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IPM Integrated Pest Management

Pheromone Traps–Effective Tools for Monitoring Lepidopterous Insect Pests of Sweet Corn

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Introduction

Traps baited with sex pheromones, the chemicals usually emitted by female insects to attract males of the same species for mating, have become a valuable tool for monitoring pest populations in survey and integrated pest management (IPM) programs. Many insect sex pheromones can now be chemically synthesized for use in pest monitoring and control.

Pheromone traps can be used to: 1) detect early pest infestations, such as the first occurrence of migratory pests, 2) define areas of pest infestations, 3) track the buildup of a pest population, and 4) help in decision making for pest management. In some instances traps have been successful in estimating pest population densities and the potential risk of crop damage. Since pheromone traps are relatively easy to use and inexpensive, species specific, and environmentally benign, they make ideal tools for IPM programs. An effective pheromone trapping system, however, requires careful preparation, handling, and selection of pheromone traps and lures, as well as proper trap placement.

Pheromone Traps in Sweet Corn IPM

Pheromone traps have demonstrated value in monitoring populations of Lepidopterous (moth) insect pests in sweet corn,


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Fig. 1. Adult male European corn borer.


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Fig. 2. Adult male corn earworm.


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Fig. 3. Adult male fall armyworm.


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Fig. 4. Proper placement of Scentry™ *Heliothis* net trap for monitoring European corn borer and corn earworm.


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Fig. 5. Bucket-style universal moth trap (unitrap) for monitoring fall armyworm.


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Fig. 6. Using the lure package to avoid cross-contamination.

particularly to indicate when a pest is present and what is the proper "window" for field scouting. With degree-day models for forecasting insect development, an "increasing" pheromone trap catch can be used to predict when the various pest life stages will occur in a field or area. By timing controls with the most susceptible life stages of the pest and crop growth, the efficacy of spray applications can be optimized. Other benefits of pheromone trapping include identification of pest problem "hot spots" and timely information about pest flight patterns

Insect Pests and Their Trapping Protocols

In the northeastern United States, the primary Lepidopterous insect pests of sweet corn are the endemic European corn borer (ECB), Ostrinia nubilalis (Hubner) and two migratory pests-corn earworm (CEW), *Helicoverpa zea* (Boddie), and fall armyworm (FAW), *Spodoptera frugiperda* (Smith).

The male ECB moth (fig. 1) is identified by reddish-brown to yellow coloring and the two dark serrated lines that run across the outer third of the forewings. When resting, the wings of ECB form a characteristic triangular shape. The male CEW moth (fig. 2) varies from a yellowish tan to brown, and each forewing has two dark spots. The main identification feature of CEW is the buff hindwing with a wide dark band at the outer margin. The male FAW moth (fig. 3), is distinguished by two whitish markings on the brown forewings: a small white marking at the wing's apex (tip), and a larger diagonal white line that runs from the outer margin to the center of the wing. A yellowish orbicular spot is also located on this line The wingspan of ECB is about 1.25 inches (3.18 ern), whereas the wingspans of CEW and FAW are about 1.5 inches (3.81 cm). Identification may be difficult if the moths are damaged in the traps.

The migratory CEW and FAW usually arrive late June to late July, depending on location, and can infest mid-late planted sweet corn. ECB occurs throughout the growing season. There are three races of ECB in the Northeast: a univoltine Z-race, a bivoltine Z-race, and a bivoltine E-race. The univoltine race has one generation per season (one flight in July) while the bivoltine races have two or more generations per season (one flight each in June and August). Although not all races of ECB are present in all sweet corn growing regions, traps for both Z-and E-races are recommended at each field site. The Z-race of ECB is also known as the Iowa strain and the E-race as the New York strain.

Throughout the field season, pheromone traps should be set out near sweet corn as each field reaches the phenological staqe of devetopment preferred by the pest(s). Pheromone-traps should continually be relocated to new fields as they enter this critical growth stage. For example, the CEW trap should be installed when green silks begin to appear, then moved to another field when silks become brown. The Scentry" Heliothis net trap (fig. 4), or a comparable trap design, is used for ECB and CEW, and the bucket-style universal moth trap (or unitrap) (fig. 5) for FAW. Generally, the ScentryTM Heliothis net trap is attached to a stake 6 ft. (2 m) above the ground, and the universal moth trap (unitrap) is suspended from a stake 4 ft. (1.3 m) above the ground. At the beginning of the trapping period, a killing (vapona) strip should be placed in the bucket of the unitrap to kill captured FAW moths. For FAW, three different lures (2-,3-, and 4-component) are available. The 2-component lure is generally more selective and used when trap contamination from nontarget armyworm moths (i.e., wheathead or common armyworm) is a problem. The specific trap and lure protocols and critical crop growth stage(s) for pest monitoring are summarized in Table 1.

