BROWN MARMORATED STINK BUG MONITORING TRAP AND LURE: PERFORMANCE SUMMARY AND DIRECTIVE

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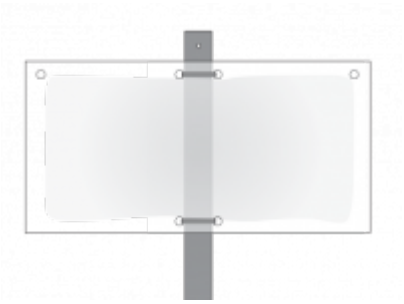
By: Dr. Danielle Kirkpatrick
Global Technical Support Coordinator, Trécé Inc

Brown Marmorated Stink Bug and Trécé® BMSB DUAL Controlled Release Lure



STKY™ Dual Panel
Adhesive Trap

attached to stake with
twist ties (Option 1)

The Trécé BMSB DUAL monitoring lure is a controlled release system comprised of pheromone and inert ingredients that are homogenized and extruded to formulate a controlled release monitoring lure. This advanced formulation technology controls the release from the lure of both components at the same rate over time. Trécé’s lure provides earlier detection and higher capture of BMSB when used in season-long monitoring programs. The long-lasting 12-week lure provides a field longevity that is 2-3 times longer than competitors lures and affords lower maintenance with the lure only needing to be replaced once during the growing season. All are key components critical for effective integrated management of BMSB and season-long crop protection.

This paper explores more about the problem of BMSB, the Trécé BMSB lure technology and why it is important, and finally, provides the published lab and field verification to support the “long-lasting” (12 week), highly effective claims for the Trécé BMSB DUAL lure.

BMSB Pheromone Discovery and MDT Synergist

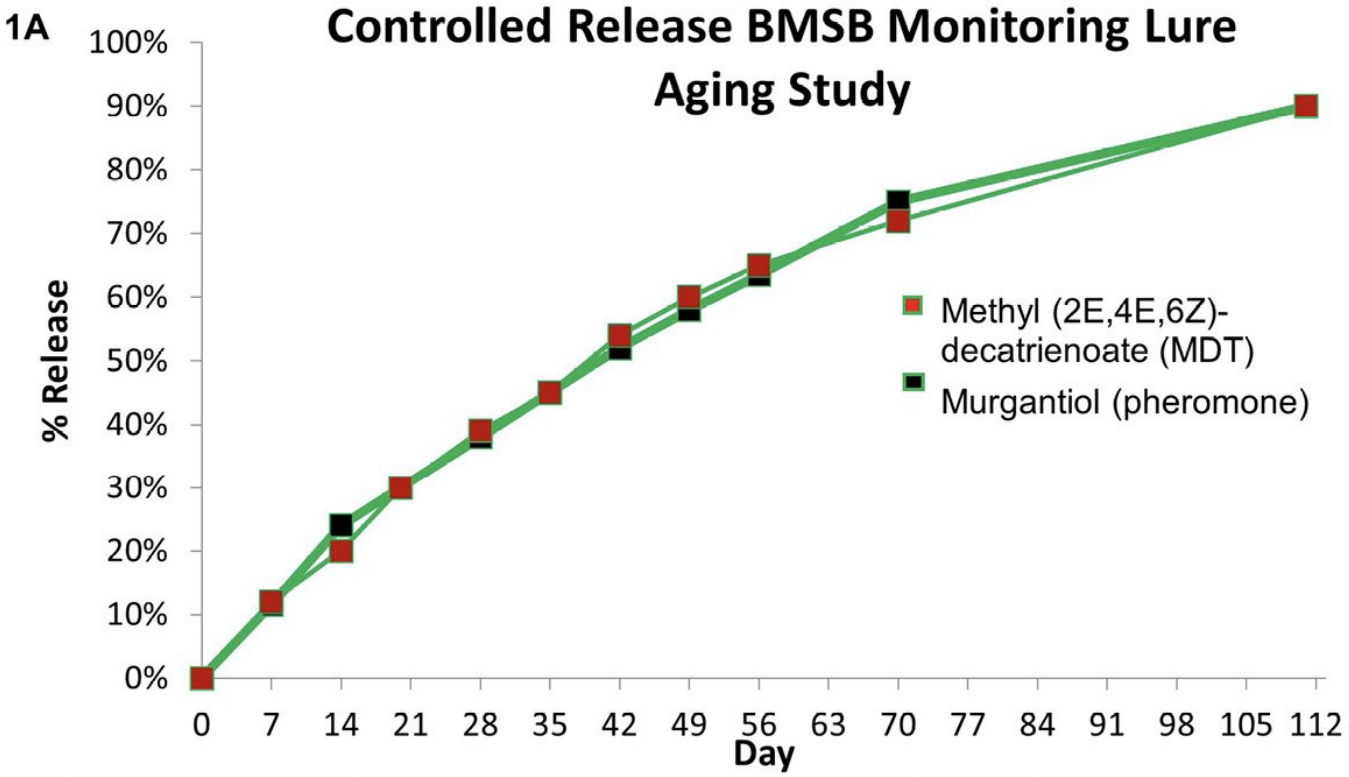
Brown Marmorated Stink Bug (BMSB), Male and Female

