

# The Mid-Season Lepidopteran Complex On Apple: How Complex Is It ?

## Lepidopteran Resistance Pest Management Strategies



**New England Vegetable & Fruit Conference**

2:30PM, December 17, 2013

Radisson Hotel in Manchester, NH

*Peter Jentsch*

*Senior Extension Associate – Entomology*



**Presentations can be found at:**  
**<http://blogs.cornell.edu/jentsch/presentations/>**

## THE JENTSCH LAB

INSECT BIOLOGY, ECOLOGY, AND MANAGEMENT IN HUDSON VALLEY AGRICULTURAL COMMODITIES OF NY



HOME

ENTOMOLOGY PROGRAM

ORGANIC AG RESEARCH

TREE FRUIT

VEGETABLE

SWEET CORN

SMALL FRUIT

GRAPE





# Hudson Valley Lepidopteran pest complex overview

## Leafroller:

Obliquebanded leafroller, *Choristaneura rosaceana* (Harris)

Sparganothis Fruitworm (*Sparganothis sulfureana*)

Redbanded leafroller, *Argyrotaenia velutinana* (Walker)

Variegated leafroller, *Platynota flavedana* (Clemens),

Tufted apple bud moth, *Platynota idaeusalis*

Fruit tree leafroller, *Archips argyrospila* (Walker),

## Internal Lepidopteran:

Oriental fruit moth

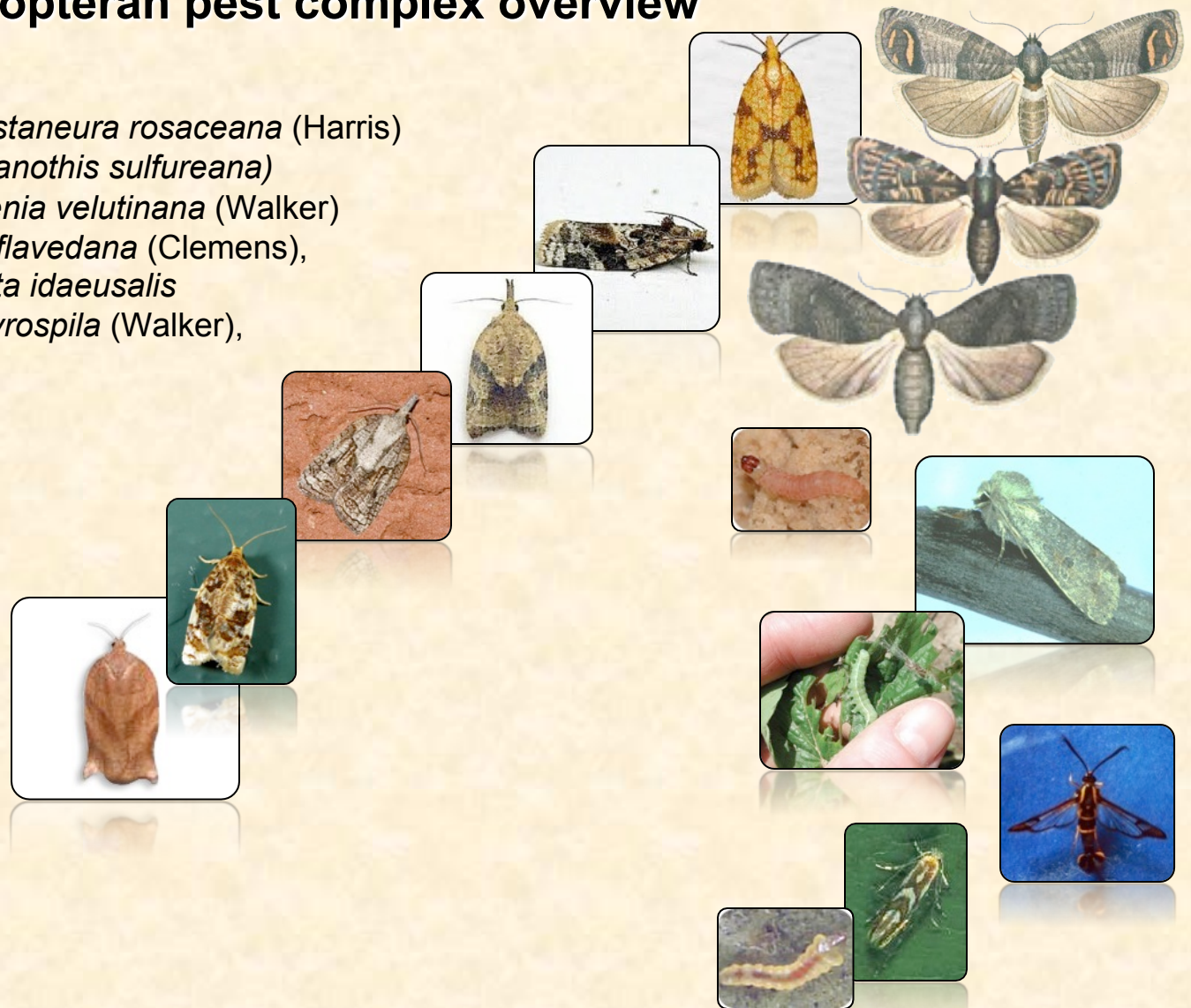
Lesser apple worm

Codling moth

## Green Fruitworm

## Trunk Borers

## Leafminers



# Hudson Valley Lepidopteran pest complex overview

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## Internal Lepidopteran:

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Lesser apple worm  
Codling moth

## Green Fruitworm

## Trunk Borers

## Leafminers





# The Lepidopteran Complex In NYS Tree Fruit Resistance Management

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## Fruit feeding

**Obliquebanded Leafroller**

**Codling Moth**

**Oriental Fruit Moth**

**Lesser Apple Worm**

Red Banded Leafroller

Spotted Green Fruitworm

## Foliar & Cambium feeders

Spotted Tentiform Leafminer

Dogwood Borer

*(8 fruit feeding lepidopteran insects)*

# **The Lepidopteran Complex In NYS Tree Fruit Resistance Management**

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**Lep. Management & Insecticide Resistance Efforts Should Be  
Concentrated On Obliquebanded Leafroller & Codling Moth**

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**Q. Life is Too Complicated.....Why Manage Resistance?**

**A. When Insects Become Resistant To Insecticides  
Then Life Really Gets Complicated!!**





## **Rejections of Apple Shipments From *Western* NY Processing Orchards Due to Increasing Internal Worm Infested Fruit**

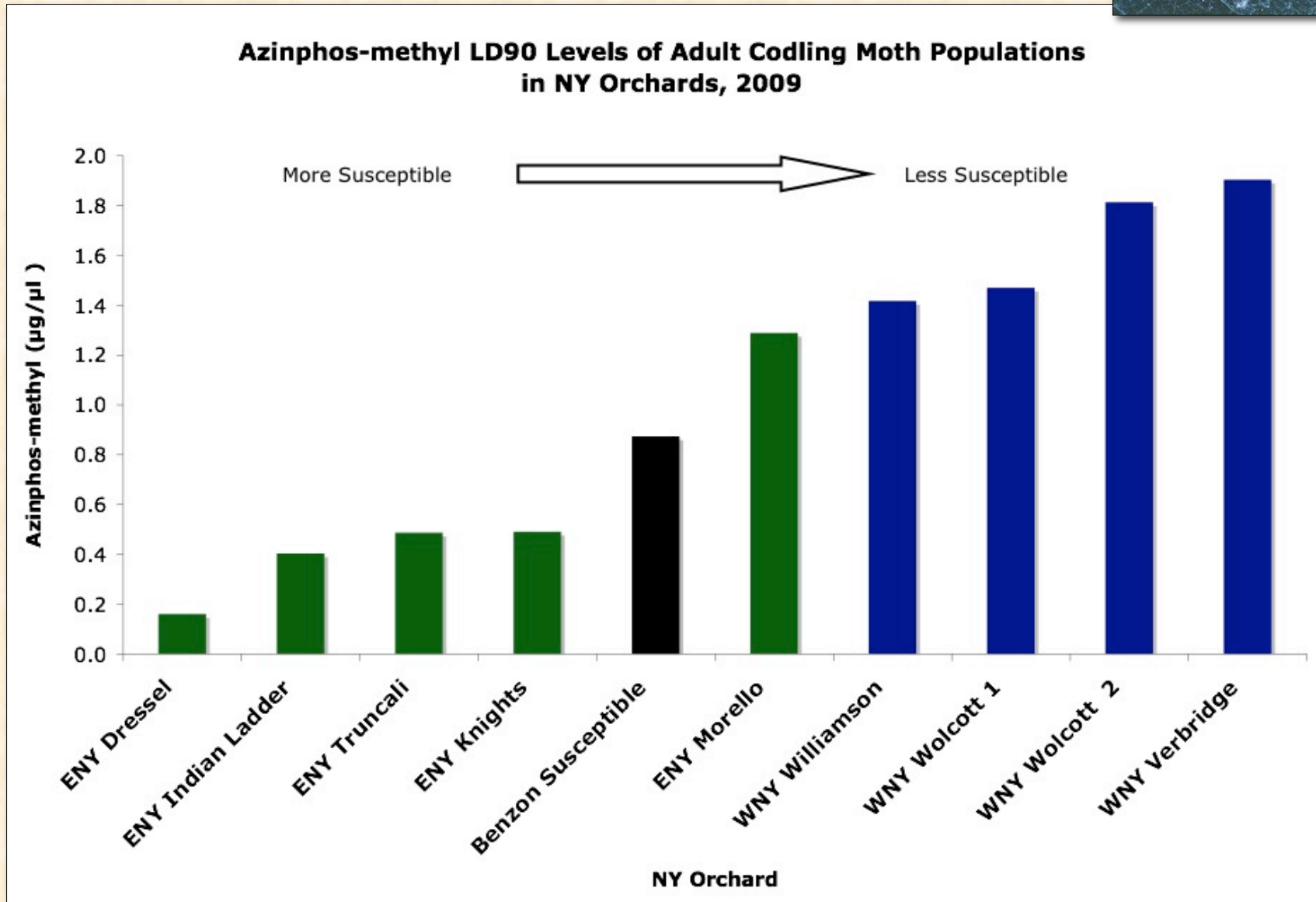
**2001: 20 loads of infested fruit**

**2002: 80 loads of infested fruit from 42 growers in WNY<sup>1</sup>**

**2005: 100 loads of infested fruit from 60 farms.**

1. Rhode Island Greening (12 loads), Monroe (12 loads), Cortland (7 loads), Idared (7 loads), Jonagold (6 loads), Rome (4 loads)