Trap Placement

Since ECB feed, rest, and mate in grassy vegetation called "action sites," the pheromone traps are placed on grassy edges of sweet corn fields out of the path of equipment (fig. 4). They are usually installed before the mid-May emergence of first-generation ECBs. For the migratory CEW and FAW, pheromone traps are installed well before their expected arrival in the edges of the field, as with ECB, or 16-24 rows in from the field's edge. The expected arrival date for these pests in New York, for example, is late June or late July. The bottom of net traps in the field should be at least 3 ft. (1 m) high and the bottom of universal moth traps (unitraps) should be above the corn canopy. Traps in the field should be marked with a flag to make it easier to locate them.

All traps should be spaced at least 60-120 ft. (20-40 m) apart to avoid possible pheromone interference, and placed on the windward side of a field so that the pheromone will be blown into the field. Wooded edges are not good trap sites because the pheromone will not dissipate over the field. Trap openings should be free of any vegetation that might impede moth entry.

Pest	Trap design	Lure	Lure field life (Long-term storage life)	Growth stage of corn
European corn borer	Scentry™ Heliothis net	Trece™ E-race (ECB II) Z-race (ECB I)	2 weeks (3 years)	Mid-whorl to silk
Corn earworm	Scentry™ Heliothis net	Hercon™	2 weeks (1 years)	Green silks present
Fall armyworm	IPS™ Universal moth trap or unitrap (all green trap)	Scentry™ (4-component) or (2-component), Trece™ (3-component)	3 weeks (2 years)	Late whorl to green silk

Table 1. Trap and lure protocols for monitoring insect pests of sweet corn.

Storing and Changing Lures

Since most pheromones degrade rapidly if exposed to bright light or high temperatures, lures should be stored in tightly sealed glass containers or foil pouches and preferably kept in a freezer or refrigerator to ensure their longevity. To avoid cross contamination, do not place different moth lures in the same container.

Because volatility and degradation rates vary among pheromone components for various insect species, and release characteristics are different for the various dispensers, no generalization can be made about the field life of lures. Expected field life and recommended intervals of lure replacement and long-term storage life for each individual species are provided by pheromone manufacturers (table 1). Rubber septum dispensers should be placed in the lure holders with the wide end pointing out (fig. 6).

Since the pheromones are impregnated onto a lure dispenser, it is very important that each species' lure is handled with vinyl/latex gloves or forceps (fig. 6) to avoid cross contamination—a pheromone lure for one insect may be a strong repellent for another. A new pair of gloves or uncontaminated set of forceps is needed for each different pheromone. Do not leave contaminated gloves, lure wrappers, or other pheromone-contaminated material near trap sites because this could attract the target insect away from your trap! Forceps should be cleaned with acetone or nail polish remover between uses. Forceps can be stored in labeled glass jars filled with acetone. Avoid contaminating traps by not handling them with gloves used to handle pheromone lures.

Checking Traps and Recording Trap Data

Traps should be serviced frequently to prevent overloading and make identification of trapped specimens easier. It is suggested that traps be checked at least weekly, preferably twice a week. When moth numbers begin to increase, checking at least two to three times a week is desirable. Once CEW captures start, for example, infestations can occur very quickly. Eggs of CEW may hatch in as little as 48 hours when temperatures are high. Information to record during each visit is shown in the sample data sheet for pheromone trapping. Trap catches can also be graphed over time to easily show seasonal trends (fig. 7).

