Back to Basics: Implementing IPM in Vermont Orchards

Integrated Pest Management (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. **Pesticides** are used only after **monitoring** indicates they are needed according to established guidelines, and treatments are made with the goal of removing only **the target organism**. Pest control materials are selected and applied in a manner that **minimizes risks** to human health, beneficial and nontarget organisms, and the environment.

http://www2.ipm.ucanr.edu/WhatIsIPM/

Undergraduate responses:

Explain IPM to a PYO customer standing in line with $50 of apples in one hand and holding their child's hands with the other

"Thank you for your concern! I would be happy to explain our pest management strategies to you. At our orchard, we use Integrated Pest Management, or IPM. What this means is that **we use an ecosystem-based strategy to aid in long-term prevention of pests**, with **chemicals as our very last resort**. Ideally, we would only **employ non-chemical controls** such as pruning, netting, and mulching, but often these tactics are not enough. When we do use chemicals, we apply them as infrequently and efficiently as possible, and **we do our very best to ensure that our pesticides only impact our trees and not the surrounding environment**. We monitor the disease susceptibility of our trees and **target pests during the most vulnerable part** of their life cycle in order to minimize pest control, and **we tolerate pests** that don't bring that much harm to the orchard. While we would love to never spray our trees, the way that industrial agriculture has evolved over time makes that relatively infeasible.


"DDT is good for me-e-e!"
The great expectations held for DDT have been realized. During 1946, exhaustive scientific tests have shown that, when properly used, DDT kills a host of destructive insect pests, and is a benefactor of all humanity.
Pennsalt produces DDT and its products in all standard forms and is now one of the country's largest producers of this amazing insecticide. Today, everyone can enjoy added comfort, health and safety through the insect-killing powers of Pennsalt DDT products
GOOD FOR STEERS
GOOD FOR THE HOME
GOOD FOR FRUITS
GOOD FOR ROW CROPS
PENN SALT
CHEMICALS
PENNSYLVANIA SALT MANUFACTURING COMPANY
WIDENER BUILDING, PHILADELPHIA 7, PA.


Profit Stealer!
Cancel out Plum Curculio
with dieldrin
Plum curculio and other eat-facing insects cost growers millions of dollars worth of marketable fruit each season. You can protect your fruit profits by knocking out these pests with powerful dieldrin.
Dieldrin is the answer to the fruit growers' need for an economical plum curculio control. Its killing action is long lasting. Many days after application, it puts an end to eat-facing insects no matter how they contact it.
You can apply dieldrin as a spray during pre-bloom or post-bloom periods. For most effective results, check the recommendations of state and federal authorities for the use of dieldrin in your area.
This season, get bigger yields of top-quality fruit. Stop plum curculio and other eat-facing insects with dieldrin. Dieldrin is available under well-known brand names from your insecticide dealer. See him today.
SHELL CHEMICAL CORPORATION
AGRICULTURAL CHEMICAL SALES DIVISION
SHELL


Stauffer
CAPTAN
50-W
FUNGICIDE 406
the Exceptional New organic fungicide
for control of fruit diseases...
Better Disease Control
Improved Fruit Quality
Longer Storage Life
STAUFFER CHEMICAL


ASSAIL®
BELCHIM
CROP PROTECTION CANADA
TRUSTED
PROVEN
CONTROL
ASSAIL INSECTICIDE
ASSAIL is a PMRA and EPA designated, reduced-risk, broad spectrum insecticide that doesn't breakdown in sunlight, making it an excellent choice for foliar applications.
ASSAIL is locally systemic and translaminar, giving it the ability to move readily within the plant to protect all sides of the feeding surface from both sucking and chewing pests.

Quick IPM poll

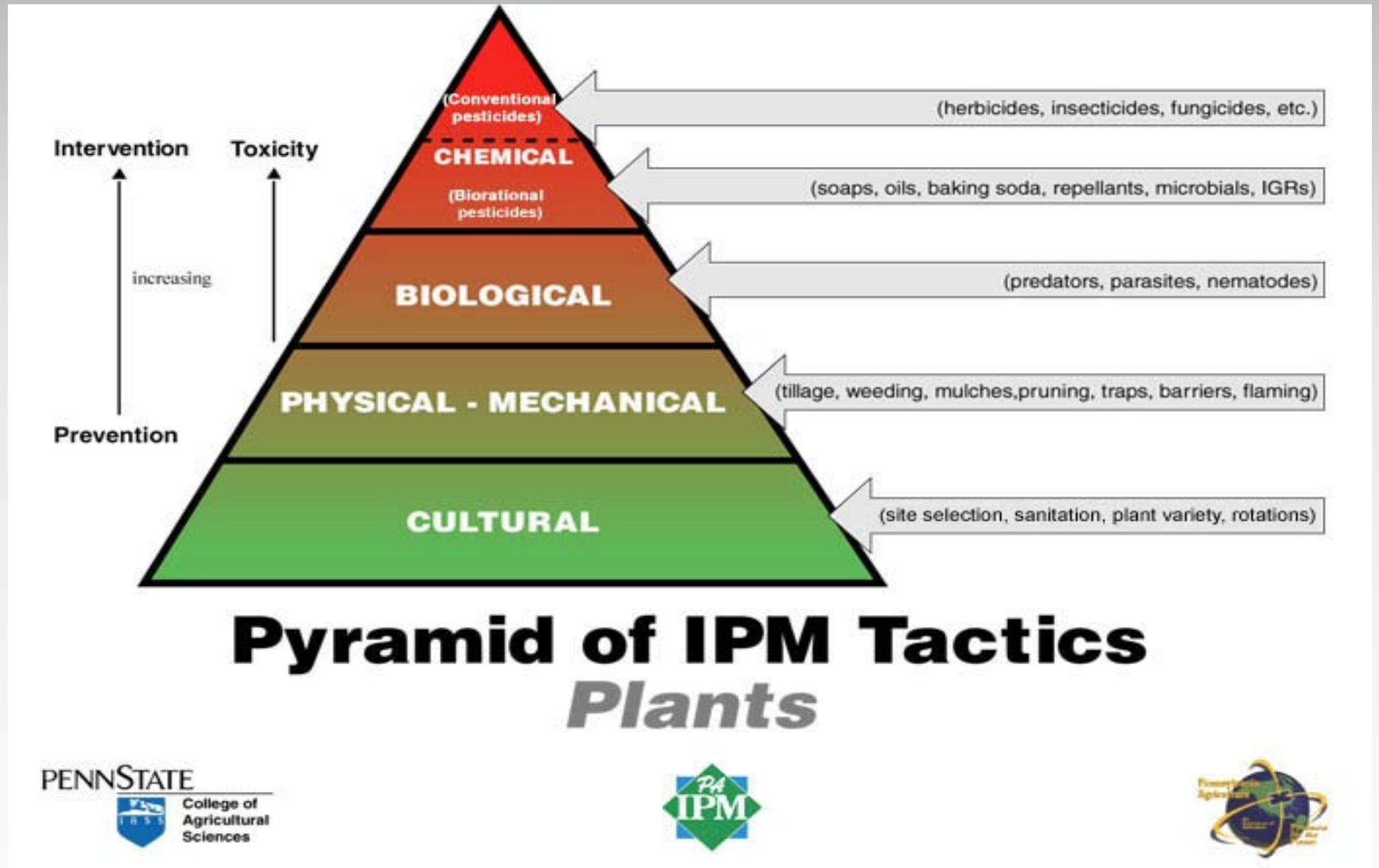
Do you use IPM in your orchard?