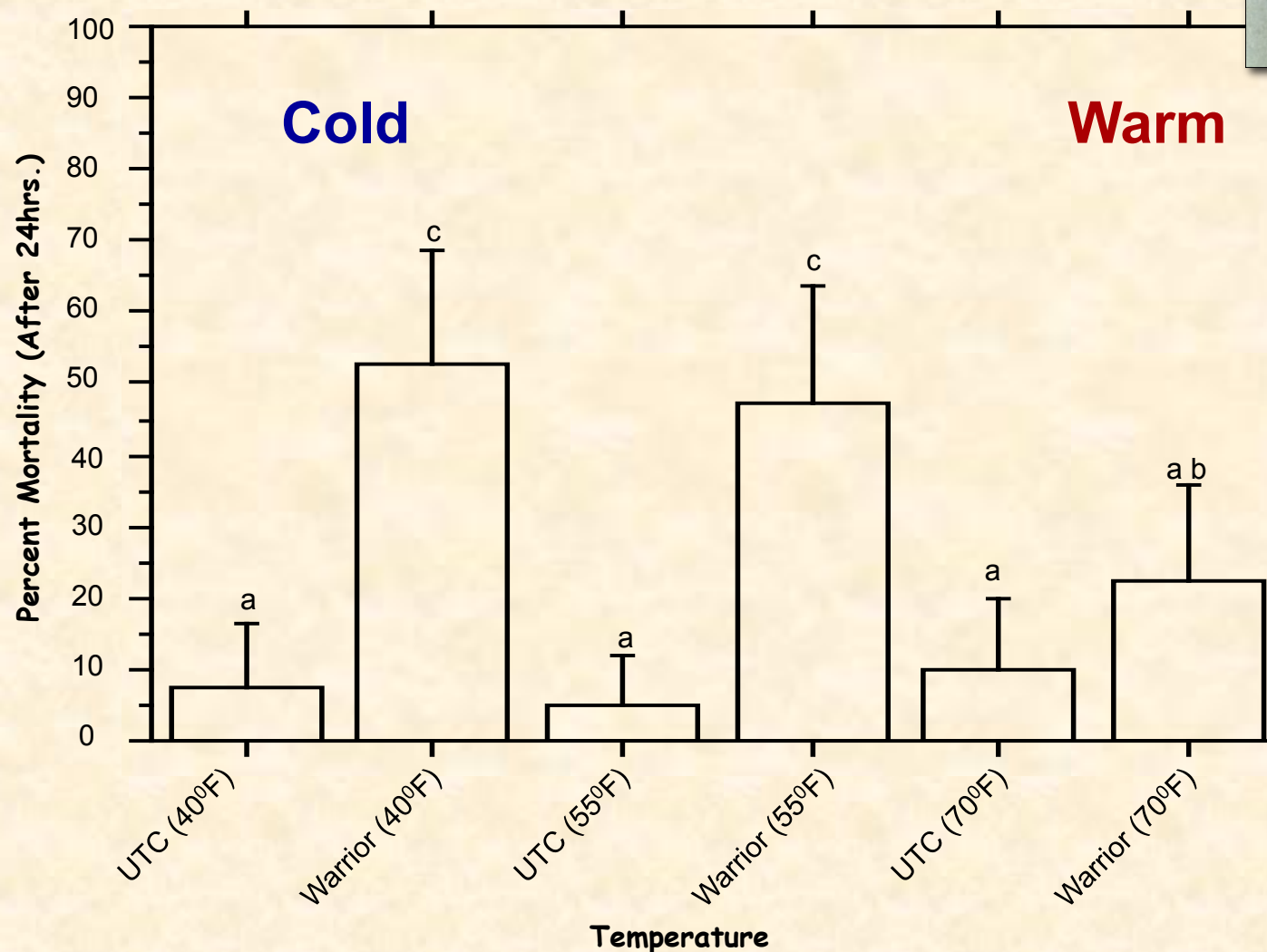
# Azinphos-methyl susceptibility levels





Codling Moth Larvae Bioassay (susceptible 'Benzon' Colony),  
NYSAES, Highland NY 2009<sup>1</sup>

Warrior @ 0.16 fl. oz. /A



<sup>1</sup> Bioassay conducted on 1st instar codling moth larva topically treated with 1 $\mu$ L droplet of lambda-cyhalothrin at 0.0005  $\mu$ g A.I./ 1000 mL or 0.0005 ppm [ **3% of the labeled field rate**] placed in temperature controlled chambers over 24 hours. ( df = 3, F-value = 8.648, P-value = 0.0001).

# ***Obliquebanded Leafroller***

## **Family: Tortricidae**



- *OW as late instar larvae*
- *Damage to blossoms/clusters from TC to 1C*
- *Two summer broods*
- *Most damage by 1st brood through- out late June and July*





# ***Obliquebanded Leafroller***

Family: Tortricidae

Overwintering larva damage to flowers, foliage and developing fruit



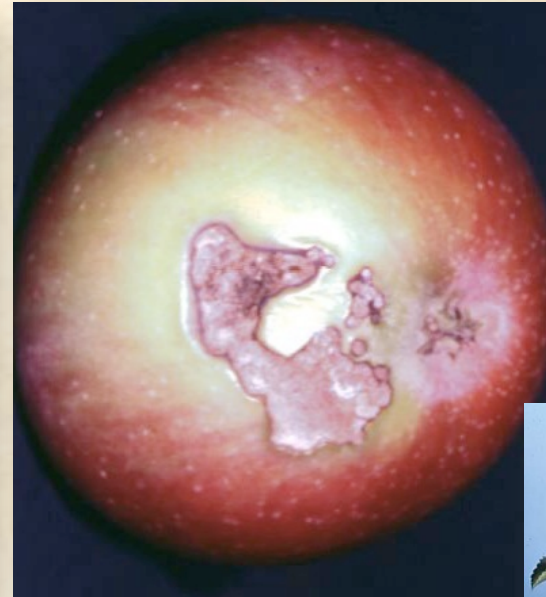
Overwintering

GT	TC	P	Bloom	PF	1C	2C	3C	4C	5C	6C	7C	8C
21 March	21 April	27 April	3 May	13 May	28 May	10 June	25 June	5 July	15 July	1 Aug.	15 Aug.	1 Sept.

# ***Obliquebanded Leafroller***

Family: Tortricidae

1<sup>st</sup> summer brood larva damage to foliage and developing fruit



1<sup>st</sup> Summer Brood

GT	TC	P	Bloom	PF	1C	2C	3C	4C	5C	6C	7C	8C
21 March	21 April	27 April	3 May	13 May	28 May	10 June	25 June	5 July	15 July	1 Aug.	15 Aug.	1 Sept.



# ***Obliquebanded Leafroller***

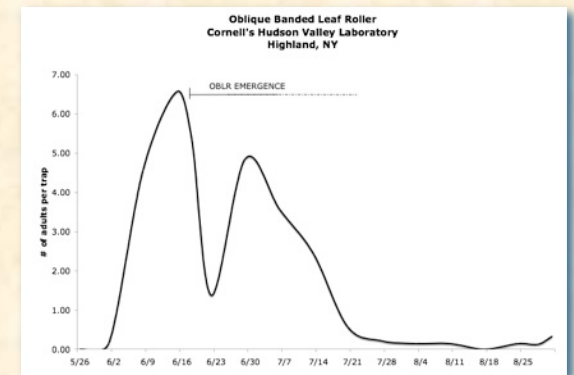
2<sup>nd</sup> summer brood occurs in Mid-August

Larval emergence gives rise to the over-wintering generation.

Pin hole feeding damage near harvest in mid-late season varieties (Jonagold)



Thoratic shield



Overwintering

1<sup>st</sup> Summer Brood

2<sup>nd</sup> Summer

GT

TC

P

Bloom

PF

1C

2C

3C

4C

5C

6C

7C

8C

21 March

21 April

27 April

3 May

13 May

28 May

10 June

25 June

5 July

15 July

1 Aug.

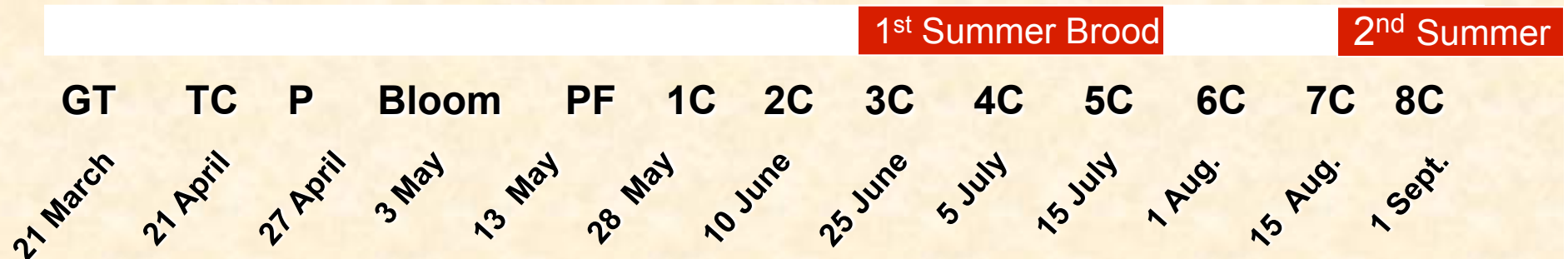
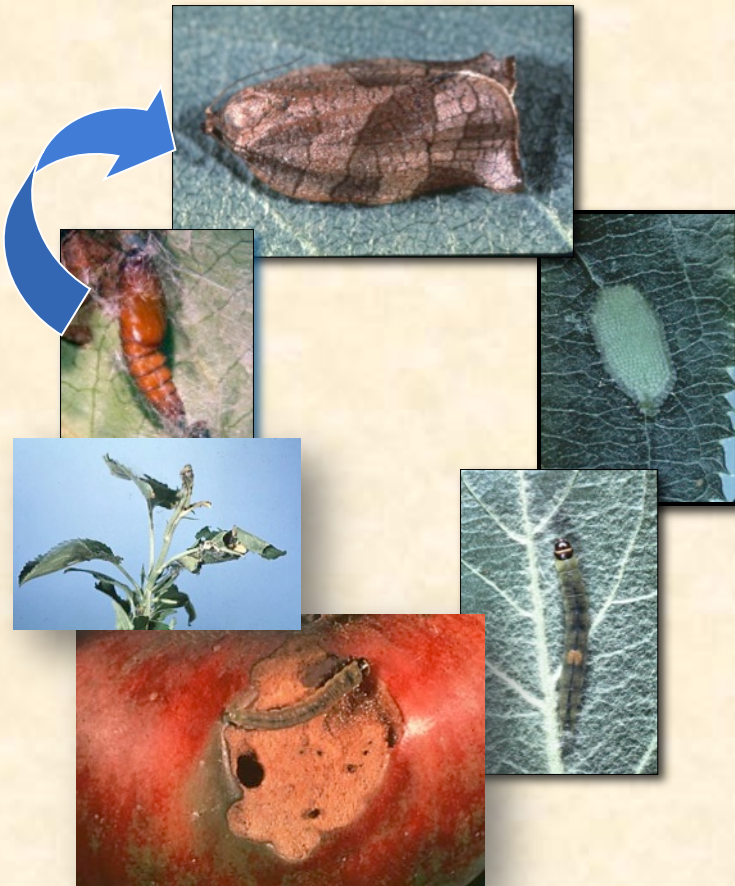
15 Aug.