The BMSB pheromone was a crucial discovery and shown to attract males, females, and nymphs (Khrimian et al. 2014). Further studies showed a synergism when the BMSB pheromone (murgantiol) was combined with MDT in baited traps and provides reliable season-long monitoring of both nymphs and adults (Weber et al. 2014). Furthermore, nymphs are less attracted to the pheromone in absence of the MDT synergist (Weber et al. 2014). These two components, murgantiol and MDT, have large differences in volatility due to their chemical structures. MDT is much more volatile than murgantiol and emits faster from a lure if emission is not controlled. Therefore, the release of the pheromone and MDT is best controlled over time when they are loaded in separate lures creating a dual monitoring lure.

Trécé Controlled Release Lure Technology

PHEROCON®BMSB DUAL Lures

The ultimate controlled release lure for BMSB ideally stabilizes both active ingredients in storage and when deployed in the field for a sustained, even release of pheromone over time. Trécé's PVC technology utilizes tested antioxidants and UV stabilizers to protect the pheromones from oxidation and damaging UV rays in the field, preventing isomerization of the components. The lure also utilizes a matrix that was developed to provide continuous controlled release of the pheromone over 12 weeks or longer in the field. Figure 1A below shows a graph of the controlled release of the pheromone and MDT over time, with both components releasing at the same rate despite large differences in volatility. Additionally, Figure 1A shows that at the 90 day of collection point, the monitoring lure had released only 90% of the pheromone and MDT from the lures, indicating the lures may last longer than 12-weeks under field conditions. Figure 1B shows a comparative controlled release graph from a BMSB lure aging study. The previous version of the BMSB lure (often referred to as the "Beef Jerky" lure) was not optimized for controlled release compared to Trécé's current BMSB DUAL lure which has been optimized to provide controlled release of the murgantiol and MDT over time.



