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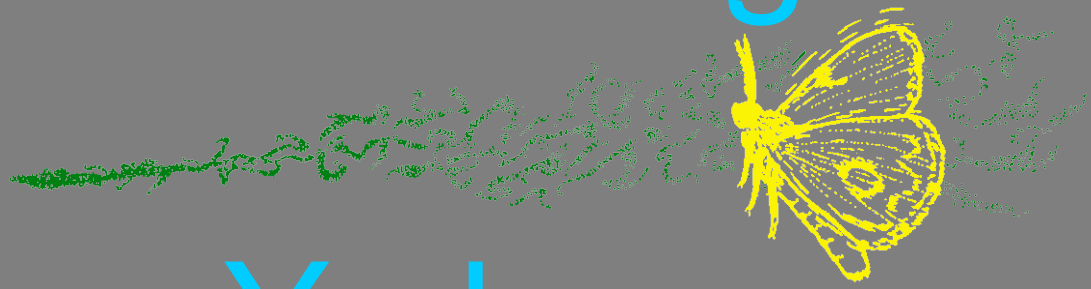
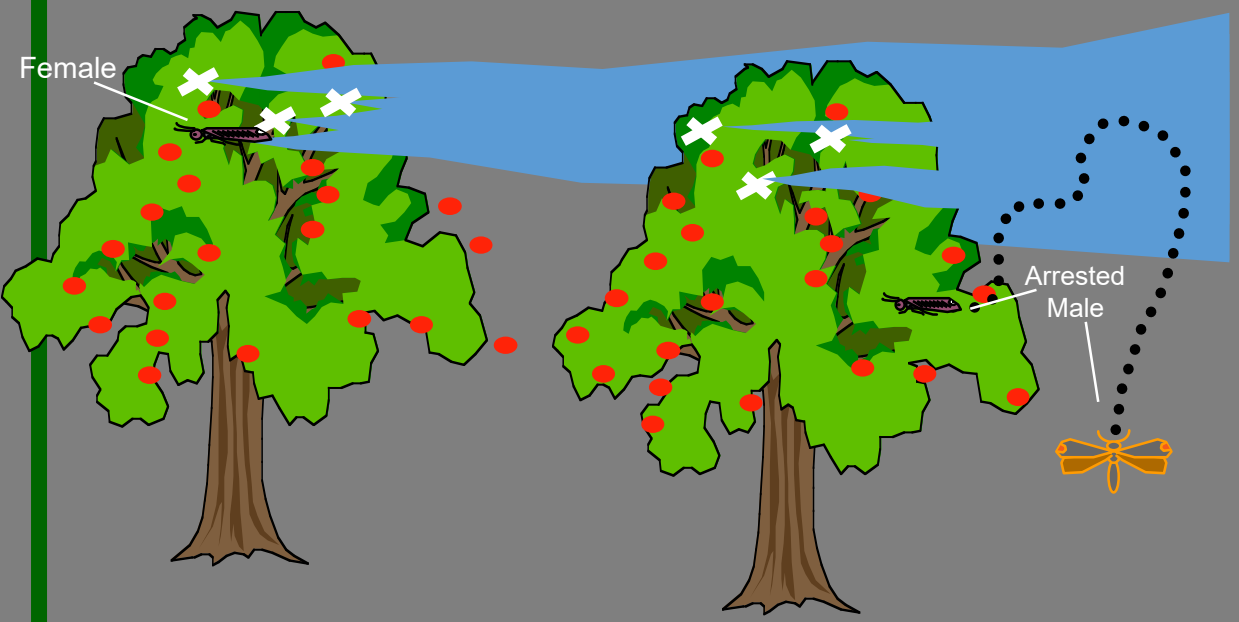
Principles of Mating Disruption In New York Apple Production



Two general mechanisms of mating disruption

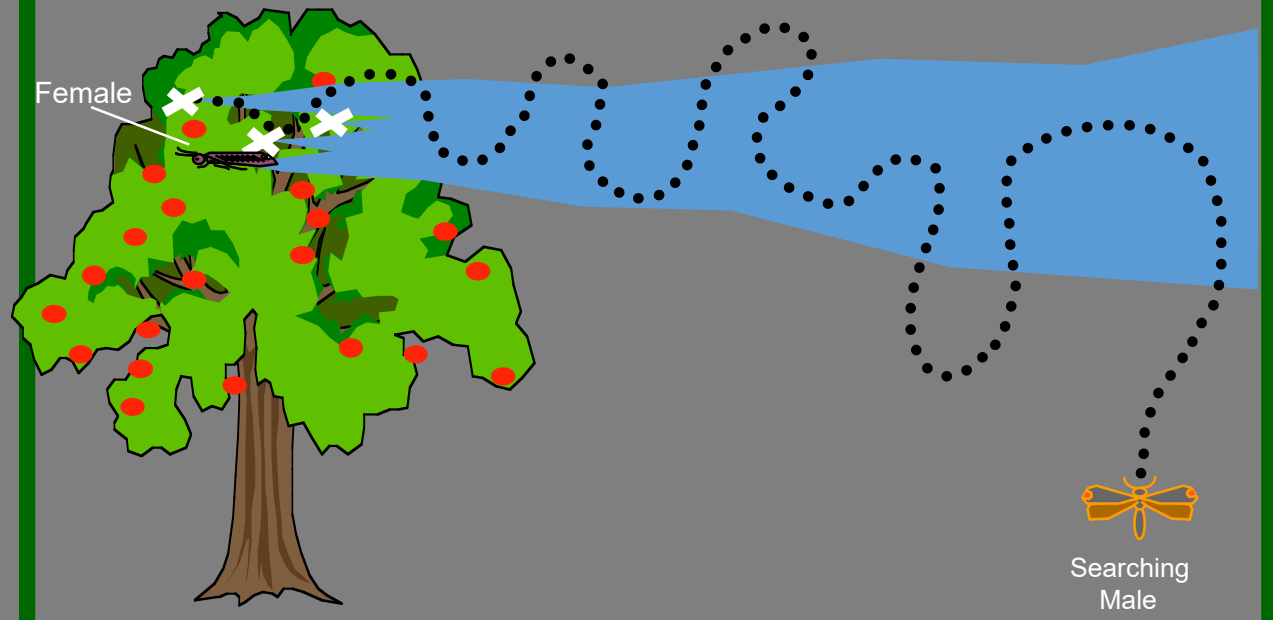
(Objective: Suppression of sexual communication with synthetic pheromones)