1 Sept.

# ***Obliquebanded Leafroller***

Family: Tortricidae

- *The 1<sup>st</sup> and 2<sup>nd</sup> summer generation adults are monitored using pheromone traps*
- *To use on-line NEWA models for management, dates for the first sustained flight using trap captures is necessary.*
- *Warm sites capture adults earlier*

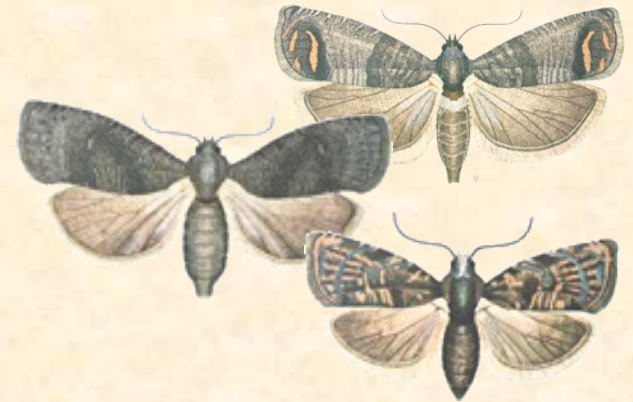




‘Delta’ Trap

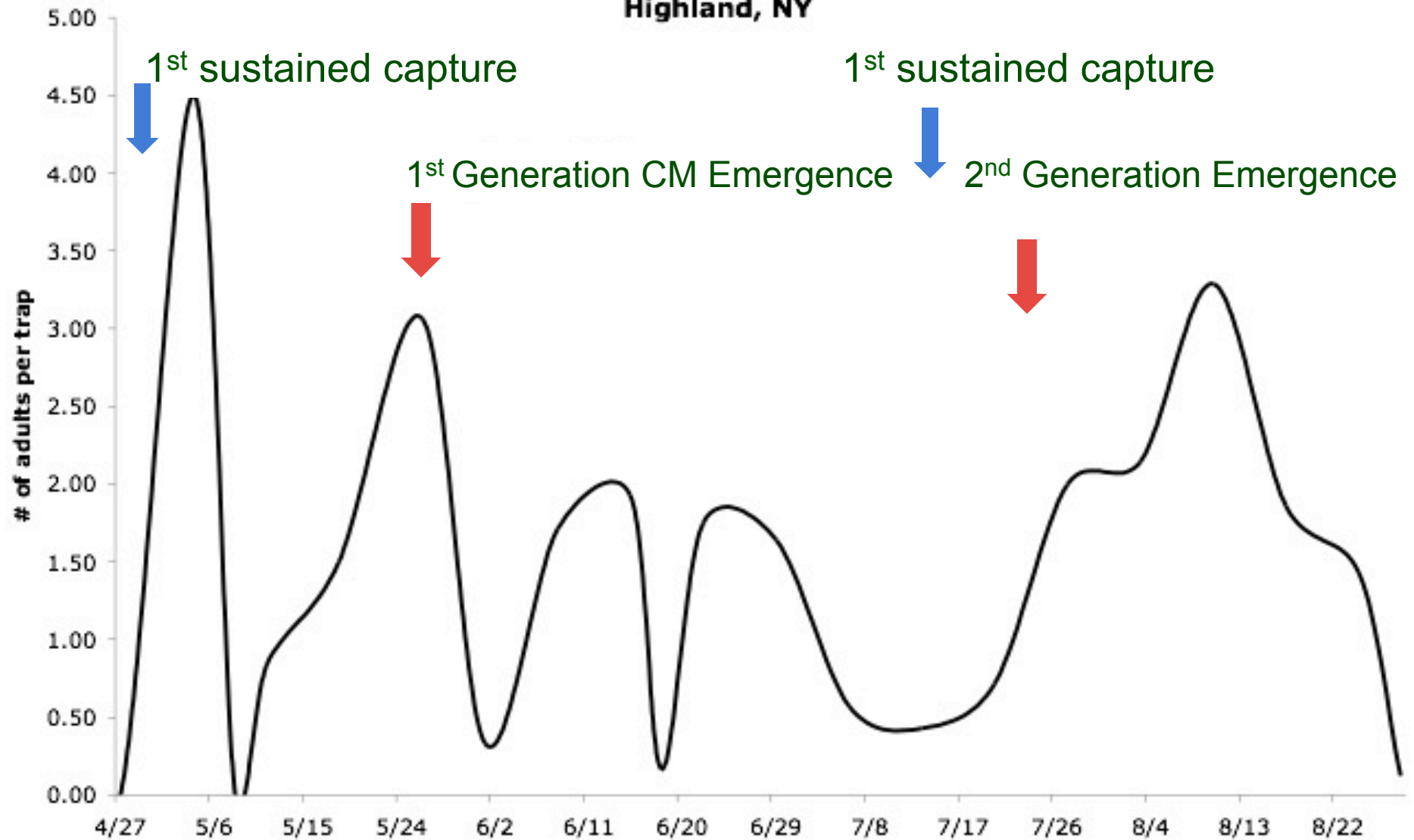


Species Specific Pheromone





**Codling Moth  
Cornell's Hudson Valley Laboratory  
Highland, NY**

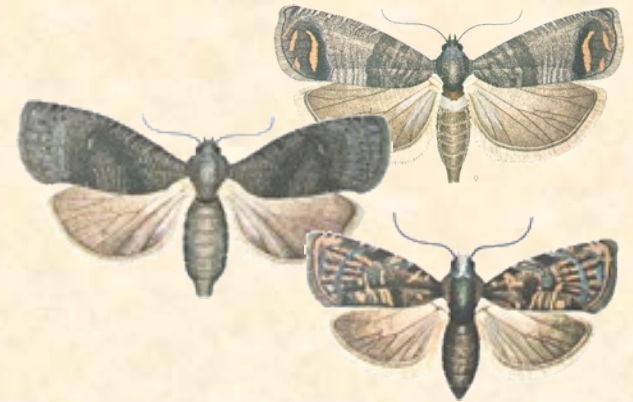




‘Delta’ Trap



Species Specific Pheromone

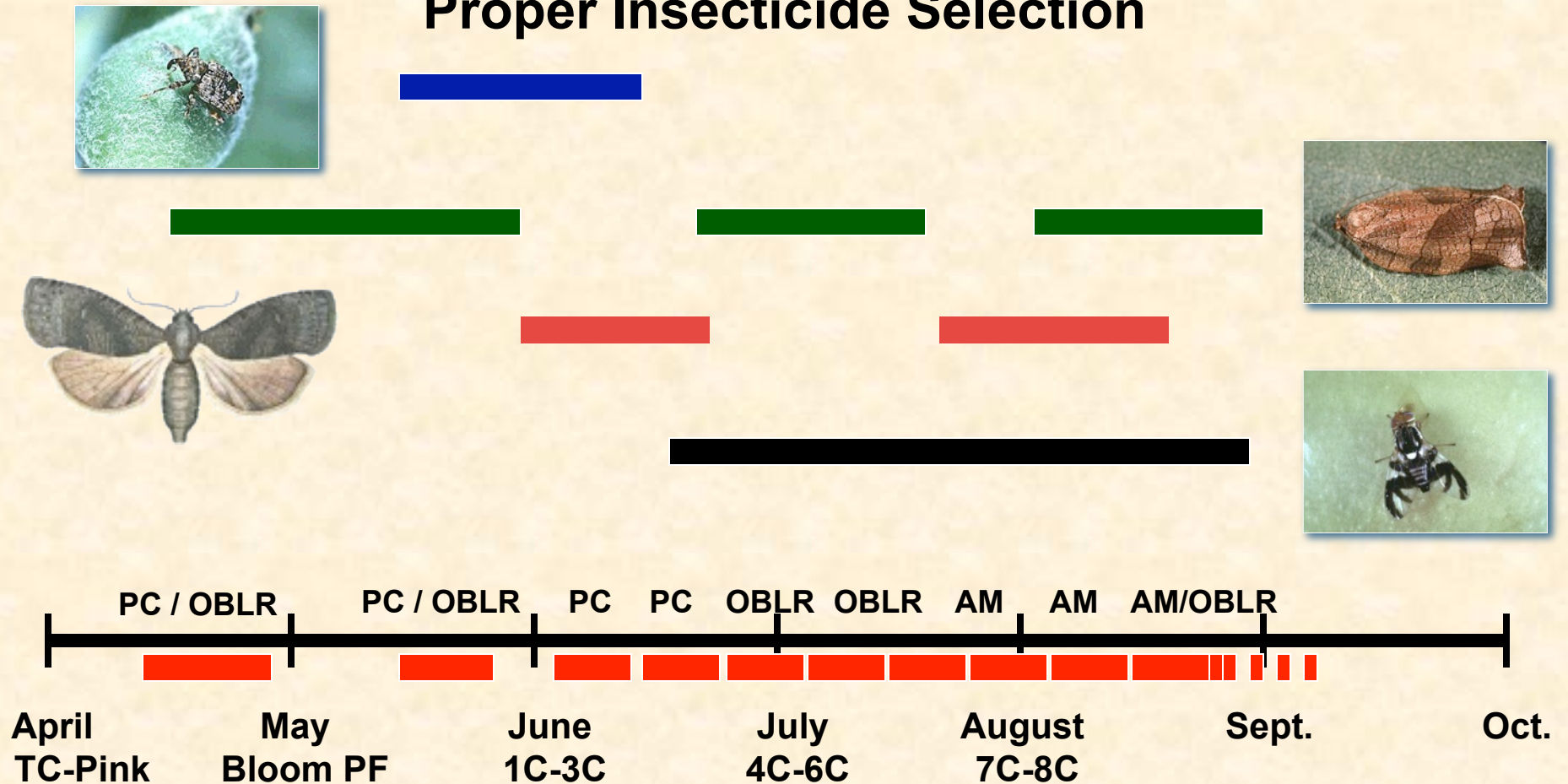


Determine key biological events of the Lep. complex in orchards.

1. Presence of the insect in our orchard.
2. Determine the ‘Biofix’ or **start of a generation**.
3. Use NEWA to find the predicted date of larva emergence.
4. Make application based on optimum weather window on either side of larval hatch.

