HOLISTIC IPM - INSECTS

3 Feb 2022

CiderCon – Richmond, VA

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What is an Insect Pest?

Pests are organisms that damage or interfere with desirable plants in our fields and orchards, landscapes, or wildlands, or damage homes or other structures.

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What is IPM?

- *IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties.* – UCANR

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A Brief History of IPM

- **470 B.C.** - Democritus, cited by Pliny, controls a blight by sprinkling plants with amurca (liquid olive oil waste).
- **300 A.D.** - First recorded use of biological controls in citrus orchards to control caterpillar and beetle pests in China. Colonies of the predatory ants (*Oecophylla smaragdina*) are set up in citrus groves with bamboo bridges, so they could move between trees.
- **1870-1890** - Grape phylloxera and powdery mildew controlled in French wine country through the introduction of Bordeaux mixture, Paris Green, use of resistant root stocks, and grafting.
- **1940** - Use of milky disease to control Japanese beetle (first successful direct use of an insect pathogen for control).
- **1950s-1970s** - Widespread development of resistance to DDT and other pesticides
- **1950s -** First applications of systems analysis to crop pest control
- **1959** - Introduction of concepts of economic thresholds, economic injury levels, and integrated control
- **1960** - First Bacillus thuringiensis (Bt) product registered
- **1962** - Rachel Carson's Silent Spring
- **1980s** - And we're off……..

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WHAT IS HOLISTIC ORCHARD IPM?

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A holistic IPM program is simply good observational science. The fact is that if you don't get out into the orchard and become one with the trees, plants, insects, and the soils, then you'll miss the most important stuff.

A holistic IPM program is an integral part of successful biological agriculture.

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Holistic IPM is about fully embracing the art and science of Integrated Pest Management (IPM) and applying it in a way that values the ecological and biological as well as the economic and social.

It is not about a specific practice or objective. It is about embracing the wholeness of nature.

Without a healthy environment we can't grow healthy food, improving our own health and well-being at the same time.

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The Basic Tenets of IPM

- Pest Identification
- Monitor Population Numbers and Damage
- Management Thresholds
- Prevent Damage
- Combination of Approaches Deployed
- Assessment of Management

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Pest ID

- **Phenology**
  - *Many insects are very closely related in appearance*
- **Life Stages**
  - *Egg, Larvae, Pupae, Adult, Nymphs, Instars*
  - *Not all life stages cause damage but are still important to management.*
- **Life Cycles**
  - *Overwinter, Emergence, Mating, Maturation, Generations*
- **Damage**
  - *Primary vs Secondary Damage, Cosmetic vs Destructive*

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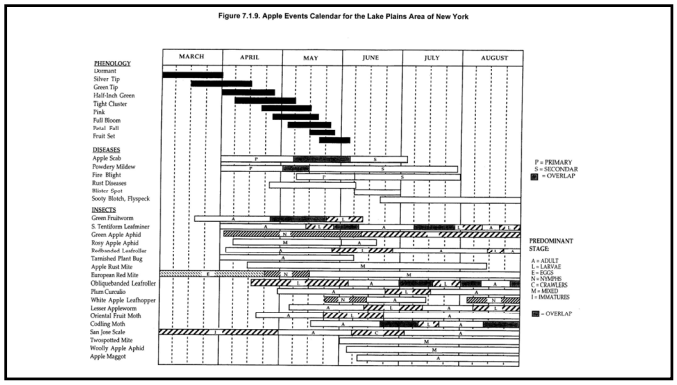

