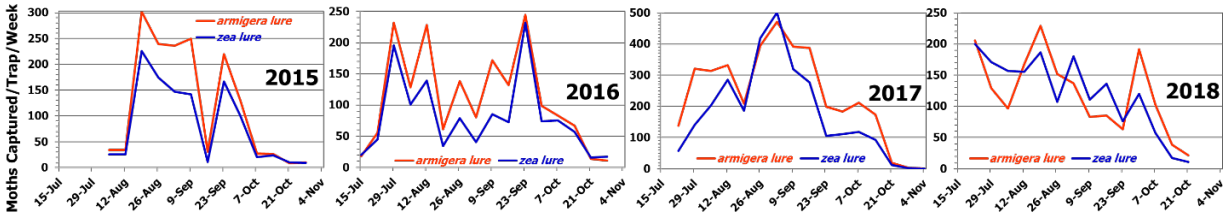

Figure 1. Texas Traps [also referred to as Texas Pheromone Trap, TP Trap or Hartstack Trap (Hartstack et al. 1979)]: Weekly *Helicoverpa* spp. male moth captures during 2015-2018 on 'Texas Traps' baited with *H. zea* or *H. armigera* Trécé™ pheromone lures.

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 (Fig. 2). The Trécé™ *H. armigera* and Trécé™ *H. zea* lure baited 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. 2 and 3). During 2016, a slightly different numerical trend was observed in which the Trécé™ *H. zea* lure baited traps captured a seasonal mean of 57 moths per trap, whereas the Trécé™ *H. armigera* lure captured slightly lower moth numbers (although not statistically different) at 54 moths per trap (Fig. 2). Trap captures in 2017 were significantly higher than that in 2016. In 2018, Trécé™ *H. zea* lure and *H. armigera* lure baited traps captured 99 and 79 moths, respectively.

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. 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; therefore, it is difficult to determine which lure type and/or lure vendor has the best pheromone lure formulation for attracting *H. armigera*. Nevertheless, USDA CAPS lure of 2015-2017 seems to discriminate *H. zea* moths significantly as shown by drastically lower moth captures in CAPS lure baited traps versus Trécé™ OWB lure. Interestingly, the 2018 formulation of CAPS lure attracted considerably higher abundance of moths compared to the formulations for 2015-2017; the 2018 CAPS lure captures were only slightly lower than (TP traps) or similar (Bucket trap) to the Trécé™ *H. armigera* lure (data not shown).

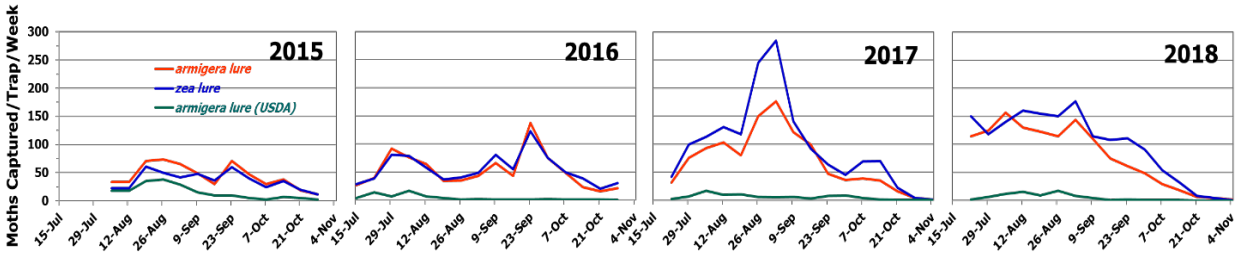

Figure 2. Green 'Bucket Traps': Weekly *Helicoverpa* spp. male moth captures during 2015-2018. Traps were baited with *H. zea* or *H. armigera* Trécé™ pheromone lures, and *H. armigera* USDA CAPS lure.

A total of 1,500 moths from Trécé™ and USDA CAPS *H. armigera* lure baited traps in the Texas High Plains were dissected in 2016. These dissections resulted in no positive identification of OWB in the Texas High Plains moth populations. All dissected male moths appeared to be *H. zea* specimens. Thirty-eight samples including 347 specimens from 2017 survey and 52 samples (7 – 1,187 moths per sample) were sent to USDA Center for Plant Health Science and Technology, Fort Collins, CO for molecular diagnosis of OWB specimens and their molecular examination also resulted in no positive identification for OWB in 2017 while the 2018 samples are currently being processed.

Acknowledgments

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