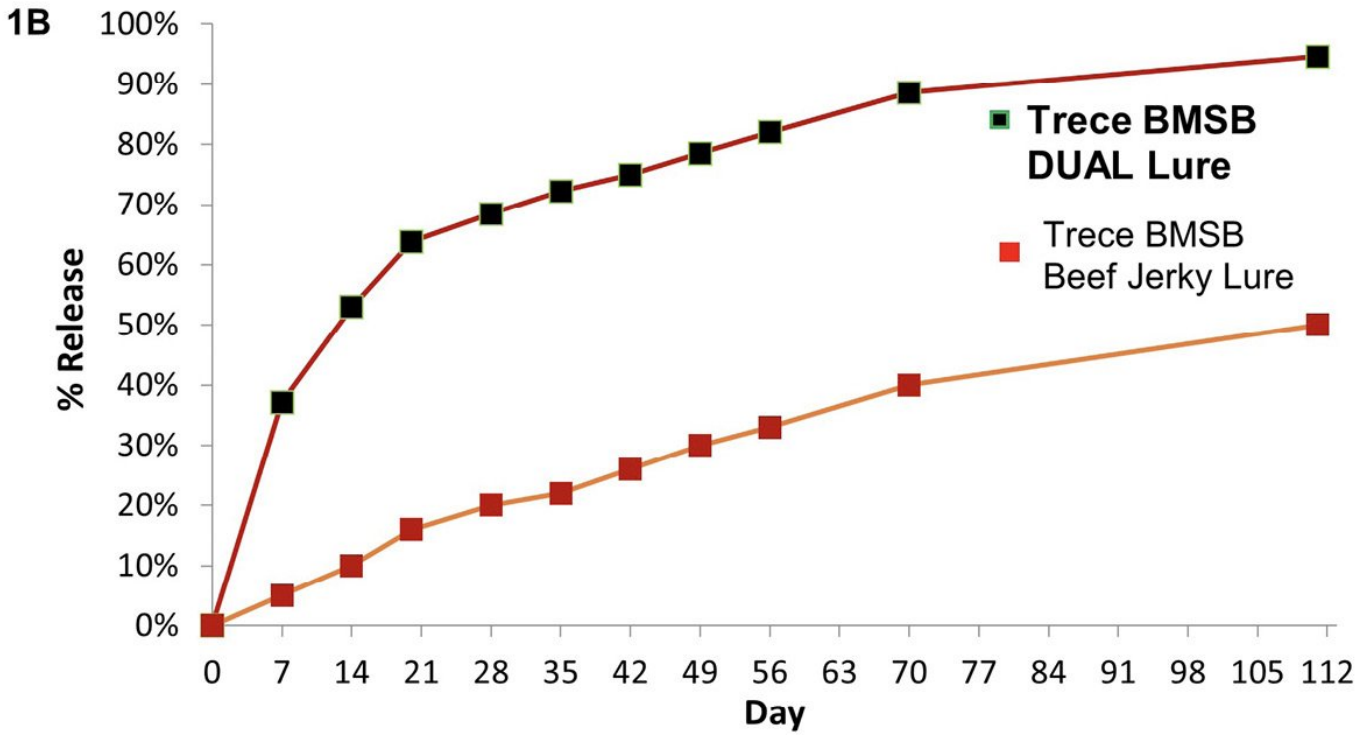


Figure 1A. Aging study showing percent (% Release on y-axis) of pheromone and MDT released from monitoring lures over time (days on x-axis) at a constant temperature. Once % released has reached 100%, all of components have been released from the lure. Pheromone components loaded into separate lures due to differences in volatility. **1B.** Percent of pheromone released from current Trécé DUAL lure compared with unoptimized previous version of the BMSB lure. (Source: Dr. Vincent Chebny, Trécé).

Trécé BMSB DUAL Lure – 12-week Field Longevity

In Georgia, BMSB was first observed during the 2015 season and significant damage to hazelnuts was reported during the 2016 season. Economic losses for Georgian farmers and exporters were more than 52 million US dollars *(National Food Agency, Ministry of Agriculture of Georgia report November 2016)*. Pheromone baited traps are extremely useful in season-long monitoring programs when captured data is collected over the entire season. Reliable monitoring of BMSB not only determines geographic presence within a host crop, but also the population abundance and phenology over time. Many peer-reviewed studies published in high impact journals have reported results of studies looking at sustained BMSB captures over 12-week periods using the Trécé BMSB DUAL lure. A few key studies will be highlighted, and conclusions summarized in the following paragraphs.

A field study was conducted in 2017 by *Murvanidze et al. (2018)* to investigate the occurrence of BMSB in two hazelnut orchards in the Republic of Georgia. Monitoring traps baited with Trécé BMSB DUAL lures were deployed in the

orchards in May, with the lures on the traps replaced every 12 weeks. Data collected shows sustained BMSB captures on the traps from May through the end of October.

Another study reporting on the first record of BMSB in Slovenia by *Rot et al. (2018)* used pheromone-baited monitoring traps for BMSB from April until November placed around orchards. The Trécé BMSB lures were changed every 12 weeks. Data shows BMSB were captured starting in the spring and continued through the late autumn.

In regions of north-western Italy *Bosco et al. (2020)* investigated dispersal to pheromone-baited monitoring traps in 2018. Baited traps were deployed in the field around overwintering sites, and lures were changed once after 12 weeks. Data shows the traps captured BMSB immediately after their placement in the field in early and mid-April and through the season.

Season-long monitoring of BMSB throughout the United States was investigated in 115 field sites across 18 states using pheromone-baited monitoring traps by *Acebes-Doria et al. (2020)*. Each trap was baited with a Trécé BMSB lure and lures were replaced every 12 weeks during the field study. Results showed season-long captures of BMSB across all regions (Figure 2) and concluded that pheromone-baited traps are reliable tools to monitoring BMSB in different geographical locations with varying population densities throughout the growing season.