Please do not advance until the next set of questions comes up

Quick IPM poll

2. How *Intensive* is your use of IPM in your orchard?

- ◯ Don't use IPM
- ◯ The bare minimum- I use less toxic pesticides and try to spray less often
- ◯ I monitor pests and orchard activities and use online models (e.g. NEWA) to time every spray
- ◯ I have developed a diverse orchard system with a focus on tree health, resistant cultivars, predator insect conservation, and both grower and market tolerance for pest damage to reduce pesticide applications to the absolute last resort.



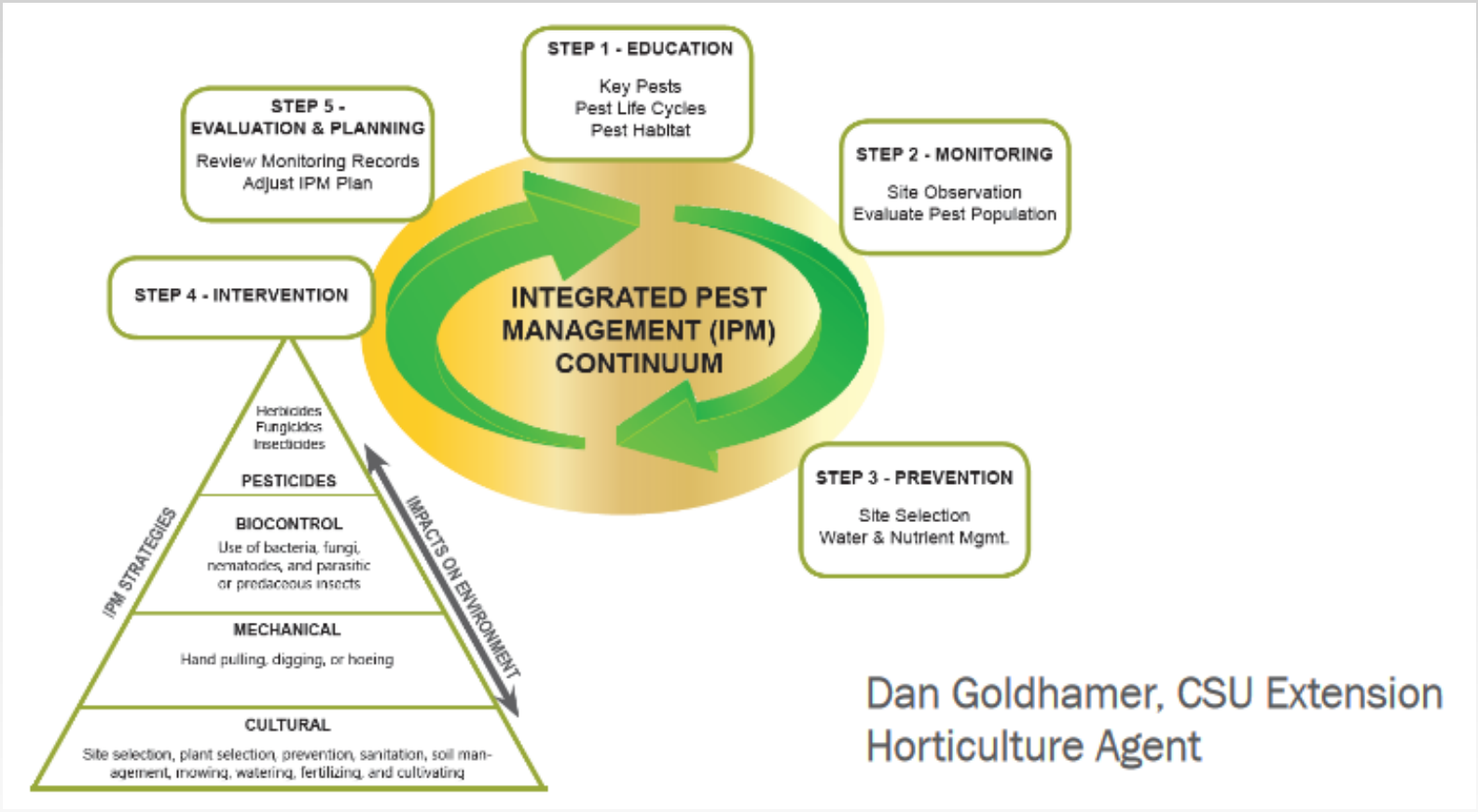
Pyramid of IPM Tactics

Plants

PENNSTATE College of Agricultural Sciences

PA IPM

The pyramid lies *within* a greater system



https://www.denvergov.org/files/assets/public/parks-and-recreation/documents/dpr-imp-bmp_presentation_1.pdf