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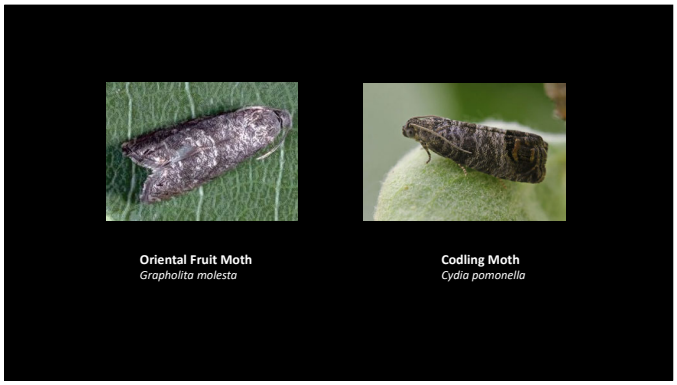

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MONITOR

- **Observation**
  - *Physical Scouting*
  - *Technology - drones*
  - *Take Good Notes*
- **Capture**
  - *Sticky Cards*
  - *Pheromone Traps*
  - *Attractants (not pheromones)*
  - *Sweeps*
- **Models**
  - *NEWA*
  - *RIMpro*

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THRESHOLDS

- **Economic**
  - *Pest levels where damage begins to inflict real economic loss*
- **Management**
  - *Pest levels where management options, usually reactive, come into play but often before there is economic damage*

"The mere presence of a pest or pest damage is not an indication that treatment is needed or that disaster is imminent."

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PREVENTION

- **Proactive**
  - *Management options that utilize biological, cultural, mechanical, or chemical controls to prevent or limit crop plant damage.*
  - *Reducing or Eliminating a Pest Threat before presence or damage occurs.*
- **Reactive**
  - *Management options that are largely "after the fact" sprays where issues have manifested into economic damage or crop destruction.*

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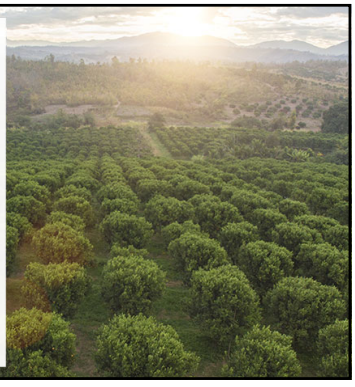
Technology

- ***Aerial Perspective***
  - *Images*
- ***Specialized Uses***
  - *Identify stresses*
- ***Practical applications***
  - *Pollination, sprays, pheromones*
- ***Computer Models***
  - *NEWA*
  - *RIMpro*



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ASSESSMENT

Did my IPM tool actually work?

- *Did it reduce the pest populations below* economic thresholds?
- *Did I eliminate the pest?*
- *What's the likelihood it'll resurge in the near future?*
- *Do I need to treat again?*

"A big part of IPM is the revisiting of observations, assessments, and treatments. Just as pest presence doesn't necessarily indicate a need for treatment, likewise it doesn't mean that it should be ignored."

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PRACTICAL APPLICATION

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TOOLS

- Orchard Scouting
- Weather station data
- Pheromone traps monitoring
- Pest modeling
  - *NEWA*
  - *RIMpro*
- Biological control
  - *Biologicals*
  - *Beneficial Insects and Microorganisms*
  - *Indigenous Microbes*
- Mating disruption
- Resistant varieties
- Management of surrounding habitat
- Sanitation
- Management of plant stress
- Soil health
  - Optimal Nutrition
  - Precision Irrigation

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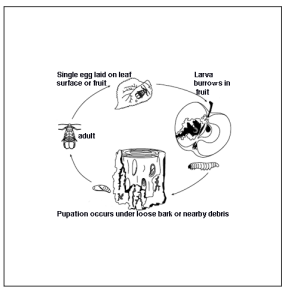

BIOFIXES

A biological event or indicator of a developmental event, usually in the life of an insect pest, that initiates the beginning of growing-degree-day calculations.