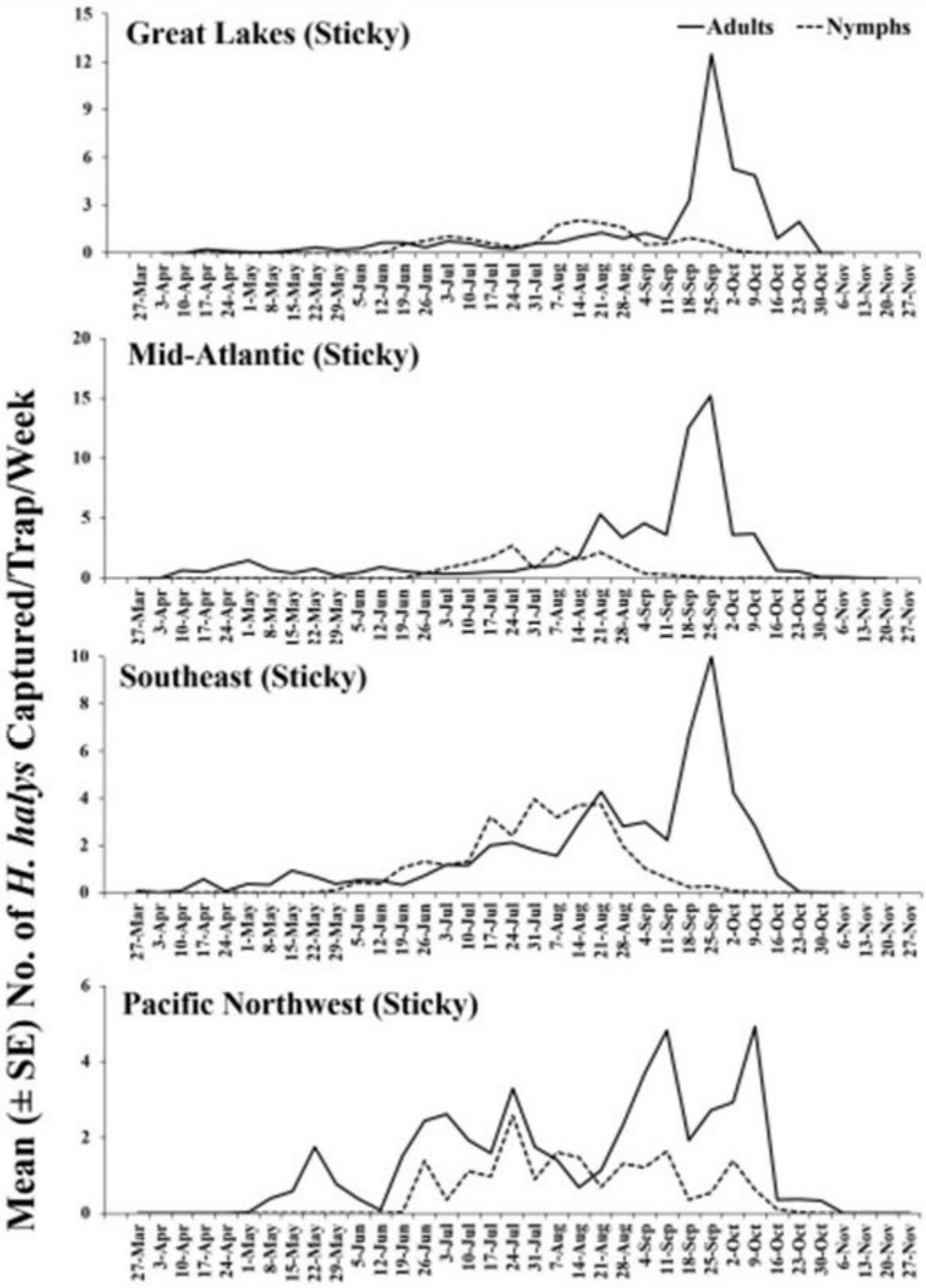


Figure 2. Average season-long captures of BMSB adults and nymphs on pheromone-baited traps in the field across five geographical regions of the US with BMSB DUAL monitoring lures changed every 12 weeks (Acebes-Doria et al. 2020).

Alternative Methods to Manage BMSB with Pheromone Lures

Traps baited with BMSB DUAL pheromone lures have been used in survey and detection programs in new geographic areas when populations often are at very low levels.

An additional management approach is the attract-and-kill (A&K) tactic. In Georgia, a major campaign was launched utilizing the A&K approach as part of the fight against BMSB. Host trees were baited with multiple pheromone lures to attract BMSB and retain them until the trees were sprayed with insecticides. This tactic, in combination with intensive monitoring with pheromone-baited traps, proved highly successful in the management of BMSB populations in Georgia.

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STORGARD® WB Probe II® Grain Beetle Trap

WB II Probe Trap: Reduced Length and Efficacy on Trap Catches

WB II Probe Trap: Reduced Length and Efficacy on Trap Catches

Charles E. Konemann

Abstract

The demand on secure non-infested grain products has increasingly grown as the world's population has continued to increase. Historically, the WB II probe trap has demonstrated its reliability as a useful tool in the monitoring of stored product pests.

Recently, our research lab performed replicated comparisons between our standard 13.125-inch STORGARD WB PROBE II grain insect monitoring trap against three reduced trap lengths using three stored product insect species over five sampling periods. Results showed that the reduced tube lengths of 6.5-, 8.5- and 10.5 inches, on average, caught statistically similar numbers of all three species combined compared to the standard length 13.125-inch probe trap.

On average 8.5-inch traps caught more insects overall than all other lengths. Thereby showing that while shorter, the reduced lengths provided optimum efficacy in trap catches, maintaining the WB II's reliability as a useful IPM tool for stored grain insect monitoring.

Introduction

According to the Food Agriculture Organization of the United Nations (FAO) rice, wheat, and corn are the top three food staples of the world, especially in developing countries (FAO, 2021). The United States produced approximately

1.86 billion bushels of wheat in 2020 worth 9.32 billion U. S. dollars (NASS, 2020; Statistica, 2021). IPM tools are a must for monitoring of stored product pests can be performed efficiently and accurately.

Pitfall style traps have previously been shown to be excellent at determining population densities of stored product insects, including *Rhyzopertha dominica, Sitophilus granaries, Oryzaephilus surinamensis,* and *Tribolium castaneum* in a variety of grain storage facilities across Europe (Aulicky et al. 2016).