# Insect Pest Management Success And Management To Reduce The Resistance Potential =

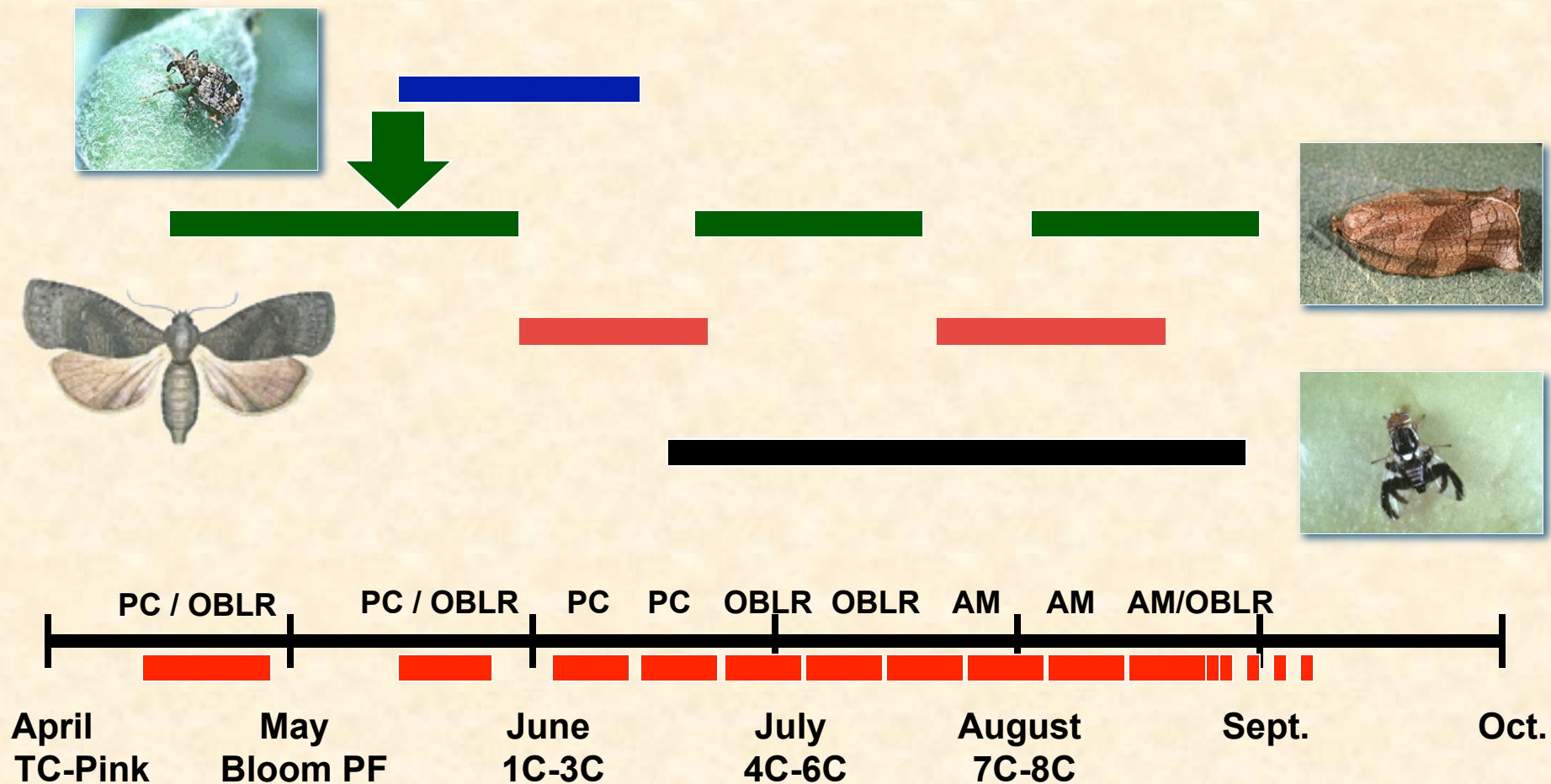
## Proper Insecticide Selection





# Use Insecticides With Efficacy To Manage:

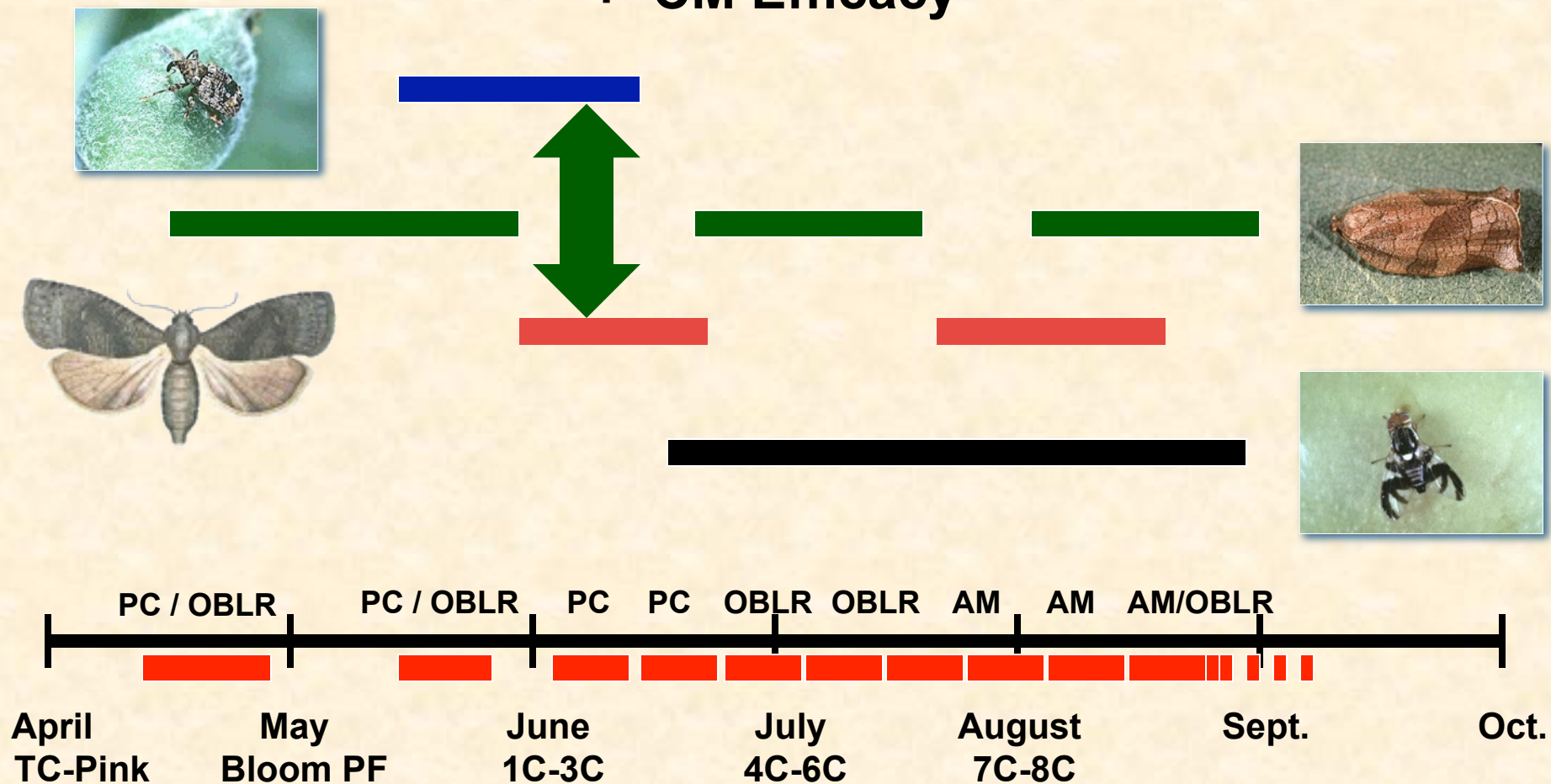
## I. Overwintering OBLR At PF (specific insecticide)



# Use Insecticides With Efficacy To Manage:

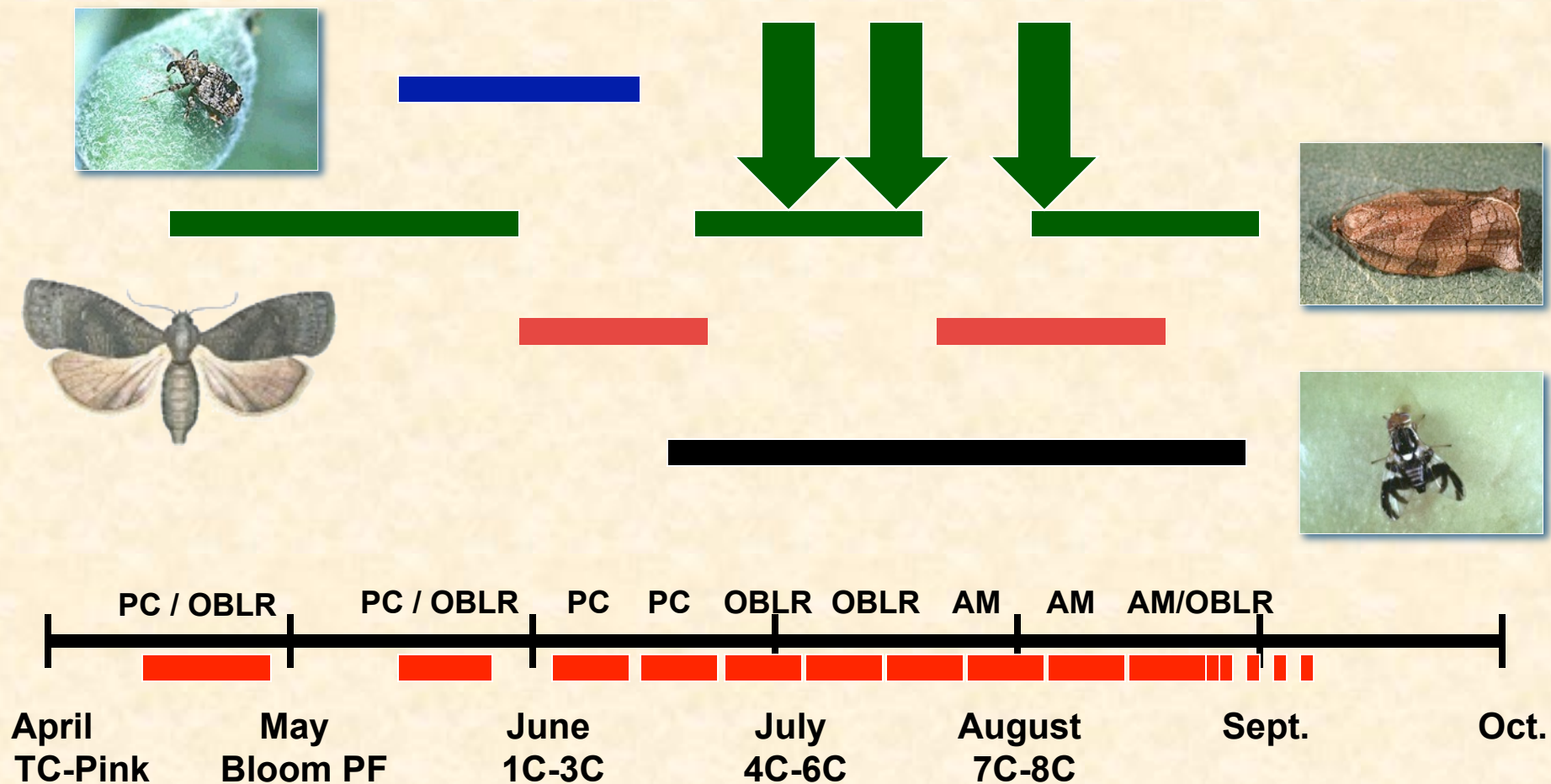
## II. Plum Curculio 2<sup>nd</sup> Application at 1<sup>st</sup> or 2<sup>nd</sup> cover (model)

+ CM Efficacy



# Use Insecticides with efficacy to manage:

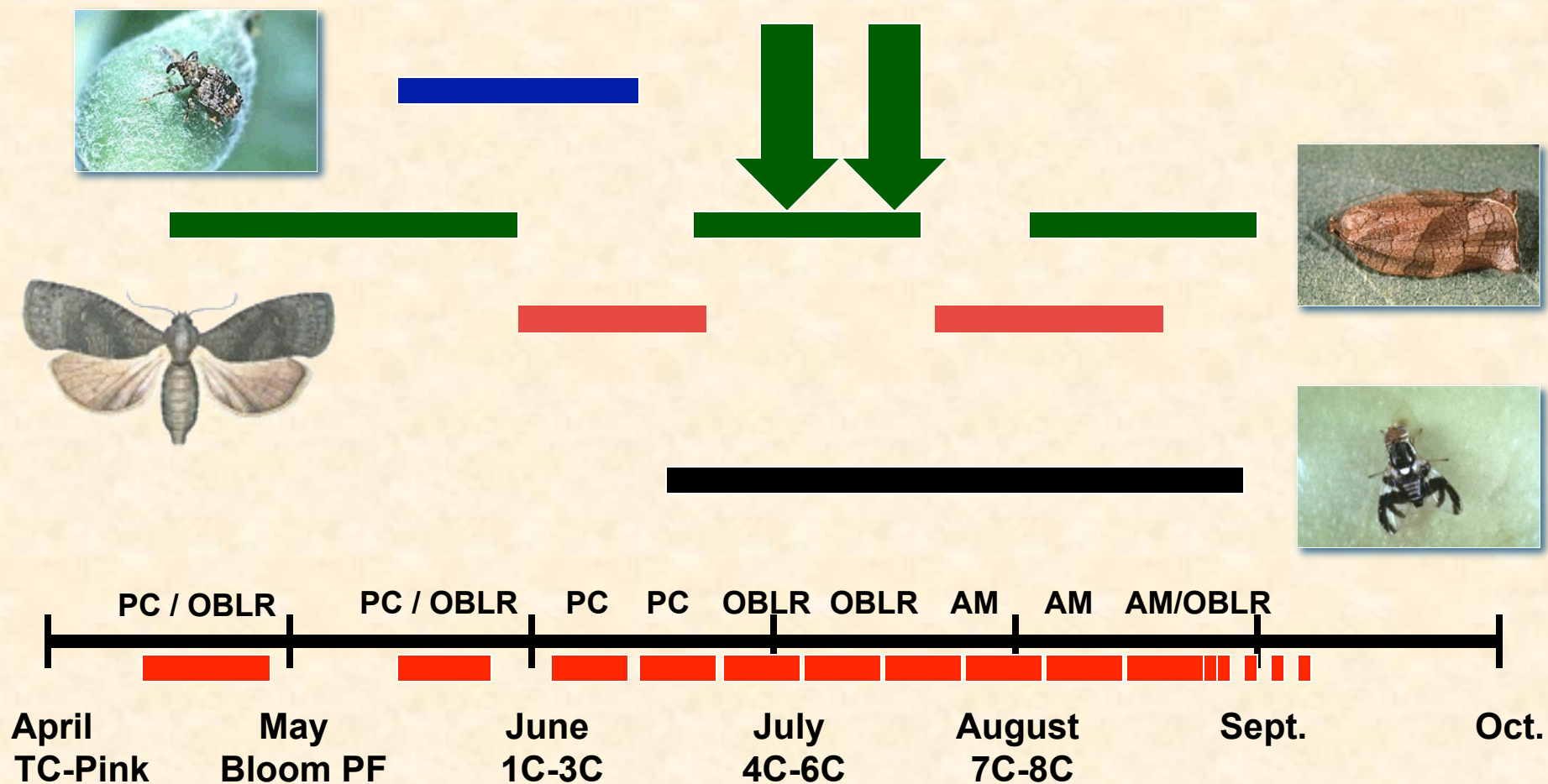
## III. A Three Spray Program For OBLR + CM Efficacy)