Inhibition of the male's ability to respond to pheromone

Non-competitive

(e.g., desensitization, exhaustion, camouflage)



Competition between dispensers and "calling females"

Competitive

(e.g., competitive attraction, induced allopatry, induced arrestment)

Formulations of Pheromone Products used for Mating Disruption (Miller & Gut 2014)

Considerations behind the development of pheromone products

- release of pheromone over an extended period of time
- protection of active ingredient from degradation
- ease of application
- affordability
- extent to which finding of females by males is impeded

Strategies of pheromone dispenser distribution

- Densely distributed point sources
  - can range from 120-400/A (hand-applied reservoir dispensers) to several hundred million release points/A (sprayable microcapsules, flakes or fibers)
- Sparsely distributed point sources
  - can range from only a few units/A (mega dispensers such as puffers) to approximately 20 devices/A (meso dispensers such as plastic sachets)

Differences in application density, emission rate, & pheromone distribution

- higher deployment density ➔ lower pheromone emission from individual point source
- dense formulations distributed via application process; sparse sources rely on wind

Examples of Pheromone Formulations

Hand-applied reservoir dispensers

- pheromone enclosed in plastic or dispersed in synthetic polymers
  - slowly diffuses from these reservoirs for up to 180 days
- hand-applied at rates of 200-400/A
- each releases up to several µg pheromone/hr
- limitations: high labor requirement for application ➔ associated cost
- disruption relies mainly on competitive attraction
  - disruption strongest when the competing sources greatly outnumber females
- efficacy is greatly affected by (high) number of point sources, and (low) population density
- despite high degree of orientation disruption, complete efficacy has been elusive
  - the most 'bang for the buck' is obtained at lower application rates
  - growers often opt to use fewer dispensers & apply supplemental insecticides as needed

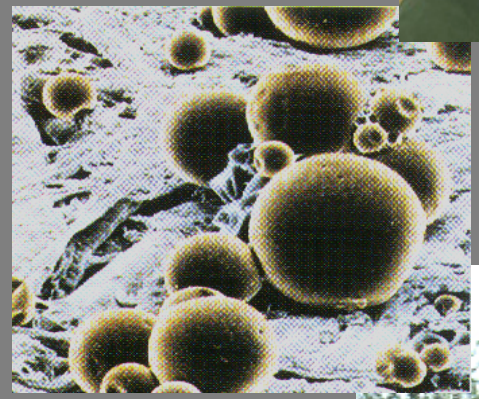
Examples of Pheromone Formulations

Meso dispensers

- Attempt to combine best qualities of reservoir dispensers, yet reduce application effort
- release substantially more pheromone than std hand-applied reservoirs
- can allow for much lower densities (8/A), less labor
- competitive attraction mechanism, but possibly also could operate by desensitization

Sprayable dispensers

- pheromone encapsulated in microscopic polymer capsules (20 µm avg. size)
- sprayed on crop at 100 million+/A
- deliver 8-40 g pheromone/A over 3-4 weeks
- easy to apply, reduced labor costs
- BUT short field life; inconsistent efficacy
- rapid decline in release rate, can be washed off
- frequent low-dose applications more effective
- non-competitive mechanism (desensitization or camouflage)



Examples of Pheromone Formulations

Mechanically applied dispensers

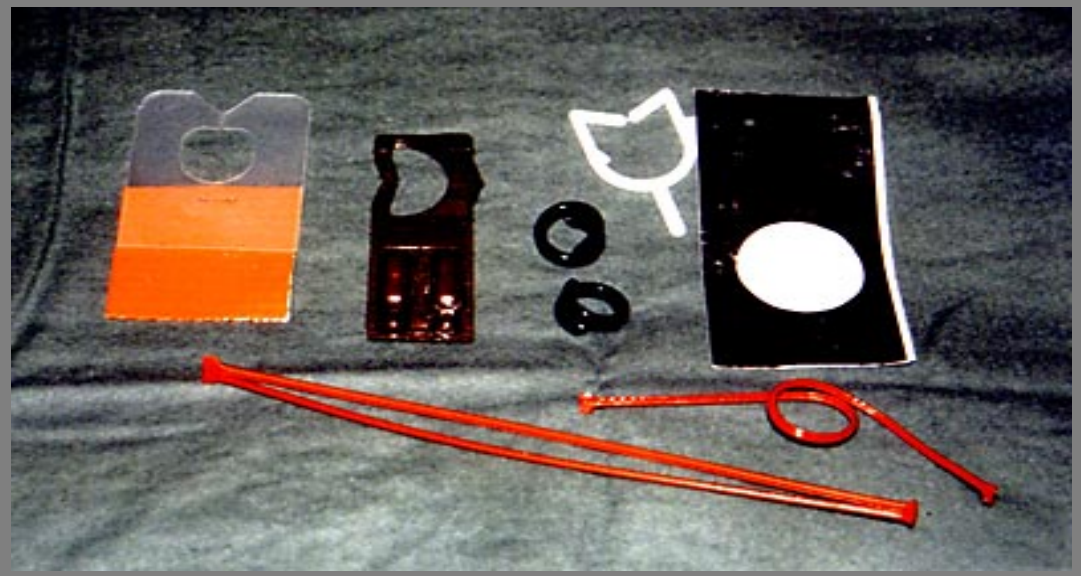
- Examples: flakes, fibers, wax droplets
- Designed to release pheromone at about the same rate as calling females (“female-equivalents”)
- Competitive disruption mechanism
- Ease of application
- May only divert males’ attention away from calling females for short period, allowing more opportunities to search for actual females

Mega dispensers

- Ultra-sparsely distributed pheromone sources: 1-2/A
- aerosol devices release large amts of sex attractants
- mg quantities released every 15-30 min over 6-12 hr
- controlled constant release rate, stable enivronment for pheromone prior to its release
- male captures within plume inhibited for considerable distances downwind of device
- low deployment density leaves areas with little pheromone coverage where mate finding can occur
- Edges a problem; supplemental border trt advised