Historically, the WB II probe trap has proven to be very reliable for the detection of stored product pests, primarily beetles (Toews et al. 2005). The WB II probe trap was previously shown to monitor for granary weevils (*Sitophilus graniarius*) during the summertime months in the United Kingdom (Wakefield and Cogan 1991). Whereas Trematerra, (1998) noted that WB II probe trap catches of *Sitophilus oryzae*, *T. castaneum* and *O. surinamensis* were similar in wheat and maize. Similarly, Toews et al, (2003), demonstrated that the WB II probe trap caught as many *Cryptolestes ferruginues* when compared with similar types of probe traps. In fact, previously it had been shown that the WB II probe trap is effective in trapping *Rhyzopertha dominica*, *Ahasverus advena*, *Typhaea stercorea* along with *Cryptolestes ferrugineus* (Hagstrum 2001).

Primarily due to increasing oil prices, production costs have also increased. we examined the idea of reducing the size of the WB II to reduce the overall cost of production allowing us to continue to sell a reliable IPM product at a reasonable price.

Materials and Methods

Probe Trap Sizes: Three shortened versions of our WB II probe traps measuring 6.5-, 8.5-, 10.5-inches and compared those with our standard length of 13.125-inches (Fig. 1). This test was performed to see if length had any overall effect, whether negative or positive, on trap catches over-time at 24-, 48-, 72-, 96-, and 120-hours.

Test commodity: USDA certified non-GMO hard red winter wheat purchased from 4-Generations farms near Alva, Oklahoma. Upon receiving the wheat, it was cleaned by using ASTM certified testing sieves; #10, #14, #18, and #20. This was done to ensure that no insects were present in the wheat before the addition of laboratory-reared species.

Bioassay arenas: This test utilized four 7-gallon sealable buckets filled with organic (certified that no pesticide had been applied) hard red winter wheat to within approximately three-inches from the top of each bucket (Fig. 2). This was done to fully insert the longest of the probes to just below the surface of the wheat.

Insects: Three species of laboratory-reared stored product beetles: Rice weevil (RW) (*Sitophilus oryzae*), red flour beetle (RFB) (*Tribolium castaneum*), and Saw-toothed grain beetle (STGB) (*Oryzaephilus surinamensis*) were utilized.

Procedure: One hundred beetles from each species consisting of mixed-sex were added to each of the four buckets 24-hours before insertion of the probe traps to allow the beetles to disperse in the wheat. Pre-cut versions of the WB II probe trap, along with the standard trap were inserted into the wheat to just below the wheat's surface. Trap catches were evaluated at 24-, 48-, 96-, and 120-hours. Dead insects found in the traps were discarded and replaced with live insects to maintain 100 individuals of each species at the time of evaluation.

Statistics: The mean number of insects caught was generated using Microsoft Excel. The data was recorded for each individual species and all three species combined.

Results and Discussion

Interestingly, our results show that after 120-hours in the wheat, our 8.5-inch version of the WB II caught slightly more of all three species combined when compared with longer versions including the 13.125-inch trap. The much shorter 6.5-inch trap had the least of all total insects caught (Fig. 3).

When evaluated according to species, after 120 hours 6.5-, 8.5- and 13.125-inch probe traps caught an equal number of RW. (fig. 4). Trap captures of STBG in the 8.5-inch WB II were comparable to the other three sizes at each sampling time, however, the 8.5inch caught more STGB at 24-,48-, and 96-hrs than the longer trap versions (Fig. 5). Interestingly, RFB showed an almost linear increase in the number of beetles caught in all trap sizes with the 8.5-inch probe trap catching the most at each sampling (Fig. 6).

Our research showed that reducing the size of the WB II did not have a negative effect on trap catches. the 8.5-inch version of the WB II was comparable to all other trap sizes in trapping all three beetle species.

The reduction in size and the ability to monitor beetle populations maintain the WB II ability to be a reliable monitoring tool. Further research is being developed to test if the depth at which the 8.5-inch probe is inserted in the grain has an impact on the number of beetles caught.

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Spotted Lanternfly (SLF)

Oklahoma Ag Company Engaging in Azerbaijani Market

OKLAHOMA CITY– Trécé, a small, Adair, Oklahoma-based company that is currently

the leading manufacturer and supplier of insect monitoring systems for agriculture in the United States is continuing to grow its worldwide footprint by working to develop a market and export its products to Azerbaijan. Trécé [pronounced tray-say] currently sells products already in all 50 U.S. states and 51 other countries around the world.

“Trécé introduces solutions for Azerbaijani farmers to fight insects in host crops through pest management approach,” said Natig Bakhishov, United States-Azerbaijan Chamber of Commerce Executive Director. “Trécé’s mating disruption technology which is widely utilized in over 50 countries globally reduces reliance on pesticides and helps to save beneficial insects and the environment. Lesser pesticides in crops mean safer and healthier food on our plates.”