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DEGREE DAY CALCULATIONS

- **Base Degree** – depends on the insect or disease pest
- **Simple** – Easy to calculate.
  - *Degree Days(DD) = Average daily temp. -Base Temp. = (max. + min.) / 2 - Base temp*
- **Baskerville Ermin** – Fits a curve to the maximum and minimum temperature.
  - *Simulate how the temperature varies, then calculates the area of the curve above the base temperature using calculus.*

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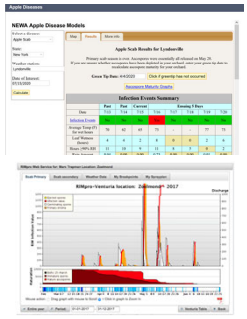

PREDICTIVE MODELING

- NEWA
- RIMpro
- Mills Chart
- Maryblight
- Cougarblight

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Common Apple Pests

- European Red Mite
- Aphids – RAA, GAA, WAA
- Oriental Fruit Moth
- European Apple SAwfly
- Plum Curculio
- Codling Moth
- Obliquebanded Leafroller
- Dogwood Borer

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European Red Mite (*Panonychus ulmi*)

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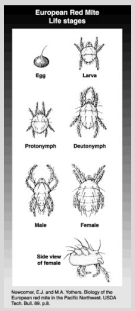

- Eggs overwinters on twigs and branches. Eggs hatch in early spring. Multiple generations per year
- Thrives in hot, dry conditions
- Certain apple varieties are more susceptible
- **Damage:** bronzing of leaves, reduced Pn
- **Natural Enemies:** The impact of beneficial predatory mites *N. fallacis, T. pyri, and Zetzellia mali* on phytophagous mite population.
- **Monitoring and Action Thresholds**
  - 2.5, 5.0. 7.5 mites per leaf
- **Control**
  - Oil sprays
  - Miticides
  - Natural Enemies

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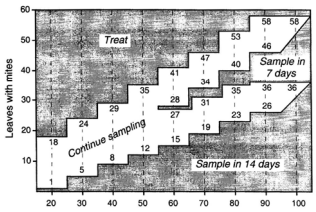
Figure 7.1.4. Mite Sampling Chart – Threshold = 2.5 mites/leaf (June 1-30)



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Aphids


Green ↑


Rosy ↓


Wooly ↑

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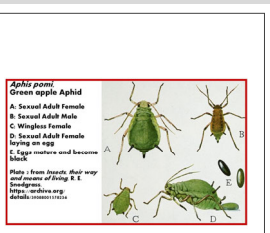

- Emerge in early spring. Multiple generations per year
- Thrives in moister, cool conditions
- Certain apple varieties are more susceptible
- **Damage:** sap sucker, viral transmission
- **Natural Enemies:** The impact of beneficial species like lacewings and ladybird beetle larvae (GAA) and *Syrphidae Heringia calcarata* and the nematode *Steinernema carpocapsae* Weiser
- **Monitoring and Action Thresholds**
  - Currently, treatment is recommended if 30% of the terminals are infested with either species of aphid, or 50% terminal infestation and less than 20% of the terminals with predators.

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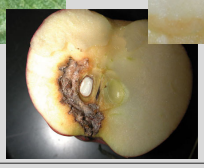
Oriental Fruit Moth (*Grapholita molesta*)





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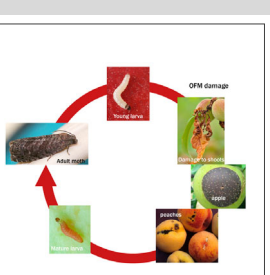

- Emerge in early spring as larva
- 3-4 generations per year
- **Damage:** bore into developing fruit spurs and fruit. Similar to codling moth
- The braconid wasp *Macrocentrus ancylivorus*, which is native to North America, is a leafroller parasite that has adapted to the oriental fruit moth.
- **Monitoring and Action Thresholds**
  - Pheromone traps
- **Control**
  - Mating disruption
  - Bt and insecticides

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European Apple Sawfly (*Hoplocampa testudinea*)