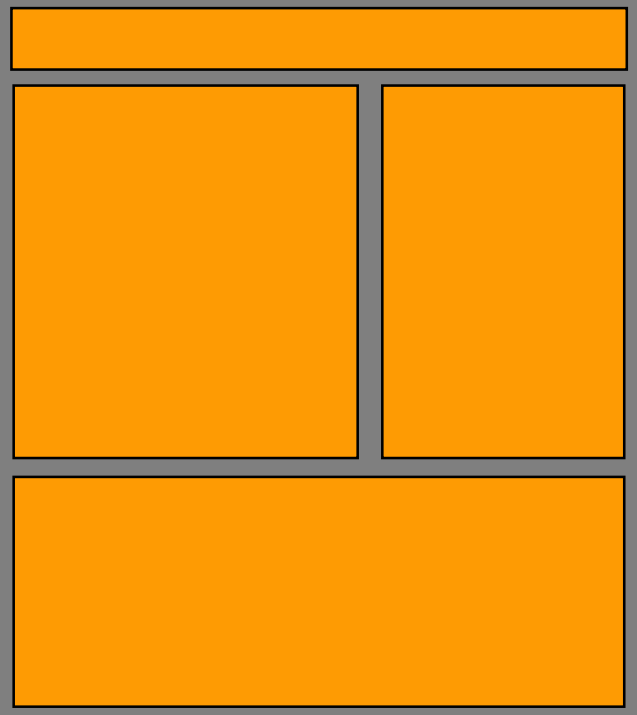
Strategies for Reducing MD Failures

- Location, Location, Location !
  - Block size, shape, and pest pressure
- Product selection
  - Release rate, number of point sources
- Monitoring
  - Trap design, placement, management
  - Lure selection (longevity, release rate)
- Supplemental treatments
  - Follow trapping thresholds
  - Focus on border controls

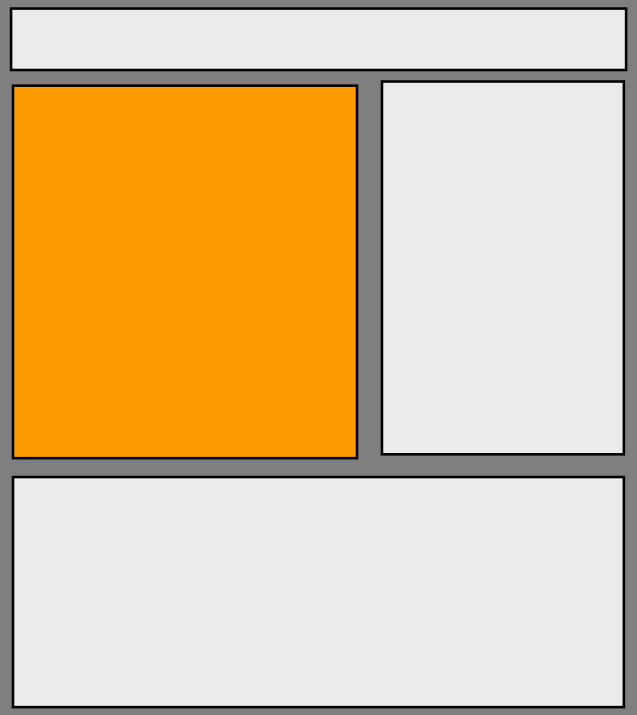


Location ! Location ! Location !

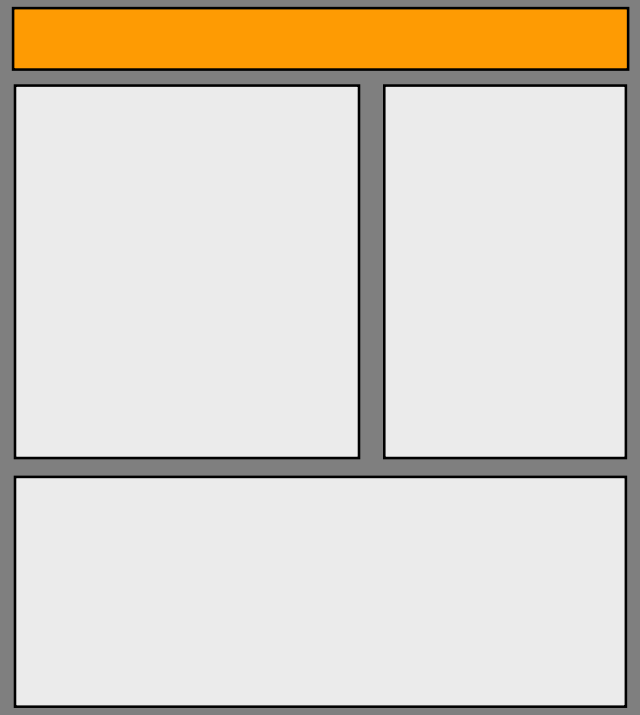
Best choice



Good choice



Bad choice



AREA WIDE

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Pheromone Disruptants Available

Isomate CM/OFM TT (200 ties/A)

Checkmate Sprayable
OFM-F
CM 2.0

Cidetrak CMDA Meso-A or OFM Meso-L (18-36 dispensers/A)

Checkmate Puffer (1-2 units/A)

Isomate CM/OFM Mist

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Management Approaches for

Problem Blocks with CM or OFM

- Monitor closely with pheromone traps
- Time sprays according to DDs and trap captures
- Use higher insecticide rates
- Tighten up spray intervals
- Rotate insecticide chemistries between generations to prevent resistance
- Supplement with mating disruption
  - hand-applied dispensers or mechanicals/sprayables
- Incorporate granulosis virus as long-term tactic