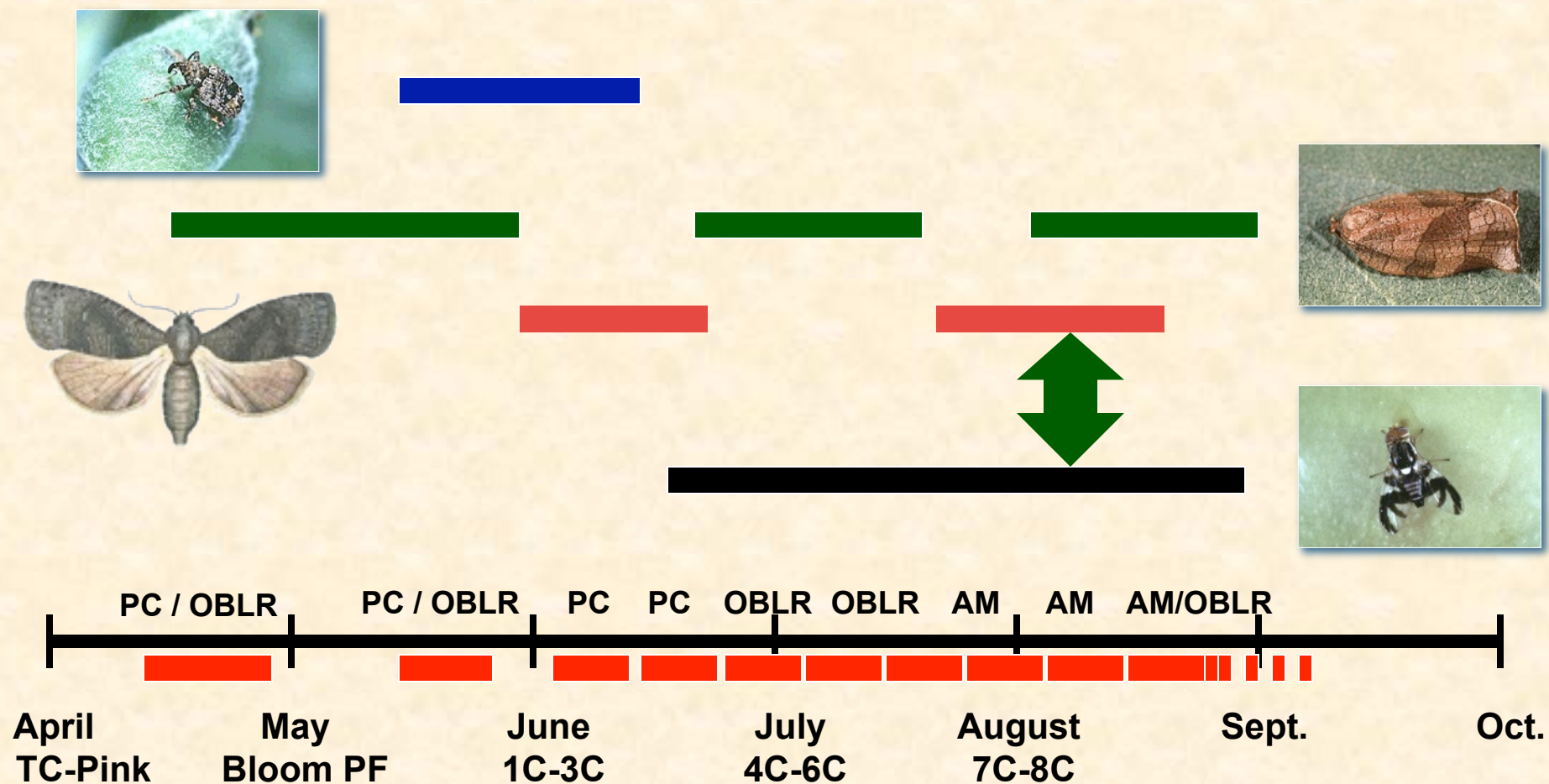
Use Insecticides with efficacy to manage:

## IV. OR Two Applications For OBLR + CM



Use Insecticides with efficacy to manage:

## IV. One Application For AM / CM



# The Lepidopteran Complex In NYS Tree Fruit Resistance Management

Using NEWA Weather Stations To Make Pest Management Decisions.

<http://newa.cornell.edu/>

The screenshot shows the NEWA website homepage. At the top, there is a Cornell University logo and a search bar. Below this, the text "New York State Integrated Pest Management Program" and "NEWA Network for Environment and Weather Applications" is displayed. A navigation menu includes links for "Weather Data", "Pest Forecasts", "Station Pages", "Crop Management", "Crop Pages", and "About Weather Stations". The main content area is divided into several sections: "National Weather Service Forecast" with a search bar for "City, ST" or "zip code"; "NEWA News and Reports" with a brief announcement about a server move and links for "Updates", "NEWA Press Releases & Reports", and "About NEWA"; "Questions and Comments" with an email link; "Pest Forecasts" with a dropdown menu; "Crop Management" with a dropdown menu; and "Crop Pages" with links for "Apples", "Grapes", "Onions", and "Potatoes". On the right side, there is a "Welcome to the NEWA Home Page" section featuring a map of New York State with numerous green tree icons representing weather stations. A red banner at the bottom of the map reads "Trying to determine location...".





# The Lepidopteran Complex In NYS Tree Fruit Resistance Management

Using NEWA Weather Stations To Make Pest Management Decisions.



[Search Cornell](#)

 **New York State Integrated Pest Management Program**  
 **NEWA Network for Environment and Weather Applications**

Search NEWA website

Enter Search...

Search

[Weather Data](#) [Pest Forecasts](#) [Station Pages](#) [Crop Management](#) [Crop Pages](#) [About Weather Stations](#)

[National Weather Service Forecast](#)

Welcome to the NEWA Home Page



Enter "City, ST" or "zip code"

City,ST

Go

[National Weather Service Information](#)

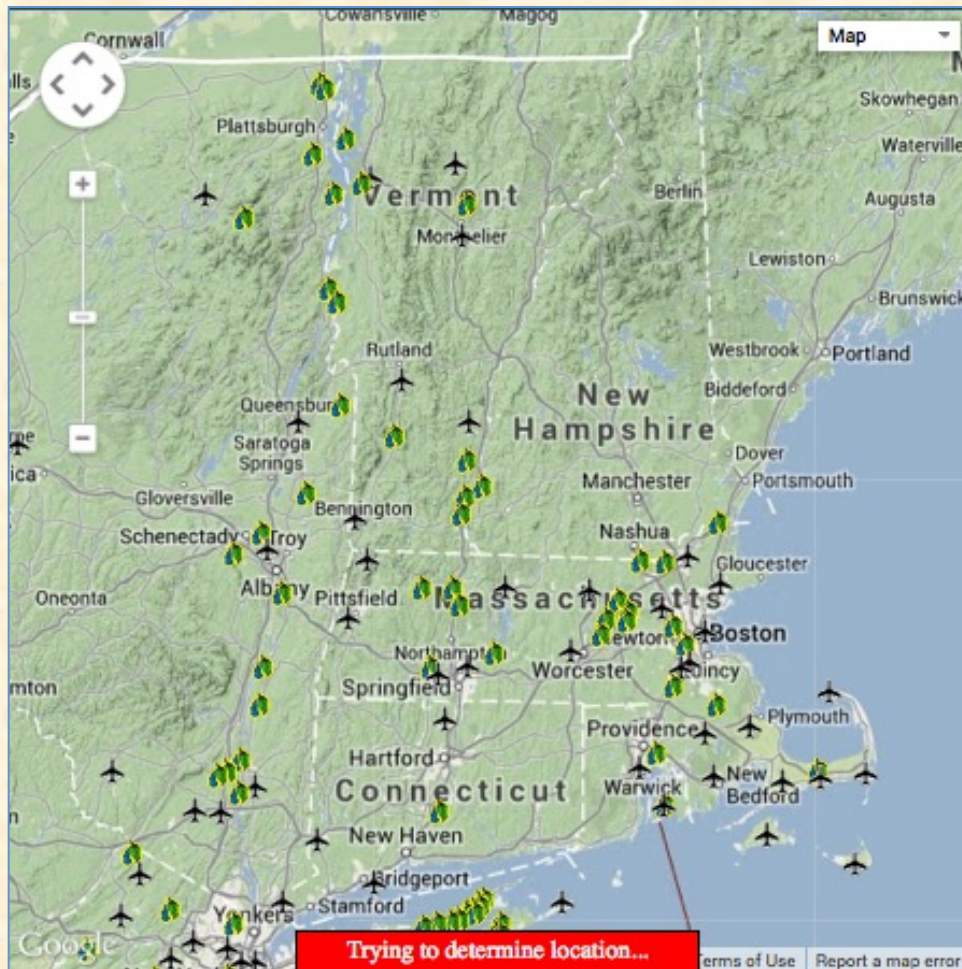
Choose a NEWA weather station home page

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



# The Lepidopteran Complex In NYS Tree Fruit Resistance Management

Using NEWA Weather Stations To Make Pest Management Decisions.