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- This pest overwinters as mature larvae. Larvae pupate in the spring and adults emerge during pink. The female begins egg laying just after the king flower opens.
- Single generation per year
- **Damage:** female lays eggs in flowers, larva tunnels into fruit.
- **Natural Enemies:** None. Probably some analogous to European counterparts
- **Monitoring and Action Thresholds**
  - White sticky cards
  - No action thresholds
- **Control**
  - Surround
  - Insecticides

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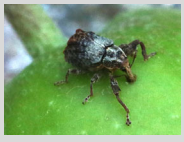
Plum Curculio (*Conotrachelus nenuphar*)



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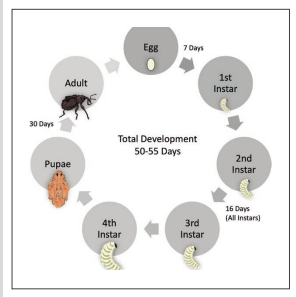

- Plum curculio emerges in the spring when the first nighttime temps are >60F and day time temps in the 70s
- Single generation per year
- **Damage:** female lays eggs in fruit, larva tunnels into fruit.
- **Natural Enemies:** chickens
- **Monitoring and Action Thresholds**
  - None
  - There are traps but are unreliable
- **Control**
  - Surround
  - Insecticides
  - Chickens

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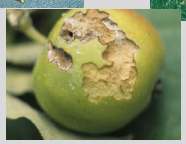
Obliquebanded Leafroller

(*Choristoneura rosaceana*)





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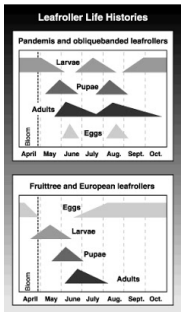

- Emerges as larva
- 2-3 generations per year
- **Damage:** roll inside leaves and feed on tissue and fruit surfaces
- **Natural Enemies:** Leafrollers have many natural enemies. Several species of parasitic wasps and a parasitic fly attack leafroller larvae. Most of these parasitoids have larvae that develop inside the leafroller larvae, existing only to pupate.
- **Monitoring and Action Thresholds**
  - Pheromone trapping
  - 3% infested thresholds
- **Control**
  - Bt

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CODLING MOTH

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Managing Codling Moth

- Historical Damage
- Understand biology and ecology
- Pheromone Trapping
- Predictive Models
- Acceptable levels of damage

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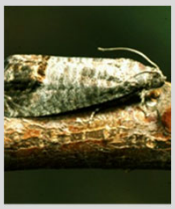
Codling Moth (*Cydia pomonella*)

- CM are introduced and effect a wide range of plant species including; apple, pear, quince, hawthorne, crabapple, and walnut.
- 1.5 to 3.5 generations annually and is a major pest in Western and Eastern U.S.
- The first flight for CM occurs as apples bloom (~May 3) with second and possible third flights or generations begin in early to mid-July and mid-August. CM only cause damage to fruit and will take a bite or two of a fruit causing an injury known as a "sting."



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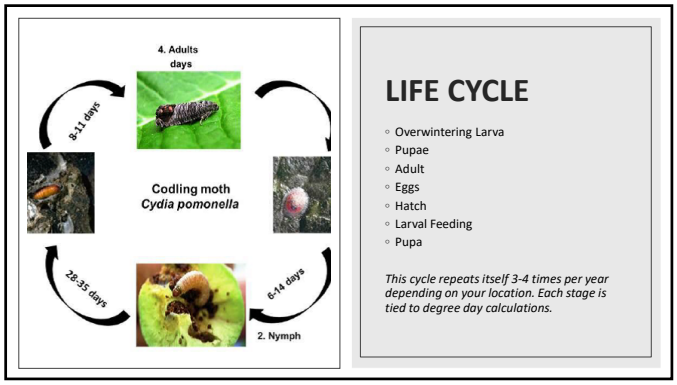

LIFE CYCLE

- Overwintering Larva
- Pupae
- Adult
- Eggs
- Hatch
- Larval Feeding
- Pupa

This cycle repeats itself 3-4 times per year depending on your location. Each stage is tied to degree day calculations.