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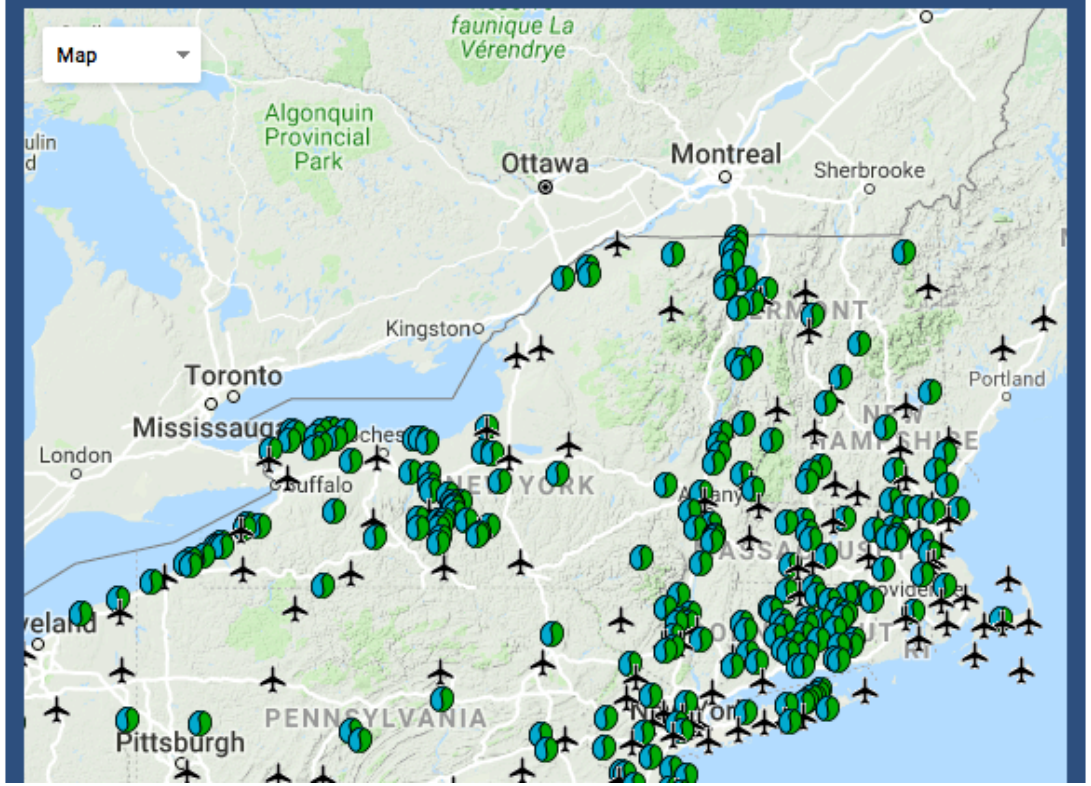
Welcome to the NEWA Home Page

Click on a map marker to go to the weather station's home page.



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Apple Insects

NEWA Apple Insect Models

Select a pest:

Codling Moth

State:

New York

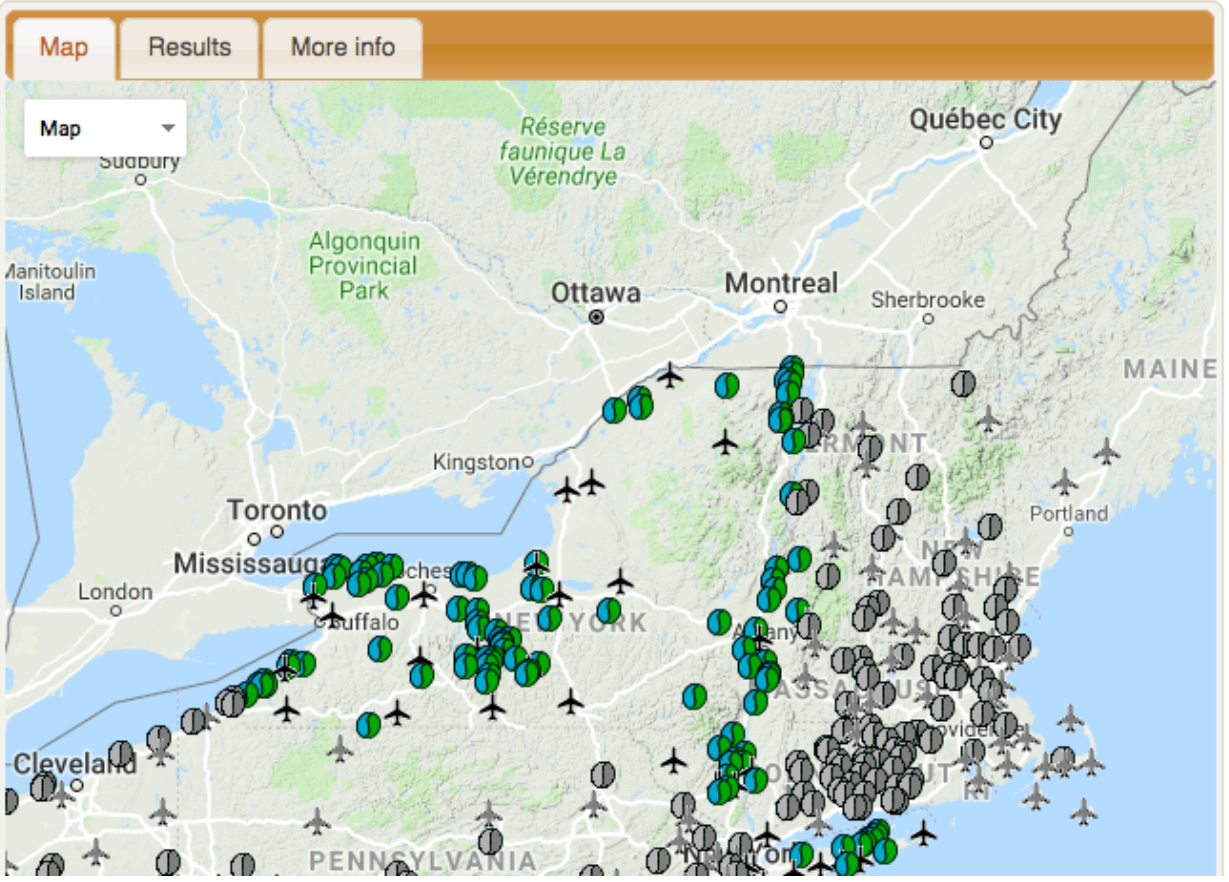
Weather station:

Sodus (Lake)

Accumulation End Date:

06/01/2017

Calculate



NEWA Apple Insect Models

Select a pest: Codling Moth

State: New York

Weather station: Sodus (Lake)

Accumulation End Date: 06/01/2017

Calculate

Map | Results | More info

Codling Moth Results for Sodus (Lake)

First Trap Catch: 5/22/2017

First Trap Catch date above is estimated based on degree day accumulations or user input. Enter the actual date for blocks of interest and the model will calculate the protection period after first trap catch more accurately.