Levels of Integration in IPM

- **Level 1 integration: Individual pest species or species complexes.**
- Level 2 integration: Community of pest species (insects, pathogens, weeds)
- Level 3 integration: Ecosystem (crop and non-crop host plants and other components)
- Level 4 integration: Farming community (including social and economic components)

Kogan M. Integrated pest management: historical perspectives and contemporary developments. Annual Review of Entomology. 1998;43(1):243–270. doi:10.1146/annurev.ento.43.1.243.

Bottrell DG, Schoenly KG. Integrated pest management for resource-limited farmers: challenges for achieving ecological, social and economic sustainability. Journal of Agricultural Science. 2018;156(3):408–426. doi:10.1017/S0021859618000473.

Level 1:

Monitoring or use of expert systems to plan pest management sprays

3. Do you methodically scout your orchard at least weekly for pests and diseases>

- ○ Yes
- ○ No

4. Do you regularly check NEWA or another real-time app to evaluate disease and pest models during the growing season?

- ○ Option 1
- ○ Option 2

NEWA Models:

Excellent application of first-level IPM

Infection Events Summary

Download CSV

Events: Dry Wet

Date (2019)	Infection Events	Average Temp (˚F) for wet hours	Leaf Wetness (hours)	Hours > 90% RH	Rain Amount
May 11	yes	44	2	0	0.01
May 12	no	-	0	0	0
May 13	no	45	4	2	0.19
May 14	no	42	15	10	0.28
May 15	no	46	7	4	0
May 16	combined	48	12	6	0.01
May 17	yes	48	6	4	0.19
May 18	no	-	0	0	0

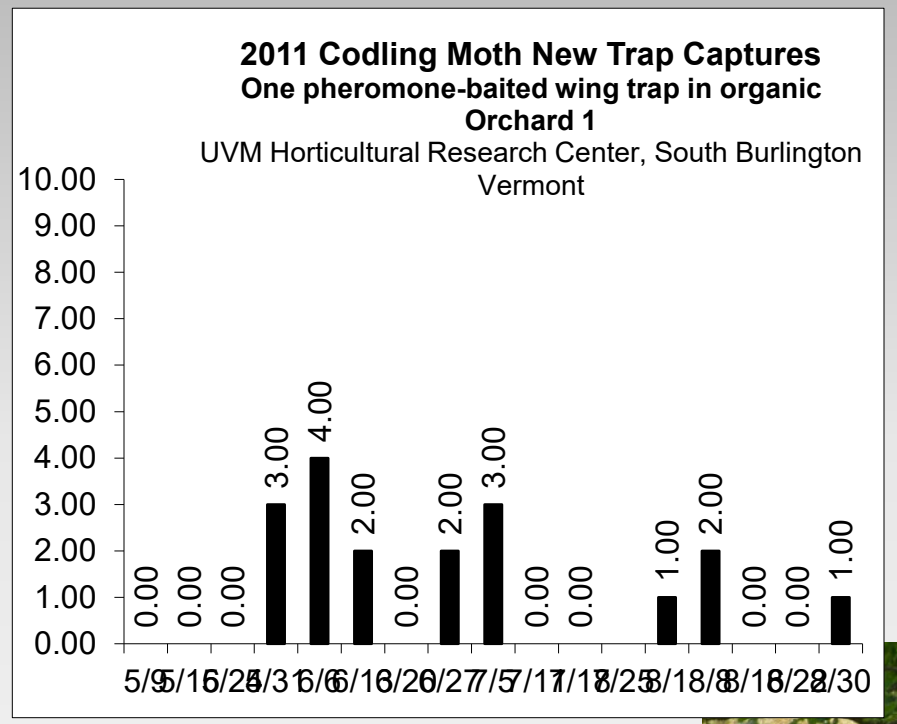
NEWA Models:

Excellent application of first-level IPM

DATE (2019)	Degree Days (base 50°F BE)		
	DAILY	FROM JAN 1	FROM JUN 15
June 29	23	662	270
June 30	17	679	287
July 1	**20**	**699**	**307**
July 2	25	724	332
July 3	24	748	356
July 4	26	774	382
July 5	27	800	409
July 6	26	826	435