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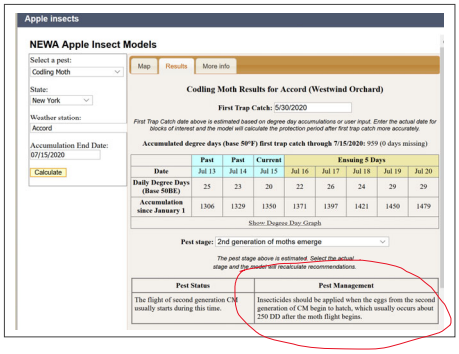
NEWA

- First Trap Catch
- Base Degree Day
- Forecast DD Accumulation
- Pest Stage
- Pest Status
- Pest Management



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CONTROL STRATEGIES

- Resistant Varieties
- Orchard Sanitation
- Cultural
- Nutrition
- Mating Disruption
- Protective Sprays

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				Pests of Concern		Sprays					
#	Stage of Growth	Degree Days	Approx Date	Diseases	Insects	Fungicides	Insecticides	Nutrition	Thinning	Biodynamic*	Notes
1	Dormant			none	mites, scale	none	none	none	none		
2	Delayed Dormant		20-Mar	none	mites, scale	copper (NuCop)	dormant oil	none	none	500	
Pear Psylla egg laying (84 DD 43F)											
3	Silver Tip	95	1-Apr	none	mites, scale	copper (NuCop)	dormant oil	none	none	BC	
4	Greentip		4-Apr	scab	none	copper (NuCop or Cueva)	dormant oil	none	none	BC, 501	
5	Quarter inch green		11-Apr	scab	OBLR	Double Nickel, Cueva, Thymeguard	Bt (DiPel)	SeaCrop, SeaShield, Micropak	none	Seq Spray (dry)	
6	Half Inch Green	160	18-Apr	scab	OBLR	Double Nickel, Cueva, Thymeguard	Bt (DiPel)	SeaShield, Micropak, SeaStim	none	505, 508	Bt apps depend on presence of OFM, GM, OBLR
7	Tight Cluster	228	25-Apr	scab	OBLR	Double Nickel, Cueva, Thymeguard or Sulfur (as	Entrust, Surround, Venerate	SeaShield, Micropak, SeaStim	none	505, 508	
OFM - traps out 289 DD (43F)											
8	Pink	289	1-May	scab, CAR	PC, EAS, TPB, leps	Double Nickel, Cueva, Thymeguard or Sulfur (as	Entrust, Surround, Venerate	SeaCrop, Micropak, SeaStim	none	505, 508	
OFM - first catch 229 DD (45F)											
9	King Bloom		5-May	fireblight, scab, CAR, PM, BR	PC, EAS, TPB	DN, Cueva, Thymeguard or Blossom Protect	none	none	none	Seq Spray (dry), 507	
OBLR - overwintering generation sample, codling moth traps out (192 DD 50F)											
10	Full Bloom	378	10-May	fireblight, scab, CAR, PM, BR	EAS	DN, Cueva, Thymeguard, Blossom Protect	none	none	none	Seq Spray (dry)	**Need to pay special attention to blossom thinning needs. (Not addressed in this chart)**
11	10% Petal Fall		20-May	scab, CAR, PM	PC, TPB	DN, Cueva, Thymeguard, Blossom Protect	Surround/Entrust	none	Regalia + oil	BC	collect PC adults for peppers
12	50% Petal Fall		23-May	scab, CAR, PM	PC, TPB	DN, Regalia,	Bt/PyGanic	none	none	501 (for thinning)	collect PC adults for peppers
OFM 1st flight catch (369 DD 45F), codling moth 1st flight catch (249 DD 50F)											
12	90% Petal Fall	479	25-May	scab, CAR, PM	PC, TPB, EAS	DN, Cueva, Thymeguard	Surround/Entrust	none	Regalia + oil	BC	collect PC adults for peppers
Plum Curculio 1st oviposition (555 DD 43F), OBLR traps out (681 DD 43F)											