Accumulated degree days (base 50°F) first trap catch through 6/1/2017: 135 (0 days missing)

	Past	Past	Current	Ensuing 5 Days				
Date	May 30	May 31	Jun 1	Jun 2	Jun 3	Jun 4	Jun 5	Jun 6
Daily Degree Days (Base 50BE)	16	17	7	6	9	5	8	5
Accumulation since January 1	395	412	419	426	435	439	448	452

Show Degree Day Graph

Codling moth
pest stage
pest status
pest management

Pest stage: Moths flying & first eggs laid

The pest stage above is estimated. Select the actual stage and the model will recalculate recommendations.

Pest Status	Pest Management
First eggs are laid at about 50 DD and the first eggs usually hatch after about 220 DD.	Apply insecticides that need to be present before egg laying at about 50-75 DD. Apply insecticides that target early egg laying period at 100-200 DD. Pesticide information

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OBLR 1st Summer Brood

- Moths start to fly the 1st or 2nd week of June
- Eggs laid immediately; young larvae begin feeding on foliage
- Eventually move to fruits; can web a leaf to fruit surface and feed underneath, or in area protected by clustered fruits
- Don’t burrow into apple, but excavate along surface
- This larval generation can be found through July

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OBLR 2nd Summer Brood

- Moths start to fly the 1st or 2nd week of August
- Foliage is hardened off, so move preferentially to fruits
- Normally don't get too big before going into diapause
- Fruit damage is very subtle, can easily be overlooked
- Necrotic spots show up while fruit is in storage


1st Summer brood


2nd Summer brood

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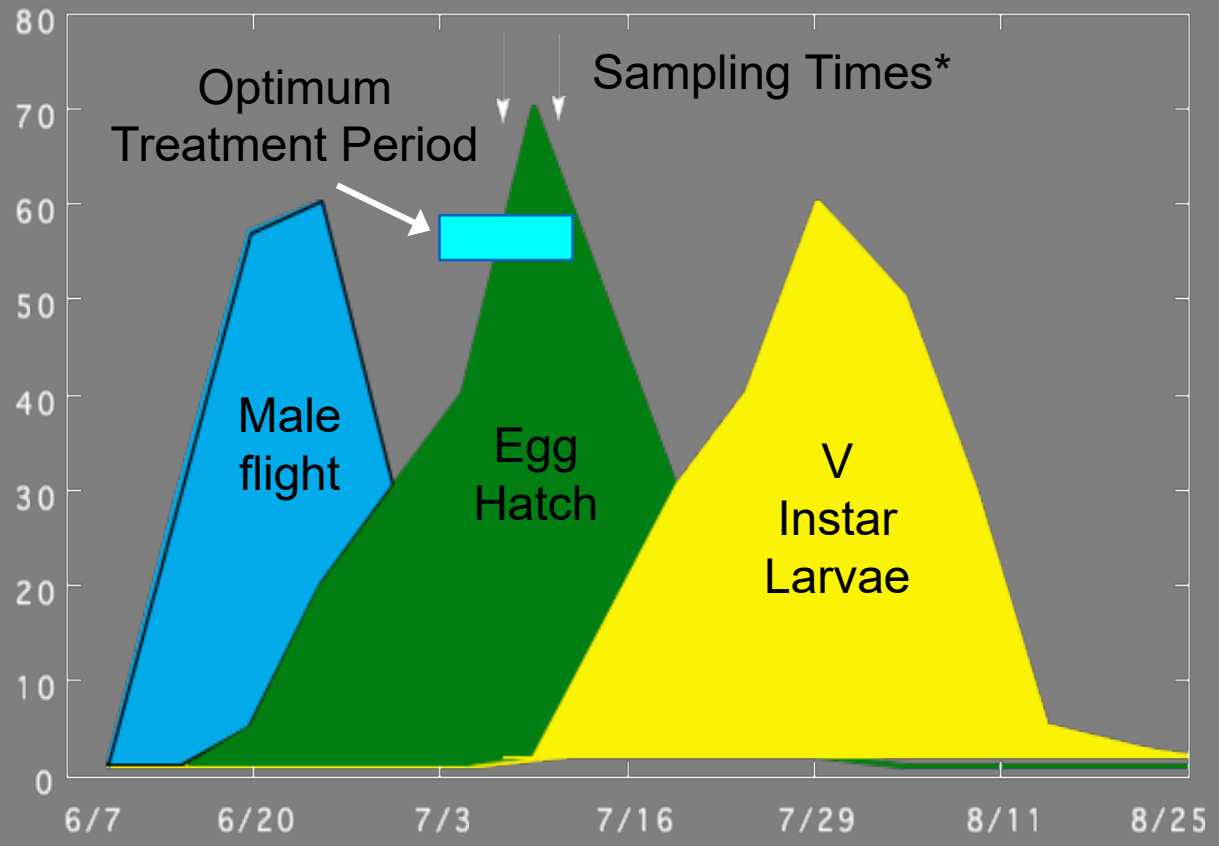
Important OBLR Life Events

Relative % Activity

(1st Summer Brood)



(*start at 600 DD [base 43°F] after 1st adult catch)