This partnership was cultivated after the 2019 Oklahoma-Azerbaijan Agriculture Forum, held in Oklahoma City. Trécé’s most recent trip followed a July trade mission to Azerbaijan by Governor Kevin Stitt, Secretary of Agriculture Blayne Arthur, Secretary of Commerce Scott Mueller and other members of the Governor’s staff.

“I am pleased to see Trécé leading the way in expanding our partnership with Azerbaijan,” said Gov. Stitt. “Trécé is an example of how Oklahoma companies have the products and expertise to improve the lives of people in Azerbaijan and all over the world.”

Bill Lingren, founder and CEO of Trécé, said their mission in Azerbaijan is to produce long-term economic and political benefits to their company, their state and their nation by aiding the Azeri agriculturists in adopting our solutions for Integrated Pest Management programs in certain of their key crops.

“Our overall main goal is to introduce the technologies that Trécé currently offers for pest-management world-wide, but has not been introduced to Azerbaijan yet,” said Danielle Kirkpatrick, Global Technical Support Coordinator for Trécé. “From my last visit, local growers were asking me how quickly we can get this product from Oklahoma to them. Azerbaijani producers are excited to get these products as quickly as they can.”

Additionally, Trécé is working with Azerbaijan State Agriculture University and Oklahoma State University through their Memorandum of Agreement for a Dual Master’s Program. They are all working together to craft an internship for students, allowing for knowledge of pesticide management to be passed to the next generation of producers.

GYPSY MOTH (GM) IPM with Monitoring Traps and Lures

Gypsy Moth (GM), *Lymantria dispar*, is one of the most destructive pests to ever be introduced to the US. Although oak is preferred, caterpillars feed on over 300 species of tree and shrub species such as apple, birches, pines, and spruces, among others. Infestations are cyclic and regional. Effective management strategies can be used to slow the spread of gypsy moth movement into suitable, uninfested areas or reduce the risk of tree mortality from repeated defoliation. Strategies include physical removal of egg masses, tree banding for caterpillars, insecticide use, and traps baited with a pheromone lure that attracts male gypsy moths. Effective programs utilize early detection through monitoring followed with well timed applications of insecticides targeting specific life stages.

Caterpillars hatch from egg masses in spring, first appearing dark and hairy, then developing characteristic markings as they increase in size. They defoliate trees as they feed; however most broadleaf trees produce new foliage in response to defoliation of less than 50%. Defoliation leaves trees vulnerable to diseases and other pests that can eventually kill the tree.

Suppression strategies include *Bacillus thuringiensis* var. *kurstaki* (Btk*)*, a naturally occurring soil bacterium that has been formulated into a commercial biological insecticide targeting foliar-feeding, early instar larvae. It is favored in many large-scale treatment programs because it is effective against high-density populations and has limited non-target effects. Btk is typically applied from an aircraft but can also be applied to the canopy from the ground. Application of broad-spectrum insecticides to the tree crown can also be used to target larvae. Immediate and persistent toxicity of these products may benefit homeowners, but non-target effects make them unfavorable for use in larger treatment programs.

Pheromone-baited delta traps can be used to detect low abundance of gypsy moth populations, providing the opportunity to manage new infestations before they reach outbreak numbers and cause detrimental effects. Additionally, pheromone traps can monitor population spread and evaluate the success of treatment programs. The PHEROCON® IIID Trap is the preferred trap used in survey and detection programs.

Adults are usually present from mid- to late-June through mid- to late-September depending on location. PHEROCON IIID Traps should be set up in a trapping grid to ensure appropriate distribution of traps throughout the survey area. The distance between traps will depend on the density of traps used and the objectives of the program. Proper traps placement is on host trees, 4-5 feet high, on woodland edges, and on the windward side so prevailing winds

carry the pheromone into the woods.

Trécé has time tested monitoring products that are frequently the choice of government research and quarantine programs like USDA APHIS and Forest Service. And the good news is that these are readily available from your local supplier, Great Lakes IPM. Visit their website and webstore to learn more about available gypsy moth traps and lures.

Always contact local extension authorities and consultants for regional advice. For additional information regarding PHEROCON GM insect monitoring traps and lures, please visit the Trécé IPM Partner® Guidelines for Use or contact a Trécé Rep.


Danielle Kirkpatrick, Ph.D.
Global Technical Support Coordinator

Navel Orangeworm (NOW) Monitoring Traps in Almonds and Pistachios

THE INSECT AND THE PROBLEM

Navel Orangeworm *(Amyelois transitella)*, or NOW, is a serious pest of almonds and pistachios. Accordingly, pheromone and kairomone based monitoring traps and lures play a significant role in the NOW IPM process.

The Trap and Lure

The Trécé line of PHEROCON® monitoring products offer different lure and trap combinations for NOW. When it comes to the selection of traps and lures, it is all about the objectives that you set for your management program and what control measures you are planning to take.