Sweet Corn Pest Pheromone Trap Network
Trap Counts

Location _____

Date checked	ECB-E race		ECB-Z race		Corn earworm		Fall armyworm	
	Number Trapped	New Lure ?	Number Trapped	New Lure?	Number Trapped	New Lure?	Number Trapped	New Lure?
5/22	0	Y	0	Y	0	Y	0	Y
5/29	15	N	2	N	0	N	0	N
6/4	51	Y	17	Y	0	Y	0	N

Sample Data Sheet for Pheromone Trapping

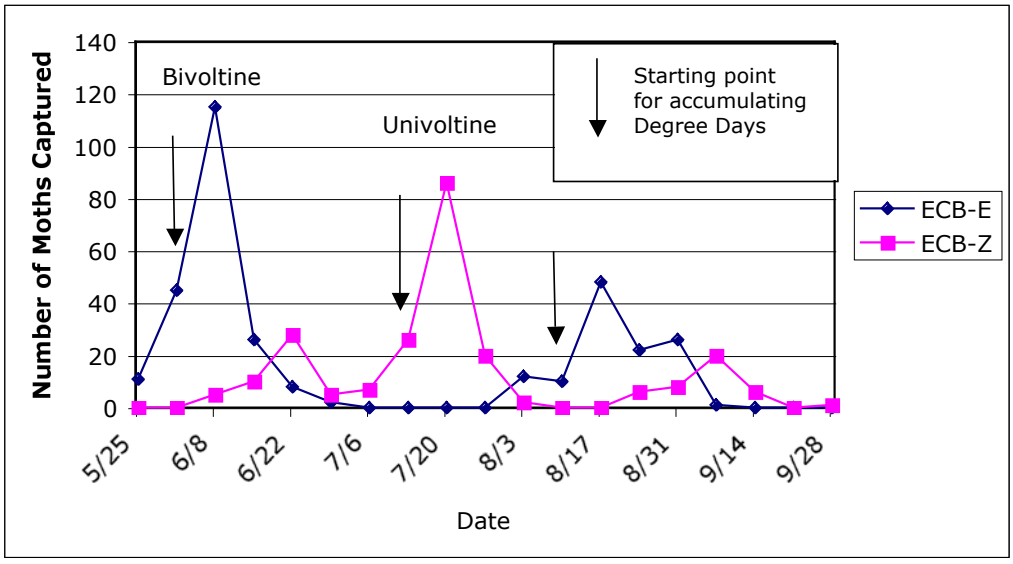

Figure 7. Flights of the E-race and Z-race of European corn borer (ECB) and how to use trap catch data to predict ECB development.

ECB Forecasting Using Growing Degree Days

Weather monitoring equipment is necessary for recording the temperature (daily maximum and minimum) at trap sites for forecasting ECB development. Weather records may also be obtained from your local weather stations, or the New York State Integrated Pest Management Program's Network for Environment & Weather Awareness (http://www.nysipm.cornell.edu/newa/default.asp). Heat units or degree days are the number of degrees above a given threshold temperature that occur each day. A simple formula for calculating degree days for one day is:

$$\text{Degree days} = \frac{(\text{Max. temperature} + \text{min. temperature})}{2} - \text{threshold temperature}$$

The threshold temperature for ECB is 50°F (10°C) Accumulated degree days are daily degree days summed over time.

Despite the geographic variation in ECB populations and different weather conditions, pheromone trap catch data have been found to be a reliable means of predicting ECB life stages, in the spring, degree days are accumulated starting with the first significant moth flight (increasing trap catches) (fig. 7). The required degree day accumulations needed to reach various life stages are given in Table 2.

Table 2. Degree day accumulations for predicting ECB activities in the field.*

Degree days from event (F°)	Life stage
0	Increasing moth flight (peak)
100	Peak egg hatch
200+	1st - 2nd instar larvae
350+	3rd instar larvae
400+	4th instar larvae
550+	5th instar larvae
900+	Pupation
1150 - 1700	Adult moths

* from: European Corn Borer Development and Management, USDA NC Reg. Ext. Pub. No. 327, May 1989. Threshold = 50°F (10°C)

Forecasts for ECB life stages are made during increasing flight periods of both the bivoltine E-and Z-races, and the univoltine Z-race. Initial forecasts are based on historical temperature data, but these are upgraded weekly using current temperature data to refine the predictions as the season progresses. Forecasts made from the first flight of the bivoltine races include all of the life stages (egg laying, larval instars, pupation) and the second adult flight. When the second flight of the bivoltine races begins to increase, the degree day accumulations can be initiated again predicting egg laying, larval instars, and so forth. The forecast for the univoltine Z-race is made for only oviposition and larval instars 1-4 since the 5th instar larvae of this race enters an overwintering condition known as diapause.

Sources of Pheromone Trapping Supplies

Contact your local county Cooperative Extension agent or IPM specialist for information on where to purchase pheromone trapping supplies.

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