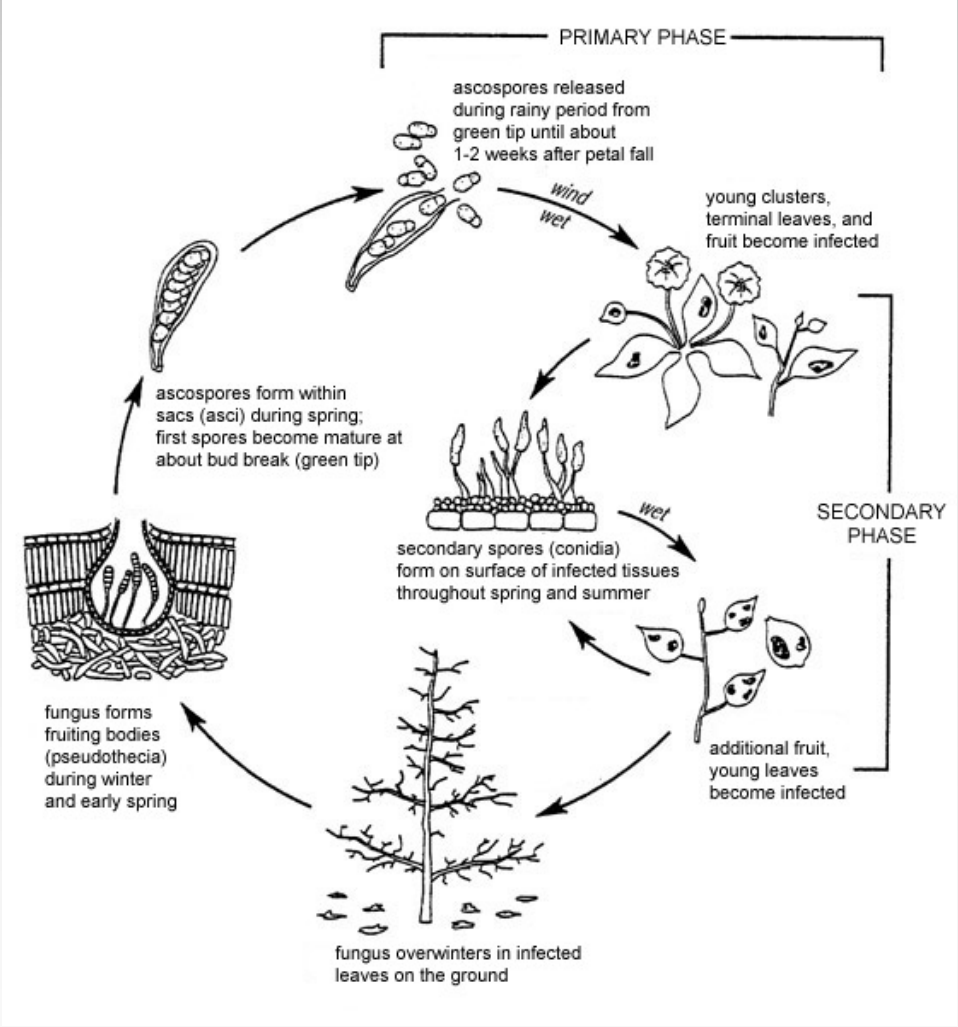
PEST STATUS	PEST MANAGEMENT
Adult flights are relatively heavy during this period and the majority of eggs are likely to hatch, so control is critical at this time.	Apply a second spray 10-14 days after the initial spray that was timed at first hatch, to provide protection during this critical time period. In high-pressure orchards, it may be particularly important to apply other classes of materials to replace organophosphates or synthetic pyrethroids.

…and monitoring makes it better



Apple Scab Biology

- Fungus overwinters in leaves from previous season
- Ascospores released in spring with rainfall
- Spores germinate with leaf wetness
- Scab lesions that develop on leaves produce secondary inoculum that spreads disease throughout season



Apple Scab, *Venturia inaequalis*

Lesions on leaves

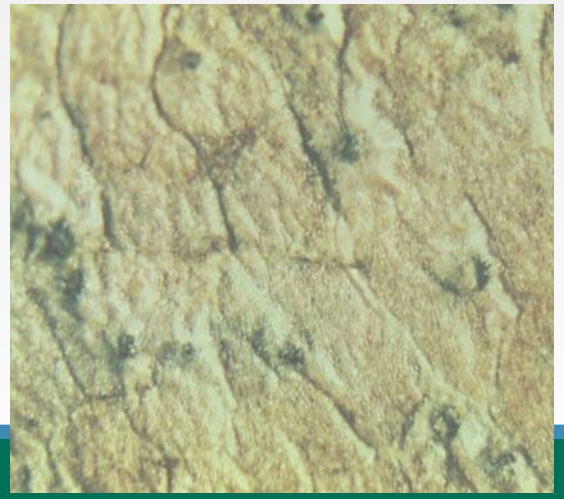
Sanitation to prevent ascospore development

Fungicide intervention

Secondary infections

Primary infections

Pseudothecia on leaf litter in spring



Ascospores

Ascospore Maturity

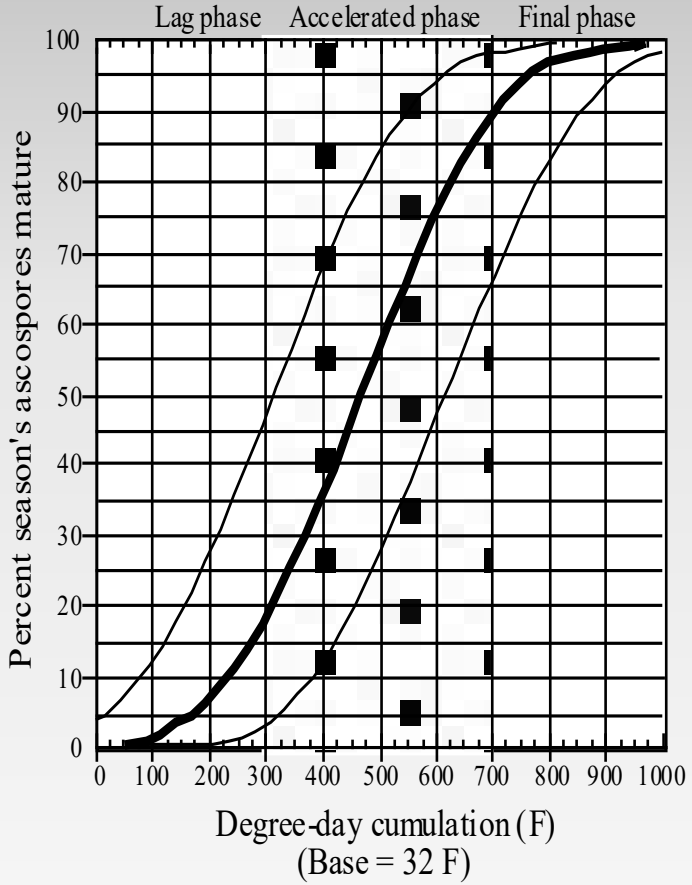


Table 6.2.2. Cumulative percentage of ascospores matured at various degree-day (base 32° F) accumulations.