Trap Use Pattern and Other Information

Your objectives will be based on whether you are using a conventional insecticide-based program or a CIDETRAK® mating disruption program for managing key pests. You may also plan on tracking beneficials for biological control of various pests, such as monitoring predacious thrips.

NEW! Predator Detection System:
PHEROCON®PREDATOR™ Trap

The first questions that arise are which traps, which lures, how many, how often should they be checked, and how should they be maintained? The following is a guideline to aid in the selection, installation, and management of PHEROCON NOW monitoring products:

PHEROCON® LURE PATTERN FOR NUT INSECTS						
PHEROCON LURE	KEY OBJECTIVE	DENSITY	CHECKING FREQUENCY	TRAP/LINER REPLACEMENT	LURE REPLACEMENT	PHEROCON TRAP
PHEROCON® NOW L2-H **PHEROCON® NOW L2-L**	BIO FIX TRAP SHUTDOWN EDGE EFFECTS TIMING ABUNDANCE	1 PER 10 ACRES	WEEKLY	MONTHLY	6-8 WEEKS 4-6 WEEKS	PHERCOCON® VI Delta
PHEROCON® IV NOW Almond Meal Bait	BIO FIX TIMING EDGE EFFECTS	1 PER 10 ACRES	WEEKLY, MORE OFTEN NEAR BIOFIX POINTS	N/A	4 WEEKS	PHEROCON® IV (NOW) Egg Trap
PHEROCON® PPO-HR L2 + NOW L2	M D PHENOLOGY EDGE EFFECTS TIMING	1 PER 10 ACRES	WEEKLY	MONTHLY	12 WEEKS	PHEROCON® 1CD QUICK-CHANGE OR PHEROCON® VI Delta
PHEROCON® PREDATOR YELLOW CARD	MITICIDE NEED AND TIMING	1 PER 20 ACRES	WEEKLY	4-6 WEEKS, WHEN DIRTY	N/A	PHEROCON® PREDATOR
GROUND MUMMY BAIT (PETERSON)	ADDED PHENOLOGY INFO.	1 PER 10 ACRES	WEEKLY	4-6 WEEKS	2-4 WEEKS	PHEROCON® 1C

Trap Capture Interpretation and Action
Research has shown that no singular trap and lure combination has a particularly high correlation to damage at harvest. But, when the data from different trap and lure combinations are considered together for any objective, the power of information is significantly increased. The table above will provide a stable basis for your monitoring program.

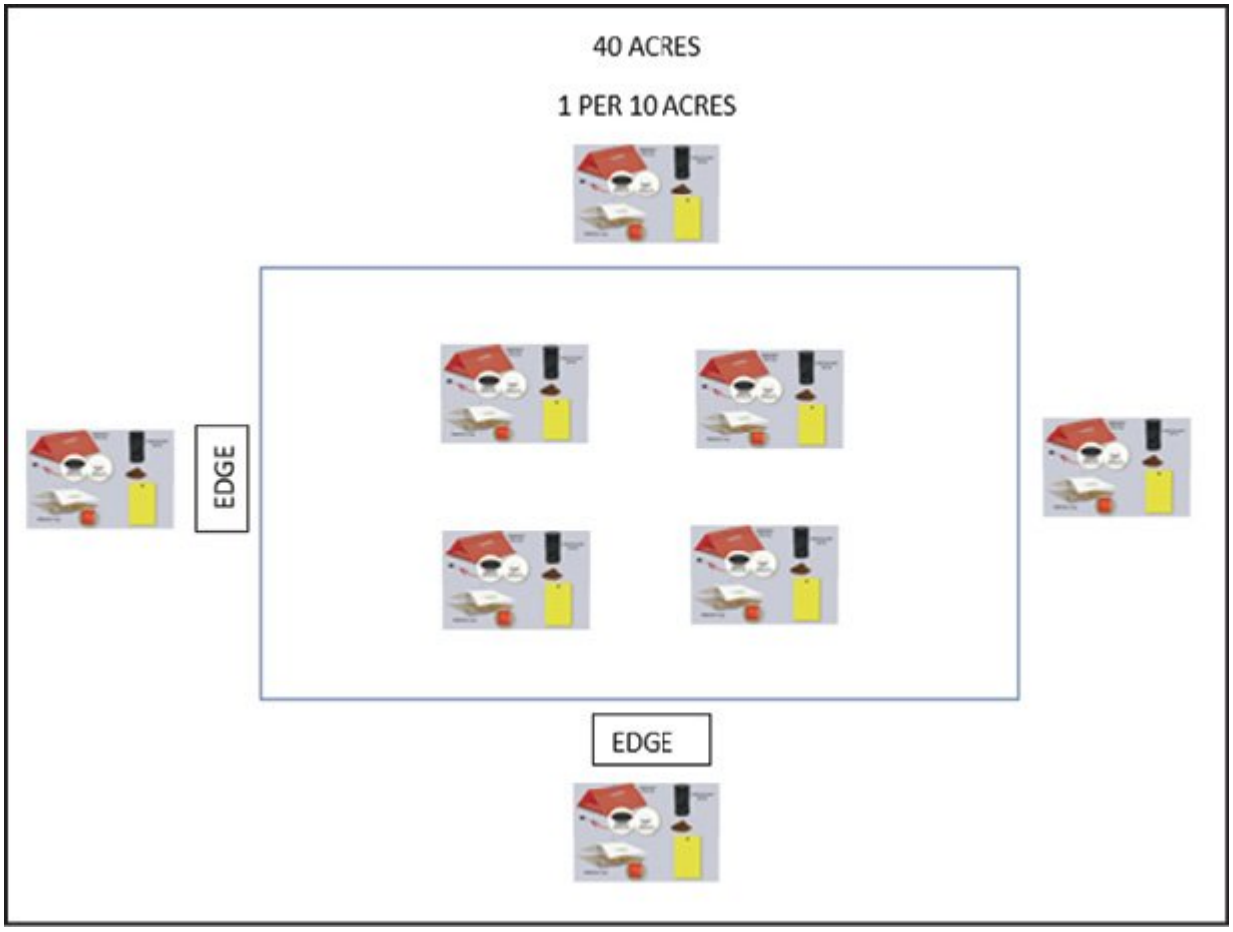
The following diagrams provide a more detailed overview of an efficient and comprehensive trapping strategy in two different size orchards, 40- and 160-acres. For the most resolution, more than one trap and lure combination would be deployed at each location, depending on the objectives.