- Choose site based on your location

# The Lepidopteran Complex In NYS Tree Fruit Resistance Management

## Using NEWA Weather Stations To Make Pest Management Decisions.

Cornell University

New York State Integrated Pest Management Program

NEWA Network for Environment and Weather Applications

Search Cornell

Search NEWA website

Enter Search... Search

Weather Data Pest Forecasts Station Pages Crop Management Crop Pages About Weather Stations

Weather Data Quick Links

Daily Summary

Jan Feb Mar Apr May Jun  
Jul Aug Sep Oct Nov Dec

Hourly Data

Jan Feb Mar Apr May Jun  
Jul Aug Sep Oct Nov Dec

Growing Degree Days (Base 50F)

Jan Feb Mar Apr May Jun  
Jul Aug Sep Oct Nov Dec

Growing Degree Days (Base 50F BE)

Jan Feb Mar Apr May Jun  
Jul Aug Sep Oct Nov Dec

Growing Degree Days (Base 86/50F)

Tyngsboro, MA Weather Station Page

These pest forecasts provide current conditions, using [default biofix dates](#), for this location, as of the last download date and time. **For prior dates and years, and other locations, choose from Pest Forecasts on the horizontal menu.**

Tyngsboro, MA Pest Forecasts

<a href="#">Apple Scab</a>	<a href="#">Obliquebanded Leafroller</a>	<a href="#">Onion Disease Forecast</a>
<a href="#">Fire Blight</a>	<a href="#">Apple Maggot</a>	<a href="#">Onion Disease Log</a>
<a href="#">Sooty Blotch/Flyspeck</a>	<a href="#">Grape Diseases</a>	<a href="#">Onion Blight Alert</a>
<a href="#">Leaf Wetness Events</a>	<a href="#">Grapevine Downy Mildew</a>	<a href="#">Onion Modified Blight Alert</a>
<a href="#">Spotted Tentiform Leafminer</a>	<a href="#">Grape Berry Moth</a>	<a href="#">Potato Early Blight</a>
<a href="#">Oriental Fruit Moth</a>	<a href="#">Alfalfa Weevil</a>	<a href="#">Potato Late Blight Blitcast</a>
<a href="#">Codling Moth</a>	<a href="#">Cabbage Maggot</a>	<a href="#">Tomato Diseases, Tomcast</a>
<a href="#">Plum Curculio</a>	<a href="#">Onion Maggot</a>	<a href="#">Late Blight Simcast</a>

- Choose site based on your location
- Obliquebanded leafroller
- Codling moth



## NEWA Apple Insect Models

Select a pest:

Obliquebanded Leafroller

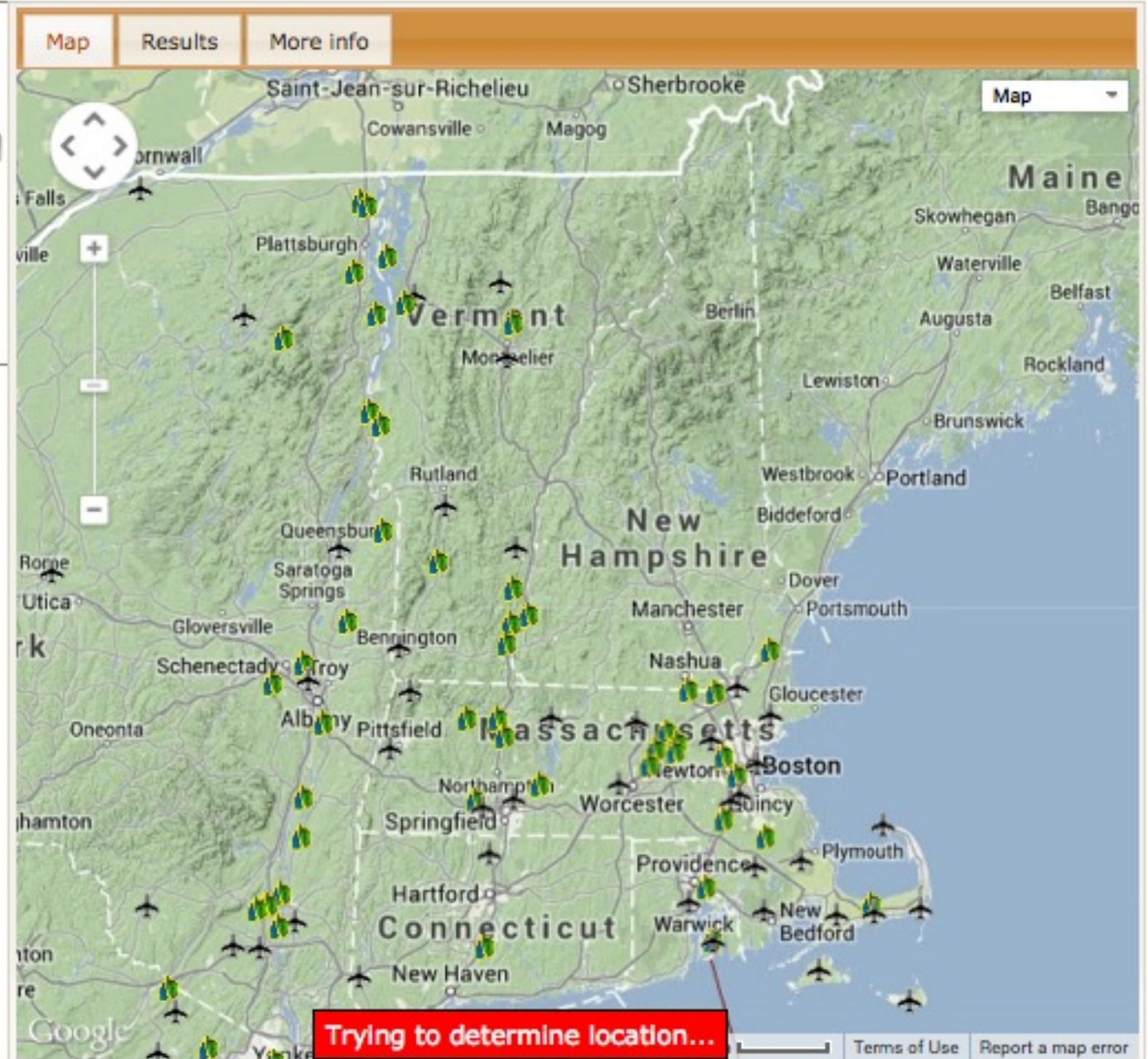
Weather Station:

Tyngsboro, MA

Accumulation End Date:

06/01/2013

Calculate



## NEWA Apple Insect Models

Select a pest:

Obliquebanded Leafroller

Weather Station:

Tyngsboro, MA

Accumulation End Date:

06/01/2013

Calculate

Map

Results

More info

### Obliquebanded Leafroller Results for Tyngsboro

Accumulated degree days (base 43°F) 1/1/2013 through 6/1/2013: 816 (0 days missing)

Phenological stage: Post Petal Fall

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

Pest stage: First generation moths emerge

Pest Status	Pest Management
<u>Adult</u> flight begins. In western NY first flight usually occurs around the middle of June.	No control measures are recommended for adults. Sprays to control summer generation of larvae are timed to coincide with the first hatch of eggs.

**Disclaimer:** *These are theoretical predictions and forecasts. The theoretical models predicting pest development or disease risk use the weather data collected (or forecasted) from the weather station location. These results should not be substituted for actual observations of plant growth stage, pest presence, and disease occurrence determined through scouting or insect pheromone traps.*





## NEWA Apple Insect Models

Select a pest:

Obliquebanded Leafroller

Weather Station:

Tyngsboro, MA

Accumulation End Date:

06/24/2013

Calculate

Map

Results

More info

### Obliquebanded Leafroller Results for Tyngsboro

First Trap Catch: 6/10/2013

*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 43°F) first trap catch through 6/24/2013: 353 (0 days missing)**

Pest stage: Peak moth flight, first egg hatch

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

Pest Status	Pest Management
First hatch of summer OBLR eggs. Adult catches in pheromone traps are near peak numbers.	In order to verify model predictions, monitor growing terminals at 600-700 DD base 43F after biofix to check for the detection of the first summer generation larvae. It is too early now to monitor populations of summer larvae at this time to determine if control sprays are necessary because most eggs will hatch later during the summer. However, applying protective sprays with the first spray timed to coincide with the first hatch of larvae at approximately 350 DD base 43F after biofix followed by a second spray 10-14 days later are recommended in orchards that have had a past history of severe OBLR fruit damage or if populations of overwintering larvae were high. <a href="#">Pesticide information</a>





# Tree Fruit IPM

Created and Maintained by the PMEP Group

[Home](#)[Weather Pest Models](#)[Pesticide Decision System](#)[Related Resources](#)

## Pesticides for Obliquebanded leafroller

Every effort has been made to provide correct, complete, and up-to- date pest information. Searches for multiple pests may this occurs, narrow your pest selection and search again to find suitable material(s).

### Growth Stage:

Additional Summer Sprays

Note: "Remarks" Field Changes depending on Growth Stage

### Program Type:

☒ All Labeled

Pesticides

☐ Conventional

☐ Organic

☐ Non-OP

☐ Reduced-Risk

### Pest Pressure: AM: CM/OFM: PC: Aph: GFW: LH: OBLR: RAA: RBLR: SJS: STLM: TPB:

None: ☒

Moderate: ☐

High: ☐

### Key:

AM - Apple Maggot

FB - Fire Blight

AS - Apple Scab

CM - Codling Moth

PC - Plum Curculio

Aph - Green Aphids

GFW - Green fruitworms

LH - Leafhoppers

OBLR - Obliquebanded leafroller

RAA - Rosy Apple Aphid

RBLR - Redbanded Leafroller

SJS - San Jose Scale

STLM - Spotted Tentiform Leafminer

TPB - Tarnished Plant Bug

**Common Name:** Bacillus thuringiensis  
(B.t.) [Details](#)

**Trade Name:** Agree 3.8WS

**Amount Per Acre:** 1.0-2.0 lb

**REI:** 4 Hours

**PHI:** 0 Days

**EPA Registration Number:** 70051-47

**Pesticide Type:** Insecticide

**Remarks:**

Recommended period for control of codling moth, lesser appleworm, obliquebanded leafroller [For Bt products, greater efficacy against summer brood larvae has been shown with 2-4 sprays at the low rate on a 7-day interval, starting 10-12 days after first adult catch], oriental fruit moth, redbanded leafroller.

**Effect on Beneficials:**

Name	Toxicity
Amblyseius fallacis	L
Aphidoletes aphidimyza	L
Typhlodromus pyri	L
Stethorus punctum	L

**L - Low Toxicity**

**M - Moderate Toxicity**

**H - Highly Toxicity**

**Common Name:** Bacillus thuringiensis  
(B.t.) [Details](#)

**Trade Name:** Biobit XL 2.1FC

**Amount Per Acre:** 2.0-7.0 pt

**REI:** 4 Hours

**PHI:** 0 Days

**EPA Registration Number:** 73049-46

**Pesticide Type:** Insecticide

**Remarks:**

Recommended period for control of codling moth, lesser appleworm, obliquebanded leafroller [For Bt products, greater efficacy against summer brood larvae has been shown with 2-4 sprays at the low rate on a 7-day interval, starting 10-12 days after first adult catch], oriental fruit moth, redbanded leafroller, Sparganothis fruitworm, variegated leafroller.

**Effect on Beneficials:**

Name	Toxicity
Amblyseius fallacis	L
Aphidoletes aphidimyza	L
Typhlodromus pyri	L
Stethorus punctum	L

**L - Low Toxicity**

**M - Moderate Toxicity**

**H - Highly Toxicity**

**Common Name:** spinosad [Details](#)

**Trade Name:** Entrust 80WP

**Amount Per Acre:** 1.5-3.0 oz

**REI:** 4 Hours

**PHI:** 7 Days

**EPA Registration Number:**  
62719-282

**Pesticide Type:** Insecticide

**Remarks:**

Recommended period for control of codling moth, obliquebanded leafroller.

**Effect on Beneficials:**

Name	Toxicity
Amblyseius fallacis	L
Aphidoletes aphidimyza	L
Typhlodromus pyri	L
Stethorus punctum	L

**L - Low Toxicity**

**M - Moderate Toxicity**

**H - Highly Toxicity**



# Tree Fruit IPM

Created and Maintained by the PMEP Group

[Home](#)[Weather Pest Models](#)[Pesticide Decision System](#)[Related Resources](#)

## Pesticide

**Trade Name:** Entrust 80WP

### Basic Information

**Common Name:** spinosad

**Pesticide Type:** Insecticide

**EPA Registration Number:** 62719-282

### Chemical Information

**Chemical Class:** antibiotic

**Amount Per Acre:** 1.5-3.0 oz

**Amount Per 100:** 0.5-1.0 oz

**REI:** 4 Hours

**PHI:** 7 Days

**Restricted Use:** § Potentially acceptable in certified organic programs



## Labels

### NYS PIMS Labels:

[508544](#)

[515186](#)

## Notes

### Notes:

Spinosad (SpinTor, §Entrust) is a mixture of spinosyn A and spinosyn D molecules, a naturally derived group of toxicants from a species of Actinomycete bacteria. Spinosad, which acts as both a contact and a stomach poison, is available for use in apples, pears and stone fruits, primarily against obliquebanded leafroller, although activity against spotted tentiform leafminer is also exhibited. Spinosad is essentially nontoxic to birds, fish, aquatic invertebrates, and most beneficials. It has a low bee-poisoning hazard.