Degree-days [1]	Cumulative ascospores matured (%)	90% Confidence interval for estimate [2]
35	1	0–7
110	3	0–14
145	5	1–19
215	10	2–32
325	25	7–55
450	50	21–80
575	75	46–94
685	90	69–98
740	95	79–99
790	97	86–100
865	99	93-100

[1] Degree-days should be recorded from the date when 50% of McIntosh fruit buds are between silver tip and green tip. The base temperature for degree-day accumulation is 32° F. Data of Gadoury & MacHardy, 1982.

[2] The width of the 90% confidence interval is a statistical measure of the precision of estimated maturity. It is the range within which the estimate should fall 90% of the time.

▬ Curve describing the relationship between the percentage of the season's ascospores that have matured and accumulated degree-days.

— The two curves that identify the upper and lower boundaries between which the model is accurate 90% of the time. The two curves show the variation in predicted maturity that can be expected at different times during the primary scab season.

▭ Accelerated phase of ascospore maturation.

NEWA Models:

Excellent application of first-level IPM

Infection Events Summary

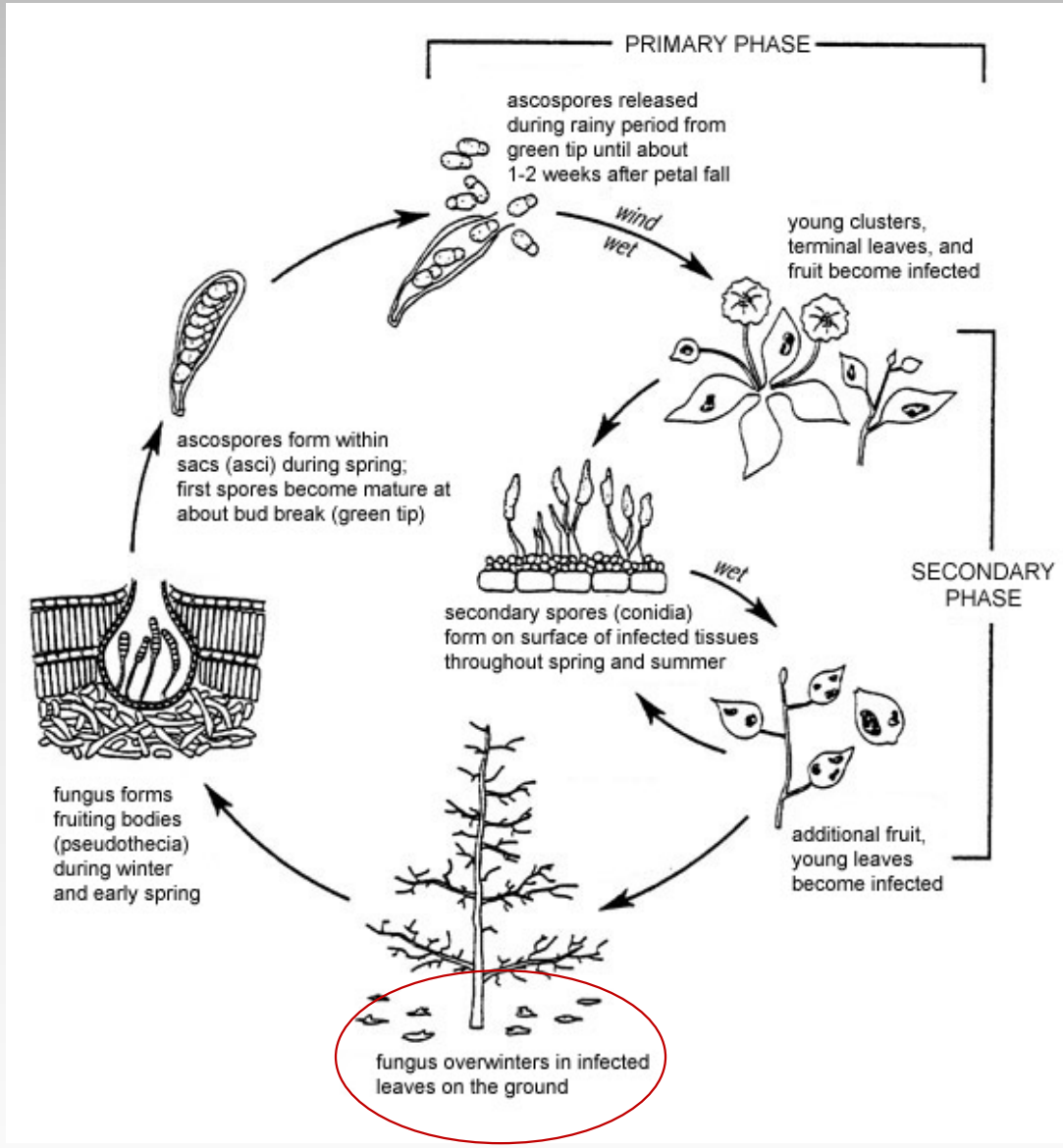
Download CSV

Events: Dry Wet

Date (2019)	Infection Events	Average Temp (˚F) for wet hours	Leaf Wetness (hours)	Hours > 90% RH	Rain Amount
May 11	yes	44	2	0	0.01
May 12	no	-	0	0	0
May 13	no	45	4	2	0.19
May 14	no	42	15	10	0.28
May 15	no	46	7	4	0
May 16	combined	48	12	6	0.01
May 17	yes	48	6	4	0.19
May 18	no	-	0	0	0

Apple Scab Biology

- **Fungus overwinters in leaves from previous season**
- Ascospores released in spring with rainfall
- Spores germinate with leaf wetness
- Scab lesions that develop on leaves produce secondary inoculum that spreads disease throughout season



Levels of Integration in IPM

- Level 1 integration: Individual pest species or species complexes.
- **Level 2 integration: Community of pest species (insects, pathogens, weeds)**
- Level 3 integration: Ecosystem (crop and non-crop host plants and other components)
- Level 4 integration: Farming community (including social and economic components)

Kogan M. Integrated pest management: historical perspectives and contemporary developments. Annual Review of Entomology. 1998;43(1):243–270. doi:10.1146/annurev.ento.43.1.243.