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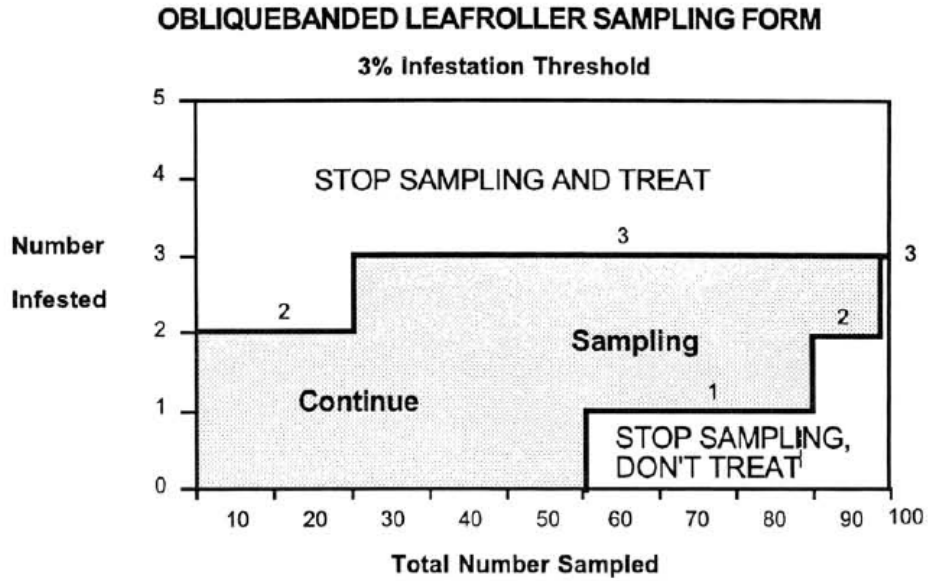
Monitoring 1st Summer Brood OBLR

- Delta or wing-type pheromone trap
- June 1 - hang at head height in each of 2-3 randomly chosen trees in block (edge and interior)
- Check traps 2-3 times/week until 1st moth caught; wait 600 DD (base 43°F) after this date
- Sample foliar terminals for larval infestations using sequential sample chart.
- If below threshold, sample again after 100 DD more have accumulated (approximately 3-5 days)
- Preferred products: Delegate, Altacor, Exirel, Proclaim, B.t., Intrepid; some pre-mixes (Besiege, Minecto Pro, Voliam Flexi)



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EUROPEAN RED MITE LIFE HISTORY