13	Fruit set (20mm)	681	1-Jun	CAR, PM	PC, CM, Aphids, mites	DN, Cueva, Thymeguard	Bt and/or PyGanic	calcium, SeaCrop, SeaStim, hydrolyzed fish	501		
Codling moth 1st flight peak (442 DD 50F), OBLR 1st adult catch (884 DD 43F), Dogwood borer 1st adult catch (964 DD 43F)											
14	1C	1032	15-Jun	PM, SBFS	PC, CM, Aphids, mites	DN, Cueva	Dipel, granulosis, grandevo, stylet oil, PF97	calcium, SeaCrop, SeaStim, hydrolyzed fish	none		275 LWH for 1st SBFS infections
15	2C		21-Jun	PM, SBFS	OBLR, CM, LH, Aphids, mites	DN, Cueva and/or sulfur	Dipel, granulosis, grandevo, stylet oil, PF97, AzaDirect	calcium, SeaCrop, SeaStim, hydrolyzed fish	hand touch up		
Apple Maggot Traps out, OFM 2nd flight starting (1180 DD 45F), OBLR 2nd gen sampling											
16	3C	1367	1-Jul	SBFS, fruit rots	OBLR, CM, LH, JB Aphids, mites	DN, Cueva	Dipel, grandevo, stylet oil, PF97, AzaDirect	calcium, SeaCrop, SeaStim	none		
Apple Maggot 1st adult catch 1509 DD 43F), OFM 2nd flight peak (1450 DD 45F)											
17	4C	1800	11-Jul	SBFS	OBLR, CM, LH, JB Aphids, mites	DN, Cueva	Dipel, PyGanic, Entrust, grandevo, stylet oil, PF97, AzaDirect	calcium, SeaCrop, SeaStim	none		
Codling Moth 2nd gen flight begins (1251 DD 50F)											
18	5C		21-Jul	SBFS	SBFS, AM, LH, JB, aphids, mites	DN, Cueva	Entrust or PyGanic	calcium, SeaCrop, SeaStim	none	501 or 505	
19	6C	2167	31-Jul	SBFS	SBFS, AM, LH, JB, aphids, mites	DN, Cueva	Dipel, granulosis, grandevo, stylet oil, PF97	calcium, SeaCrop, SeaStim	none		
Apple Maggot flight peak (2394 DD 43F), Codling Moth 2nd gen peak flight (1585 DD 50F), OBLR 2nd gen flight (2413 DD 43F), OFM 3rd gen flt (2275 DD 45F)											
20	7C	2450	10-Aug	SBFS	SBFS, AM, LH, JB, aphids, mites	DN, Cueva	Dipel, granulosis, grandevo, stylet oil, PF97	calcium, SeaCrop, SeaStim	none		
OFM 3rd flt peak (2625 DD 45F)											
21	8C	2715	20-Aug	SBFS	apple maggot, BMSB	DN, Cueva	Entrust, PyGanic, DiPel, Grandevo		none		
22	9C	2800	30-Aug	SBFS	CM, OFM	DN, Cueva	Grandevo		none		
23	Pre-Harvest		7-Sep	SBFS	CM, OFM	DN, Cueva	Grandevo		none		

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KNOW YOUR ROOTS UPDATES

- We are currently in the process of cataloging commercial biological sprays and updating our **Biointensive Spray Guidelines.**
- **Holistic Orchard Webinar Series** - 16 seminars, starting Feb 19. www.knowyouroots.com
- **Biodynamic Orcharding** – Josephine Porter Institute, Floyd, VA – March 12
- eNewsletter – available by subscription
- Volunteer, Inter, Employment, and Learning Opportunities. **Sign up today!**

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KNOW YOUR ROOTS

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