Bottrell DG, Schoenly KG. Integrated pest management for resource-limited farmers: challenges for achieving ecological, social and economic sustainability. Journal of Agricultural Science. 2018;156(3):408–426. doi:10.1017/S0021859618000473.

Level 3:

5

Do you practice orchard sanitation by using any of these practices?

- [ ] Nope.
- [ ] Flail mowing leaves and debris at beginning / end of season
- [ ] Spraying leaf litter with urea or compost teas
- [ ] Diligently removing all fire blight cankers
- [ ] Removing all black rot mummies

Sanitation

OCTOBER 29, 2014 DAVE SCHMITT

Fall Urea Sprays for Apple Scab Control

It's time to consider sanitation practices that can help reduce over wintering scab inoculum. These practices should be considered an essential part of apple IPM programs.

In 2014 scab was once again a problem in most orchards we scouted. Even if you didn't see scab on the fruit at harvest there still could be infected leaves in the orchard at low levels. In addition, in the northeast and other regions scab is becoming increasingly resistant to chemistries we rely upon for primary season control. Therefore, all growers should consider integrating sanitation practices into their scab control program. The recommended sanitation program involves either: fall or spring applications of Urea; flail mowing fallen leaves; or preferably both.

Apple Scab Control with Urea.
Video link: http://youtu.be/8g0WyVi68GM

For a refresher we've linked a short video explaining this approach.