## Insecticide

IRAC ([Insecticide Resistance Action Committees](#)): 5

**Toxicity To Bees:** Low

**Insecticide Type:** Organic, Non-OP, Reduced-Risk

## For Use on Apples

### Pests

Name	Type	Efficacy
Codling Moth	InsectsAndMites	Moderate
Apple Maggot	InsectsAndMites	Moderate
Spotted Tentiform Leafminer	InsectsAndMites	Moderate
Green fruitworms	InsectsAndMites	High
Obliquebanded leafroller	InsectsAndMites	High
Redbanded Leafroller	InsectsAndMites	High

# Specimen Label



## Naturalyte<sup>®</sup> Insect Control

®Trademark of Dow AgroSciences LLC

A Naturalyte<sup>®</sup> insect control product formulated for control of lepidopterous larvae (worms or caterpillars), leafminers, thrips, and red imported fire ants.

Group	5	INSECTICIDE
-------	---	-------------

Active Ingredient:

spinosad

(a mixture of spinosyn A  
and spinosyn D) .....

80%

Other Ingredients .....

20%

Total .....

100%

Contains 80% active ingredient on a weight basis.

EPA Reg. No. 62719-282



### Mixers/loaders must wear:

- An approved dust/mist filtering respirator (NSHA/NIOSH approval number prefix TC-21C), or NIOSH approved respirator with any N, R, P or HE filter.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

### User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

### First Aid

**If in eyes:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-992-5994 for emergency medical treatment information.

### Environmental Hazards

This product is toxic to bees exposed to treatment for 3 hours following treatment. Do not apply this pesticide to blooming, pollen-shedding or nectar-producing parts of plants if bees may forage on the plants during this time period. This product is toxic to aquatic invertebrates. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. Do not apply where runoff is likely to occur. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Apply this product only as specified on the label.

### Directions for Use

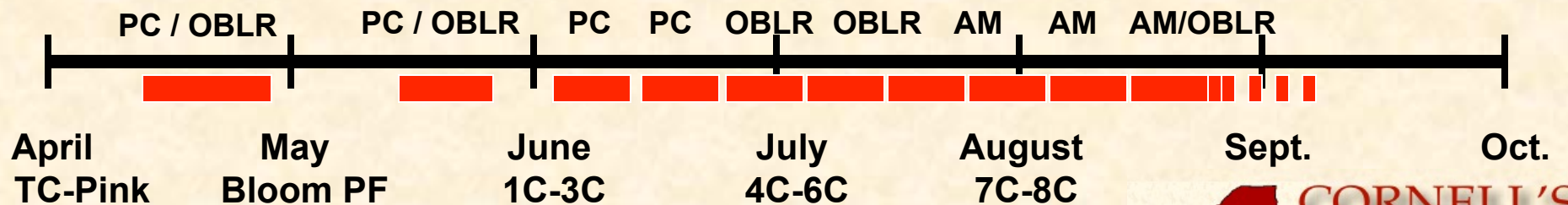
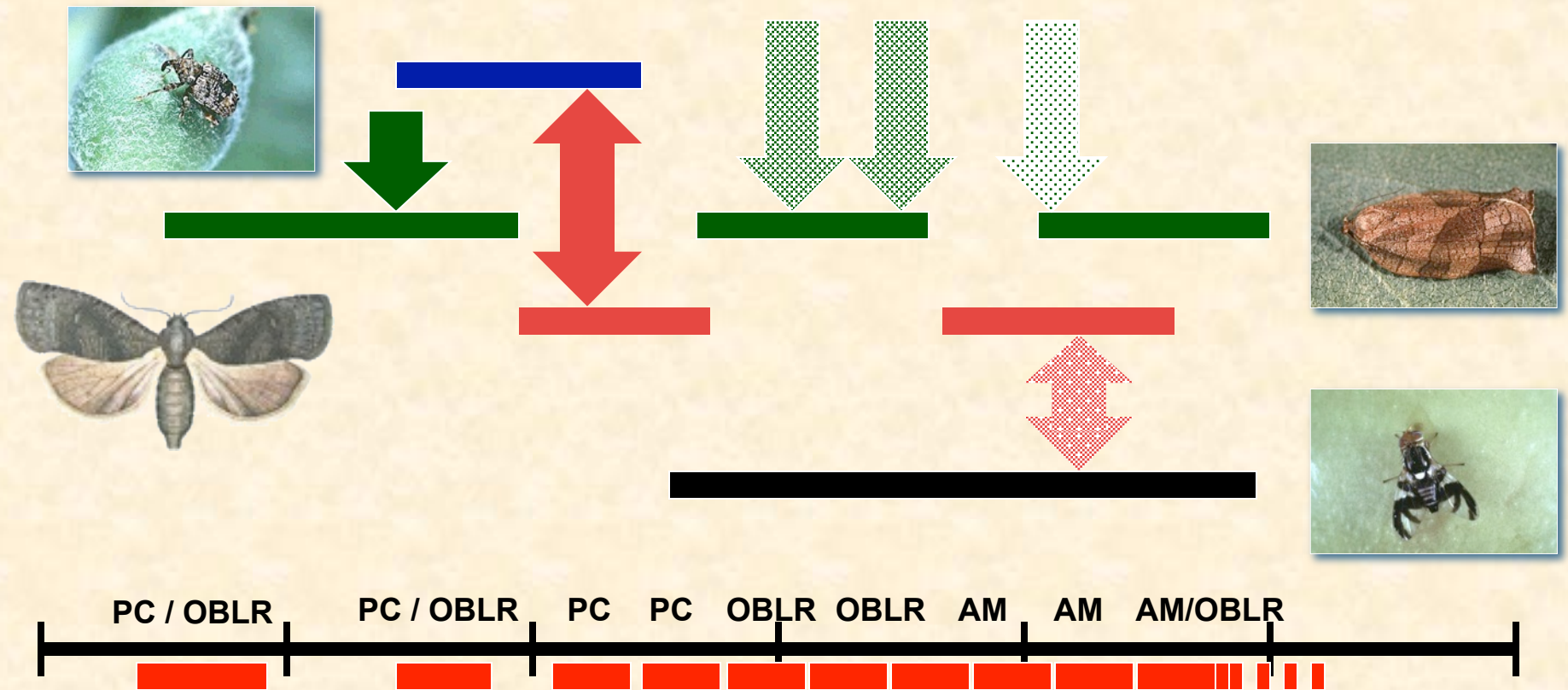
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read all Directions for Use carefully before applying.