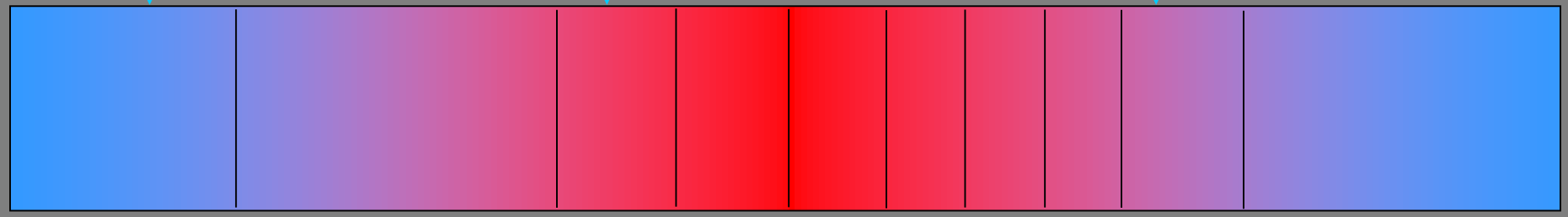

overwintered eggs;
bases of buds, spurs


1st summer eggs


mixed stages;
7-8 generations

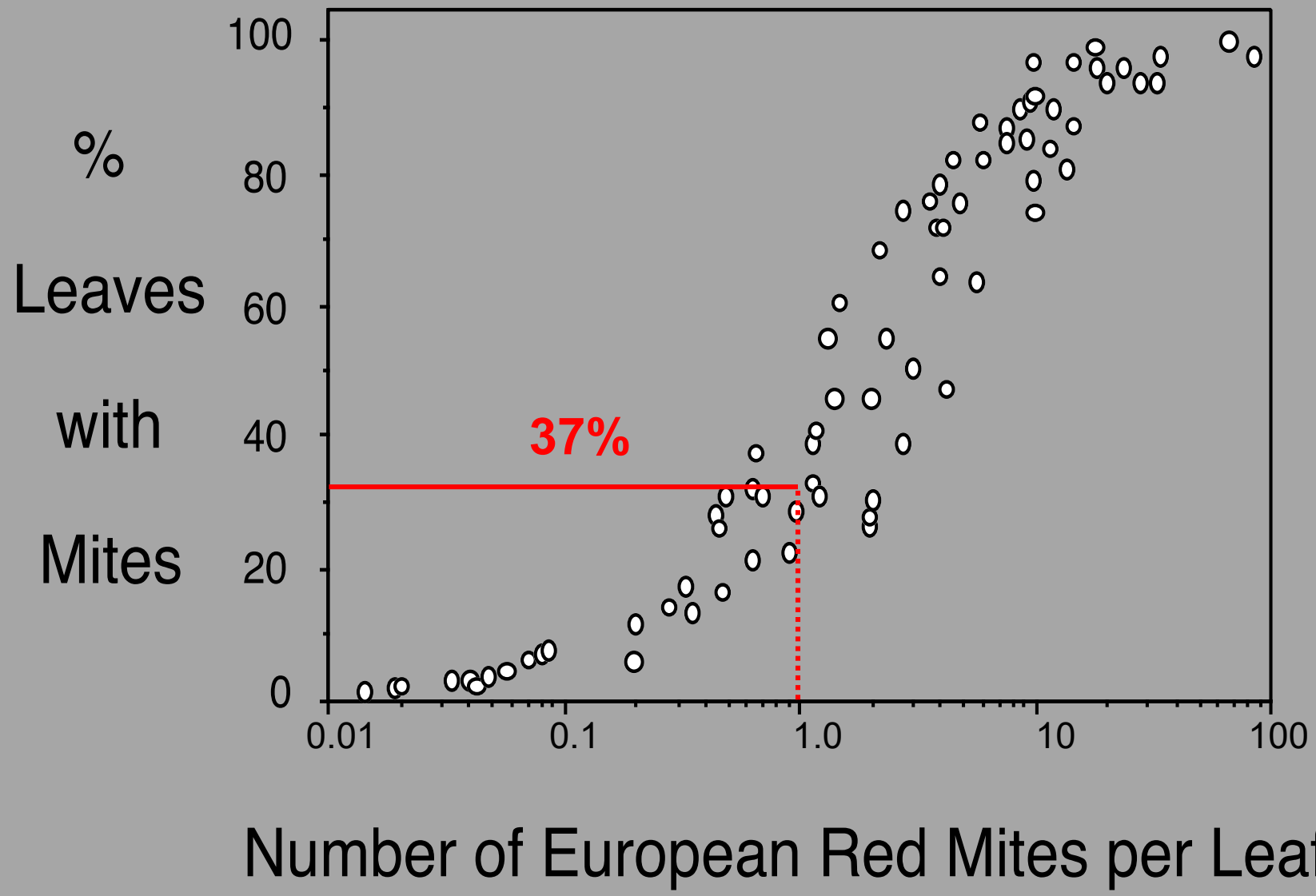
1st winter eggs

eggs hatch;
nymphs, larvae



Dormant
TC (Macs)
Pink
Petal Fall
Fruit Set
mid-June
Early August

RELATIONSHIP OF EUROPEAN RED MITE DENSITY TO DISTRIBUTION



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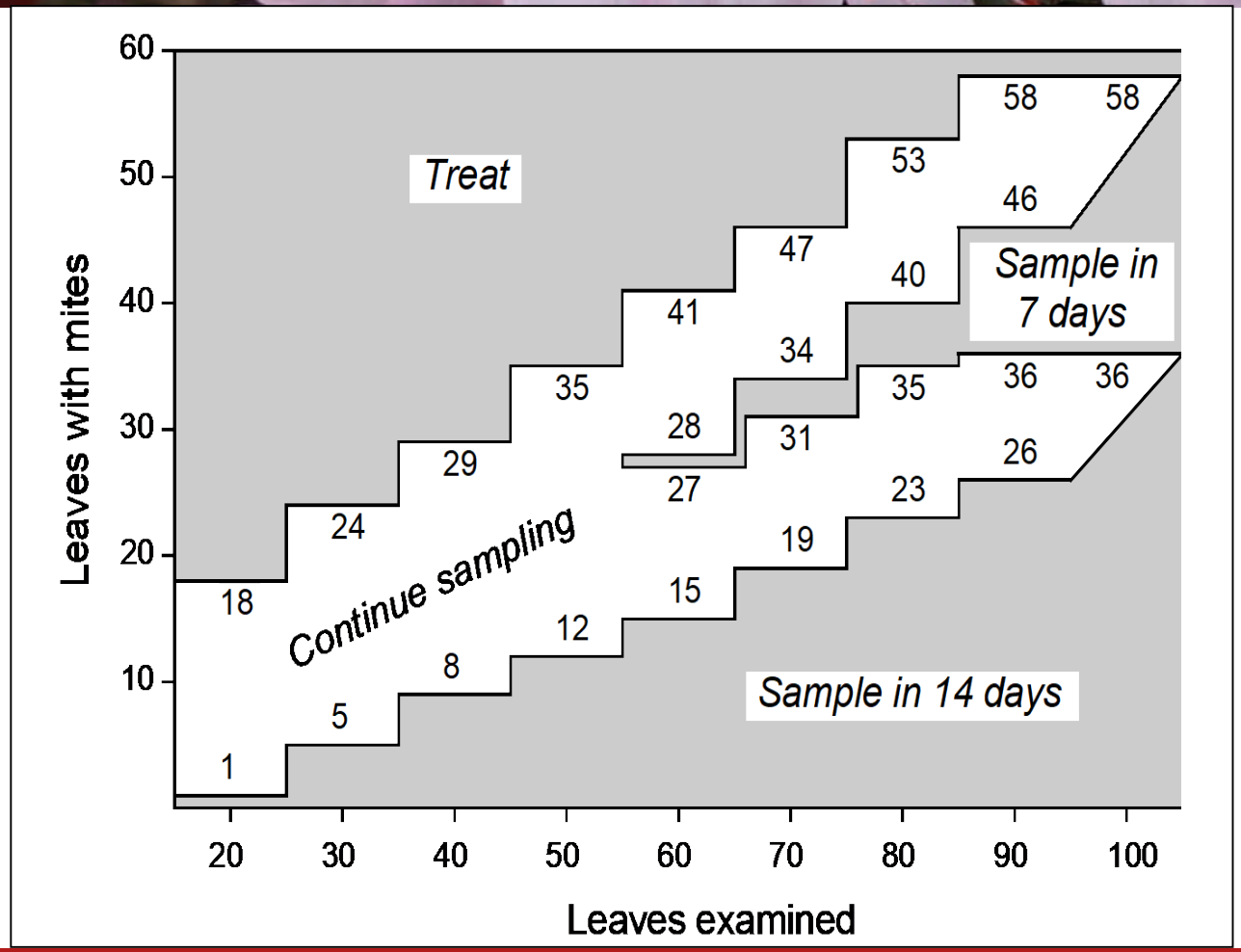
SEQUENTIAL SAMPLING CHART FOR MITES

MITE SAMPLING CHART - Threshold = 2.5 mites/leaf (June 1 - 30)



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Thresholds for Sampling Mites During the Summer

Period	Mite Threshold	Corresponding % of Leaves with mites
June 1 – 30	2.5 mites per leaf	62%
July 1 – 31	5.0 mites per leaf	76%
August 1 – 15	7.5 mites per leaf	85%
After August 15	10.0 mites per leaf	91%

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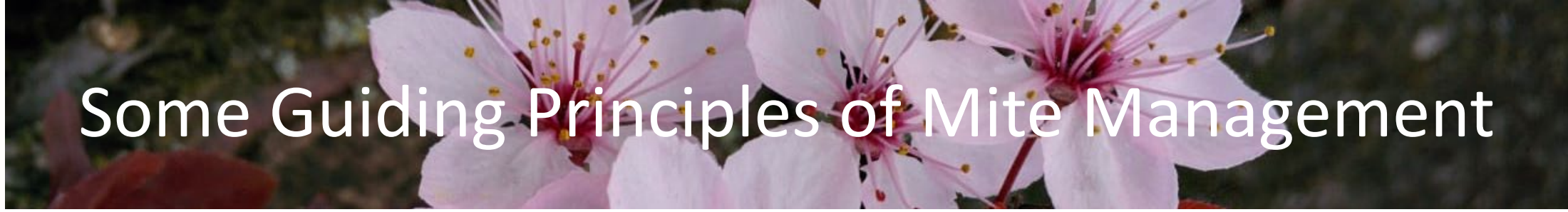

Some Guiding Principles of Mite Management

- Can be considered a 2-phase process:
  - Early season program, against overwintering generation
  - Summer program, against new populations

- Usually, a preventive approach (i.e., without need to sample) is advised for early season, depending on previous year's pressure:
  - Delayed dormant oil, an ovicide-larvacide (Apollo/Savey/Onager/Zeal) applied prebloom or (for Agri-Mek) after petal fall.