http://youtu.be/8g0WyVi68GM

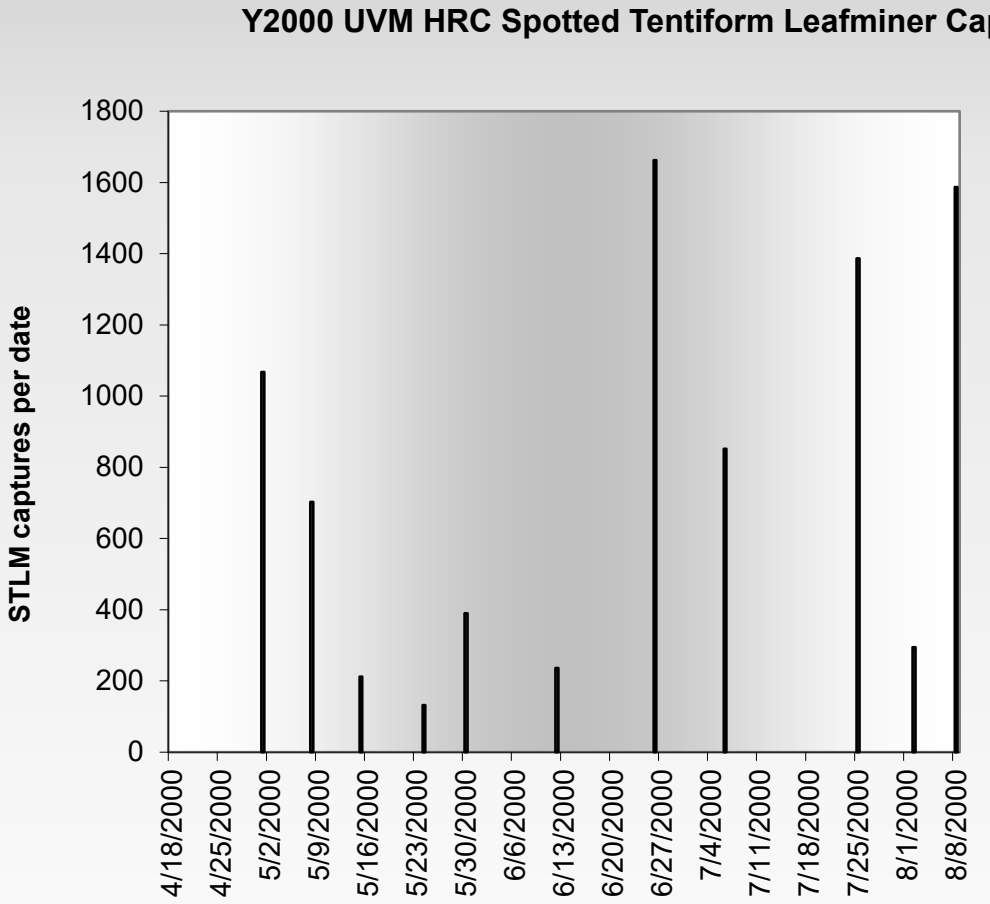
Sanitation

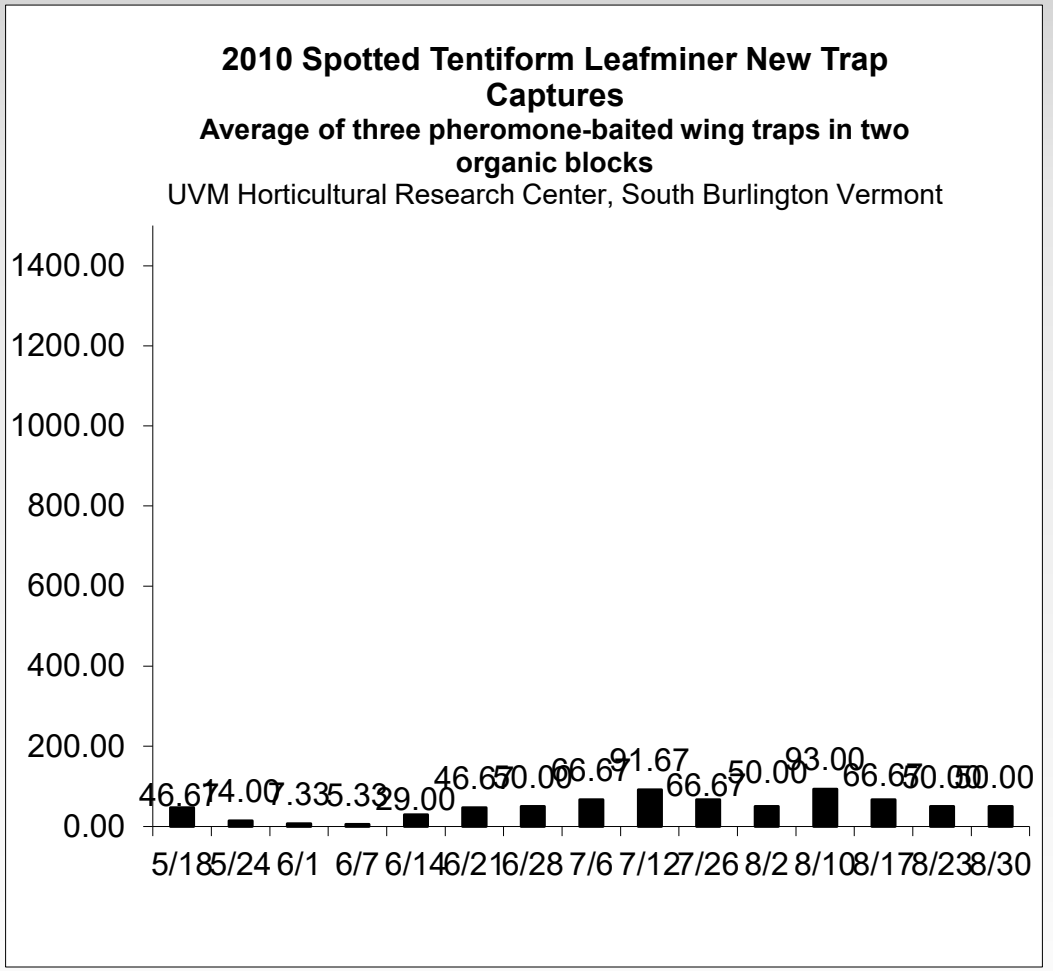
Shredding leaves. Shredding all leaves on the orchard floor in November or April reduces the number of scab spores by about 85%. If the strip under trees cannot be reached with shredding equipment, then flail chopping the remaining area between trees will reduce scab spores by about 50%.

Urea treatments. Spraying the surface of the leaves on the ground with urea will reduce spores by about 66%.

https://ag.umass.edu/fruit/fact-sheets/reducing-apple-scab-risks-saving-scab-sprays

Sanitation effects on other pests





Levels of Integration in IPM

- Level 1 integration: Individual pest species or species complexes.
- Level 2 integration: Community of pest species (insects, pathogens, weeds)
- **Level 3 integration: Ecosystem (crop and non-crop host plants and other components)**
- Level 4 integration: Farming community (including social and economic components)

Kogan M. Integrated pest management: historical perspectives and contemporary developments. Annual Review of Entomology. 1998;43(1):243–270. doi:10.1146/annurev.ento.43.1.243.

Bottrell DG, Schoenly KG. Integrated pest management for resource-limited farmers: challenges for achieving ecological, social and economic sustainability. Journal of Agricultural Science. 2018;156(3):408–426. doi:10.1017/S0021859618000473.

Level 3:

6

Do you maintain diverse habitat including flowering plants near your orchard edge to promote beneficial insects?