# Use Insecticides with efficacy to manage:

## Active Ingredient (AI) Rotational Strategies For Resistant Mgt.

### Different IRAC Group For Each Generation

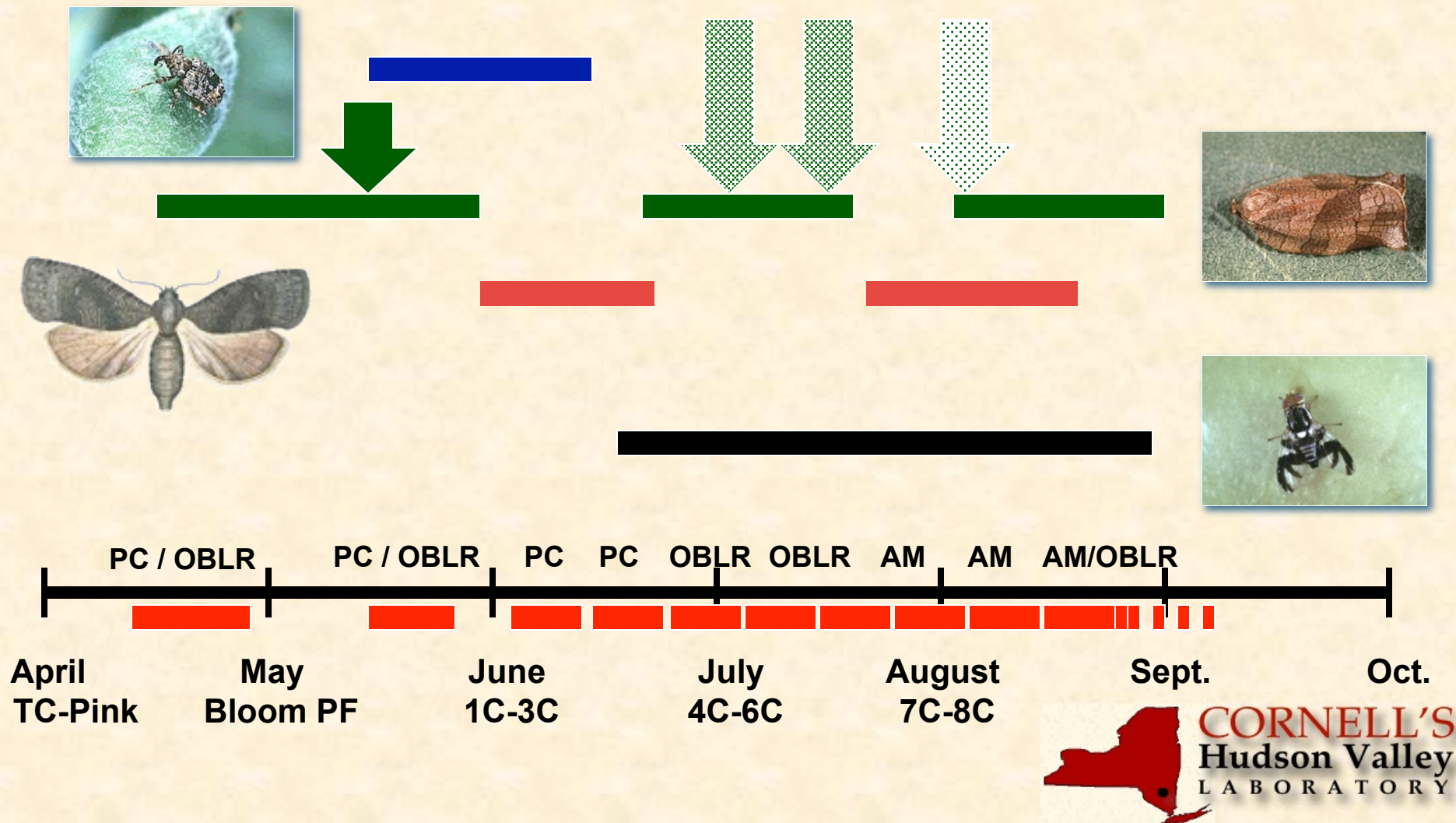




# Use Insecticides with efficacy to manage:

## Active Ingredient (AI) Rotational Strategies For Resistant Mgt.

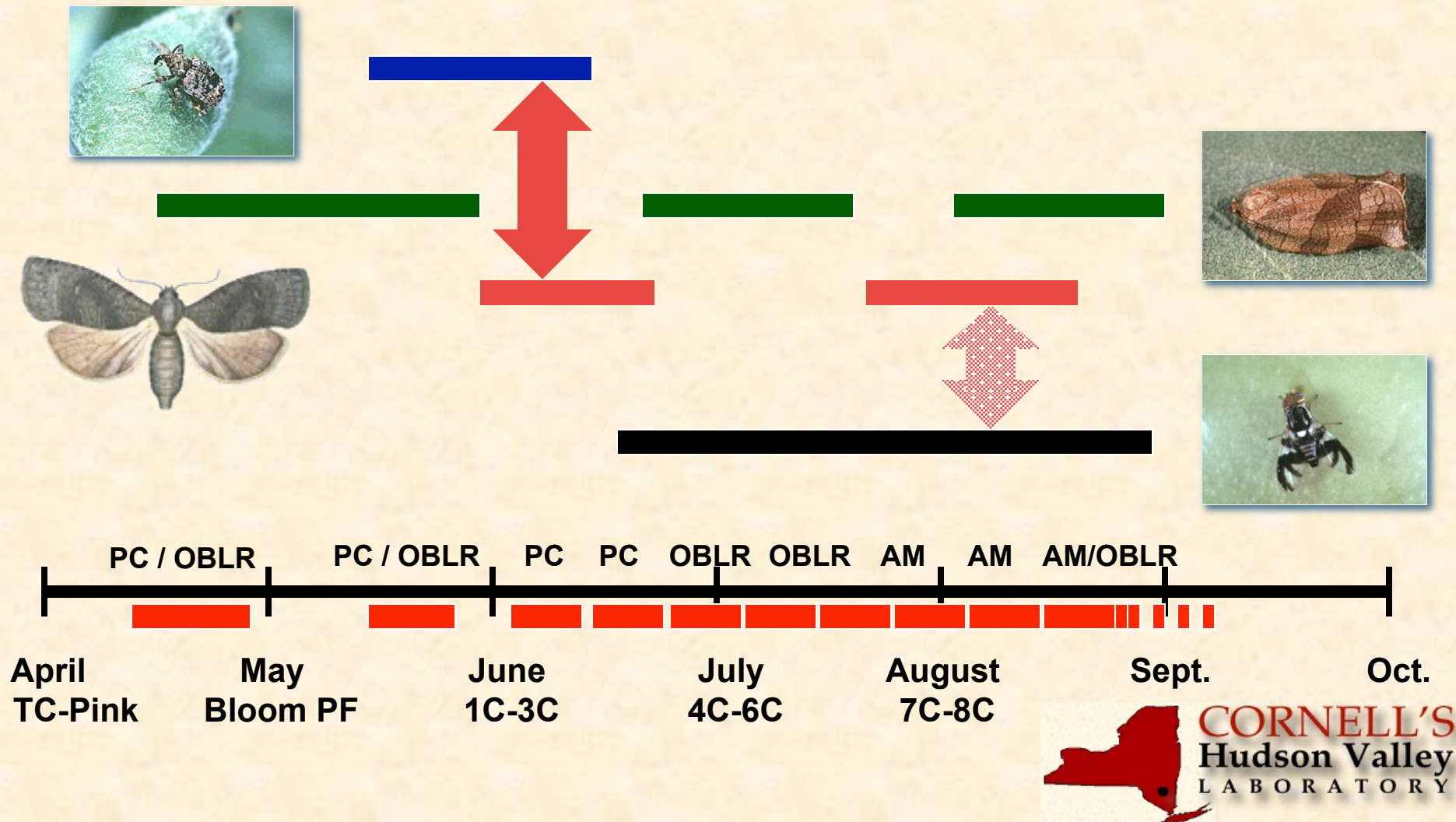
### For OBLR: 3 Different IRAC Groups



# Use Insecticides with efficacy to manage:

## Active Ingredient (AI) Rotational Strategies For Resistant Mgt.

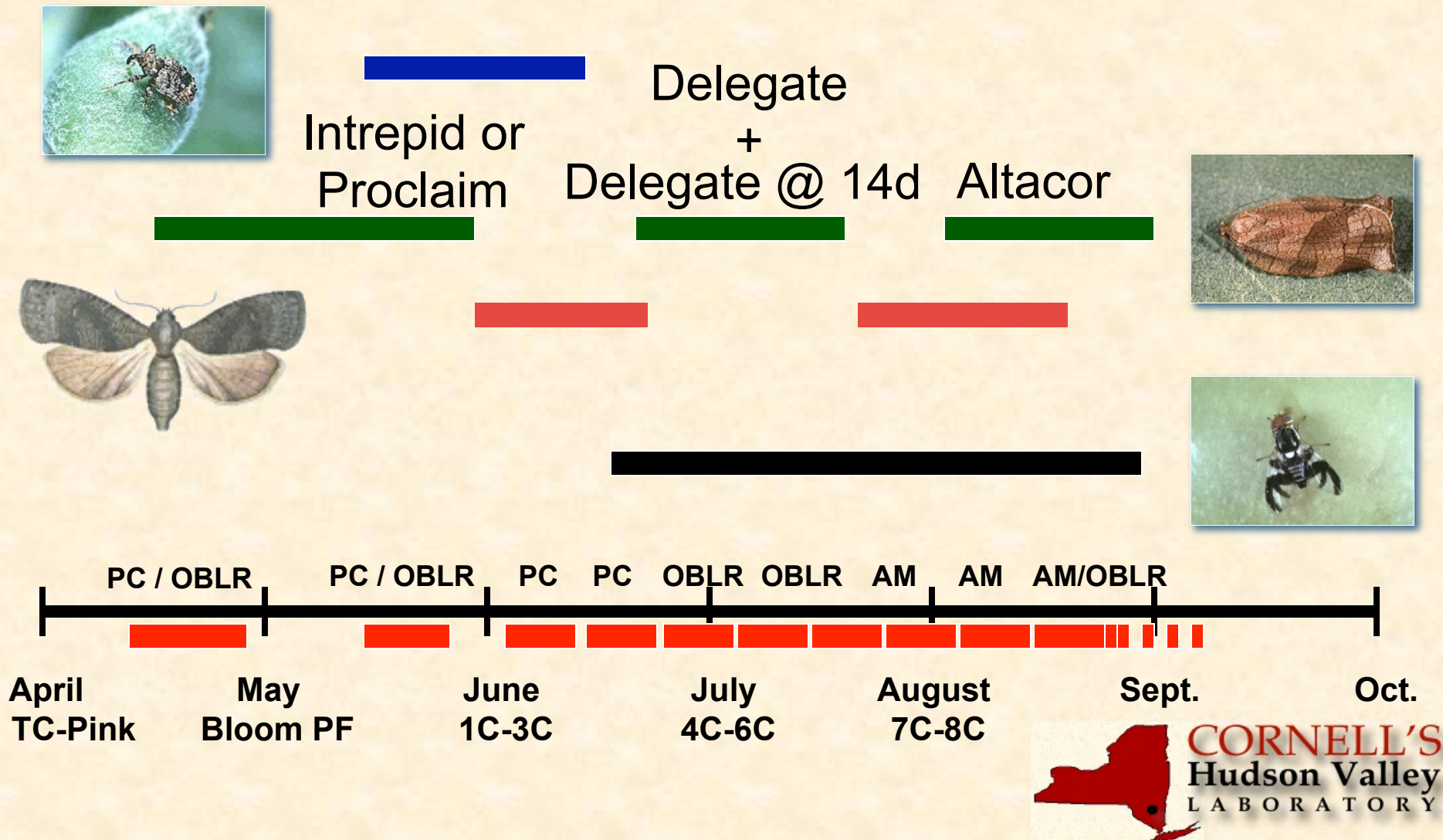
### For CM: 2 Different IRAC Groups



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## Active Ingredient (AI) Rotational Strategies For Resistant Mgt.

### For OBLR: 3 Different IRAC Groups

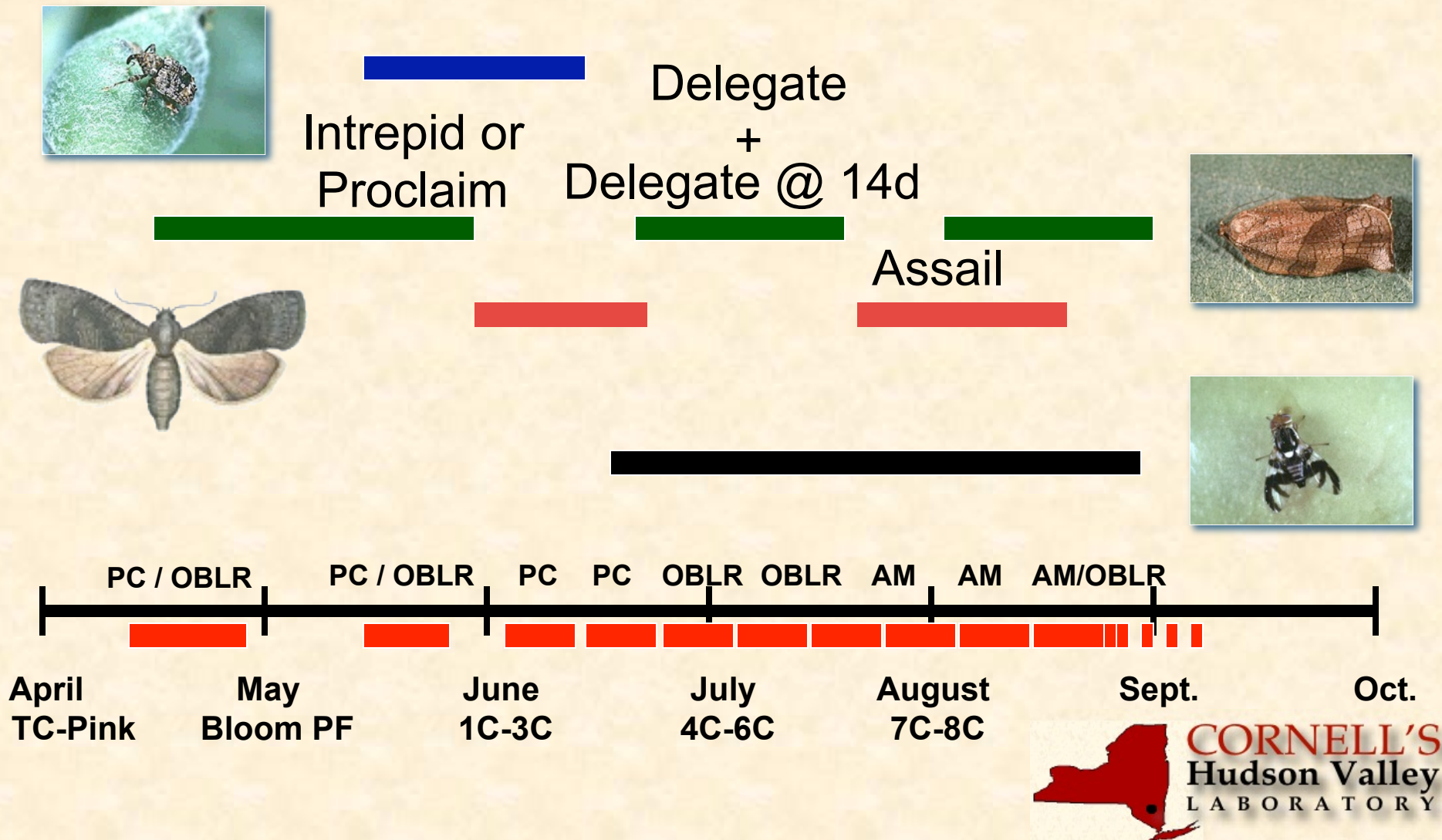




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## Active Ingredient (AI) Rotational Strategies For Resistant Mgt.

### For OBLR: 3 Different IRAC Groups



# Thank You...Questions??