160 ACRES

1 PER 40 ACRES

EDGE

EDGE



Other Important Considerations
The foregoing outlines a solid monitoring program, but it is only as good as the consistency of the data collection, maintenance, and proper storage of these products. Using the products for specific treatment decisions, not only when but where to treat, is an art and requires careful examination of the data and the relative values (different monitored locations within a year and historically). It is essential to keep accurate and accessible records for developing your orchard history. All Trécé PHEROCON products will provide actionable information that will lead you to a much more successful and economical outcome than simply taking a risk and just spraying.

Contact local extension authorities and consultants for regional advice. For additional information regarding PHEROCON NOW insect monitoring traps and lures, please see the Trécé IPM Partner Guidelines for Use, or contact a Trécé Rep.

 *Danielle Kirkpatrick, Ph.D.*
Global Technical Support Coordinator

CODLING MOTH (CM) Monitoring Lures and Traps

SPOTTED WING DROSOPHILA (SWD)

Trécé expanding, and economic development wheels are spinning

Trécé Inc., a 20-year old Adair company that ships environmentally-friendly insect control products to 50 countries around the world, is planning construction of a new building to add at least 12 employees – and Mayes County, Grand Gateway, Rural Water District No. 5, State of Oklahoma and the federal government are in line to help make it happen.

Mayes County commissioners last Monday agreed to sponsor Mayes County Rural Water District No. 5's request for a $395,000 CDGB/EDIF grant from the federal government to fund the majority cost of constructing a new eight-inch, 2.5-mile water line to serve the new building.

CDBG/EDIF is an abbreviation for Community Development Block Grant for Economic Development Infrastructure Financing.

Grand Gateway is writing the grant, Mayes County is the sponsor, RWD-5 will manage construction, and the grant request must be approved by the state Department of Commerce before federal funds are released.

RWD-5 is committed to provide $50,000 of water line construction costs in participation with the $395,000 in federal funds, and is expected to apply for a CDBG grant for that amount, also through Grand Gateway.

Trécé, located on State Highway 28 just west of Will Rogers Turnpike, is a customer-focused, market-driven organization that develops, manufactures and markets insect pheromone and kairomone-based products designed to respond to customer needs, protect food production and preserve the environment.

Bill Lingren, founder of Trécé, grew up in Adair, and established his company headquarters here where Trécé's own chemists and scientists conduct research and development, create and manage the production of its pheromone formulations and sophisticated equipment, and oversee all system design and technical matters.

Lingren's other investments in the Adair community include donation of land for the construction of a new fire station for a local volunteer fire department, and the creation of a scholarship program that provides annual scholarships to students at Adair High.

The Trécé product catalog currently contains more that 100 species-specific, pheromone-based kits, attractants and lures, and a full line of trap models designed for a wide variety of flying and crawling insect pests that attack standing and stored crops.

These products are marketed under the internationally respected PHEROCON®, CIDETRAK®, and STORGARD® brands.

Trécé collaborates closely with universities, government agencies and business associates around the world in an ongoing effort to refine and advance our insect attractant, monitoring and storage system technologies.

The Trécé-related business before county commissioners created an additional page of agenda because the federal government is potentially involved in this project, and that means I's get dotted and T's get crossed.