- For summer populations, scouting/sampling advised to pick up rapid mite increases on new foliage, especially during early summer when trees are most susceptible.
  - Thresholds increase as the summer goes on:
    June: 2.5 ERM/leaf; July: 5.0 ERM/leaf; Aug: 7.5 ERM/leaf
  - When numbers of motiles (everything but eggs) reach or approach threshold, a "rescue" material can be recommended:
  Acramite, Apollo, Envidor, Kanemite, Nealta, Nexter, Onager, Portal, Savey, Zeal

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Principles of Apple Maggot Management

- Commercial apple orchards generally have no internal infestations of AM.
- AM management programs are designed to control flies immigrating into orchards from outside sources.
- Broad-spectrum organophosphate insecticides have historically been extremely effective in controlling AM.

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Host Removal for Management of AM

- Unfortunately, it is normally not possible to remove all potential hosts for AM in close proximity to many commercial orchards.
- If possible, improved control can be obtained by removing all apple and hawthorn trees within 100 m of the borders of a commercial apple orchard.

Crataegus holmesiana

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AM Preferences for Different Apple Varieties

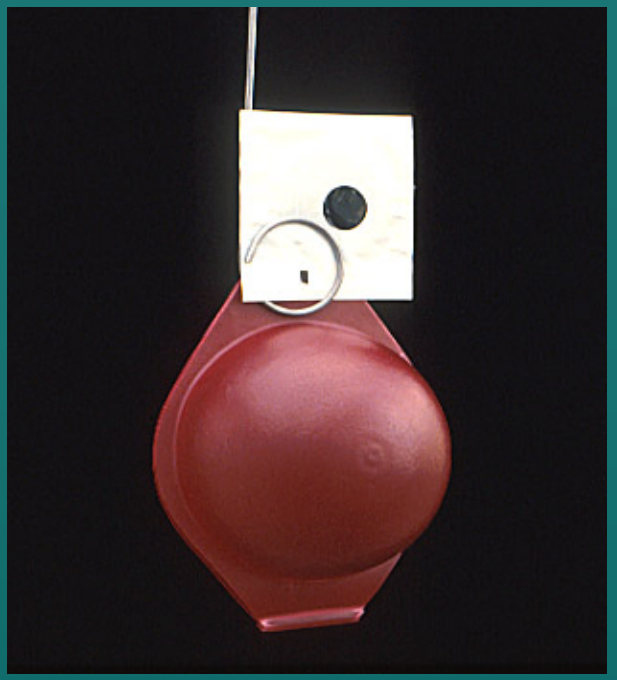
- Softer, earlier ripening varieties are most preferred for AM oviposition and favorable for larval survival: Ginger Gold, Jonagold, McIntosh, Wealthy, Cortland.
- Harder, late ripening varieties are least preferred: Rome, Red Delicious, Golden Delicious, Northern Spy.

Apple Maggot Monitoring Traps

Yellow Board

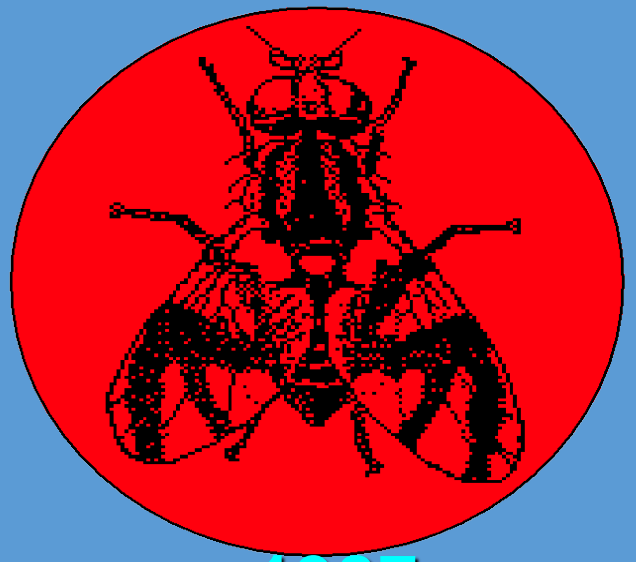
Sphere

Combination
("Ladd")



Disposable Volatile-Baited AM Sphere Trap

Evolution of Apple Maggot Sampling Procedures



Before Calendar-based sprays after catch of 1st fly on yellow board trap.

1987 Unbaited red sphere traps, checked 1-2x per week. Threshold: 1 fly caught

After Volatile-baited sphere traps, same monitoring method. Threshold: 5/trap

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Assumptions in Apple Maggot Monitoring Programs

- AM traps are attractive only over a relatively short range (20-25 m).
- Protective residues from an insecticide (organophosphate) control spray will last only 10-14 days under typical Northeastern summer conditions.

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Common Deviations from AM Monitoring Protocol

- AM traps used only for timing the first spray. Additional sprays are applied at regular intervals, regardless of trap catch.
- Entire farm's AM treatment program is based on catches in 1 or 2 monitored blocks.
- The recommended treatment threshold (avg. of 5 flies/trap) is ignored.

1. The main goal of mating disruption is:

A – to repel all the male moths away from the females

B – to trick the male moths into mating with other moth species

C – to “turn off” the males’ searching behavior

D – to interfere with the males’ ability to find the females

2. Obliquebanded leafroller late season feeding damage is often not visible in the field.

A – True

B – False

3. The purpose of sampling for European red mites several times during the season is:

A – They're so small it could take more than one sample to get an accurate count

B – The treatment threshold changes according to the time of the season

C – It's necessary to count the adults in the spring and compare it with the immatures later in the summer

D – They change their appearance as the season progresses

4. Which of the following statements about apple maggot is true?

A – The main threat of attack comes from AM adults emerging from the orchard floor

B – AM control sprays should target alternate host volunteer apple and hawthorn trees near the orchard

C – Volatile-baited sphere traps have a higher threshold than yellow cards because they're more efficient at catching incoming adults

D – AM adults only attack trees on the edge of the block