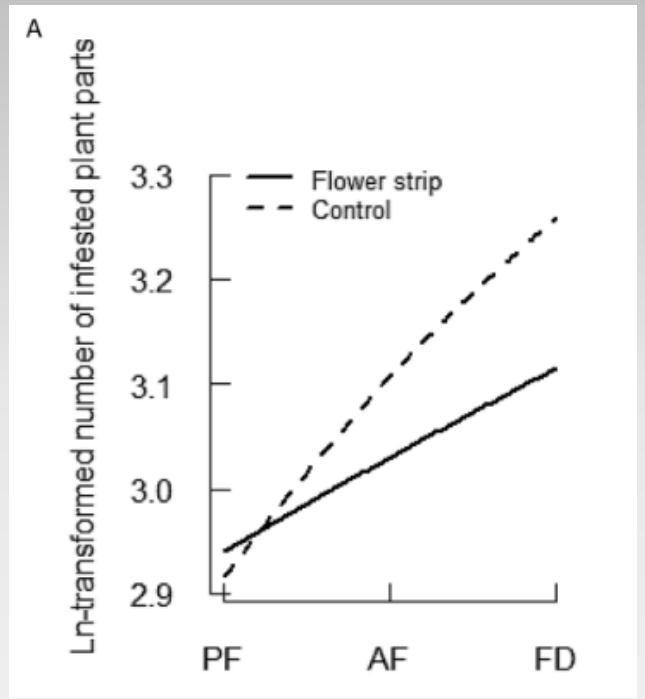
- Yes
- No

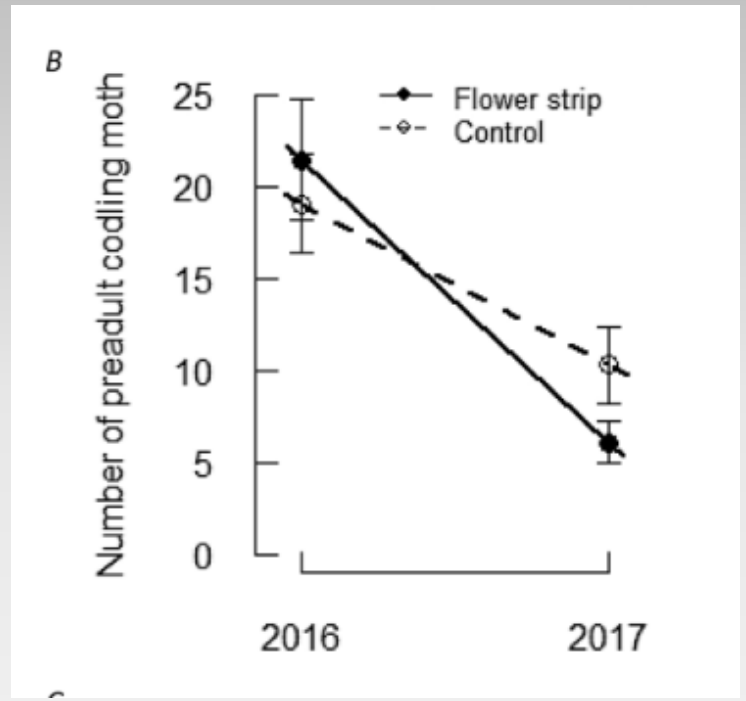
7

Do you maintain wild pollinator habitat spaces on your farm?

- Yes
- No

Herz A, Cahenzli F, Penvern S, Pfiffner L, Tasin M, Sigsgaard L. Managing Floral Resources in Apple Orchards for Pest Control: Ideas, Experiences and Future Directions. Insects. 2019 Aug 11;10(8):247. doi: 10.3390/insects10080247. PMID: 31405257; PMCID: PMC6723448.





Cahenzli, F., Sigsgaard, L., Daniel, C., Herz, A., Jamar, L., Kelderer, M., … Pfiffner, L. (2019). Perennial flower strips for pest control in organic apple orchards - A pan-European study. Agriculture, Ecosystems & Environment, 278, 43–53. doi:10.1016/j.agee.2019.03.011

The Role of Orchard Habitats and the Surrounding Landscape in Supporting Apple Production and Conserving Biodiversity:
Report of a Hudson Valley Pilot Project.
Conrad Vispo, Claudia Knab-Vispo, Kyle Bradford, and Otter Vispo.
Hawthorne Valley Farmscape Ecology Program, Jan. 2015.

https://www.hvfarmscape.org/sites/default/files/farmscape_orchard_report_jan_2015.pdf

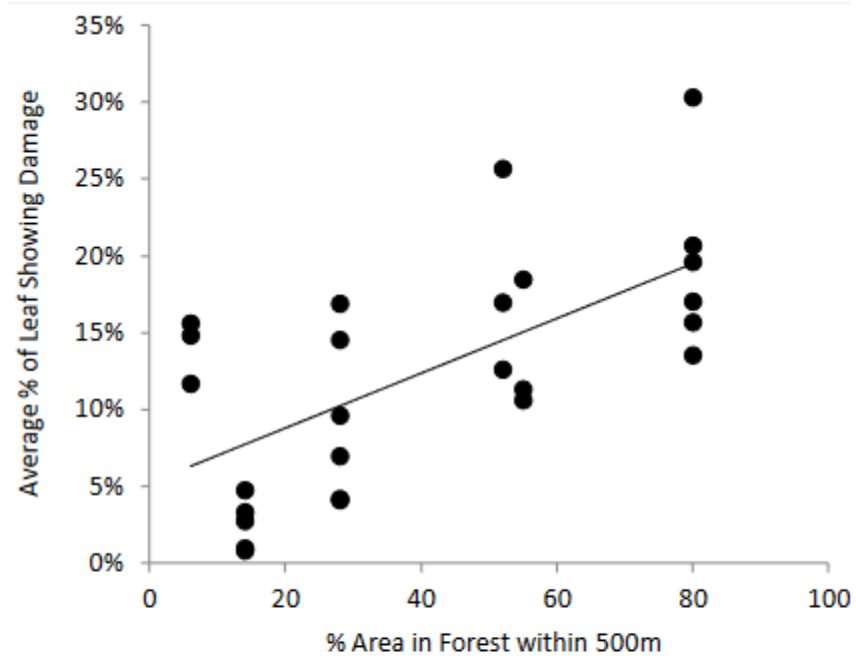


Figure 11. Not only was forested landscape associated with certain beneficials, it was also associated with certain disease and pest damage, as indicated by this relationship between forest area and the average % of leaf damage during July-August scouting.

The Role of Orchard Habitats and the Surrounding Landscape in Supporting Apple Production and Conserving Biodiversity: Report of a Hudson Valley Pilot Project.
Conrad Vispo, Claudia Knab-Vispo, Kyle Bradford, and Otter Vispo. Hawthorne Valley Farmscape Ecology Program, Jan. 2015.

https://www.hvfarmscape.org/sites/default/files/farmscape_orchard_report_jan_2015.pdf

Figure 157. One orchardist's joy is another's headache. This abundance of wild flowers attracted numerous bees, but, the literature suggests, may have also created nutrient competition and pest habitat.

Levels of Integration in IPM

- Level 1 integration: Individual pest species or species complexes.
- Level 2 integration: Community of pest species (insects, pathogens, weeds)
- Level 3 integration: Ecosystem (crop and non-crop host plants and other components)
- **Level 4 integration: Farming community (including social and economic components)**

Kogan M. Integrated pest management: historical perspectives and contemporary developments. Annual Review of Entomology. 1998;43(1):243–270. doi:10.1146/annurev.ento.43.1.243.

Bottrell DG, Schoenly KG. Integrated pest management for resource-limited farmers: challenges for achieving ecological, social and economic sustainability. Journal of Agricultural Science. 2018;156(3):408–426. doi:10.1017/S0021859618000473.

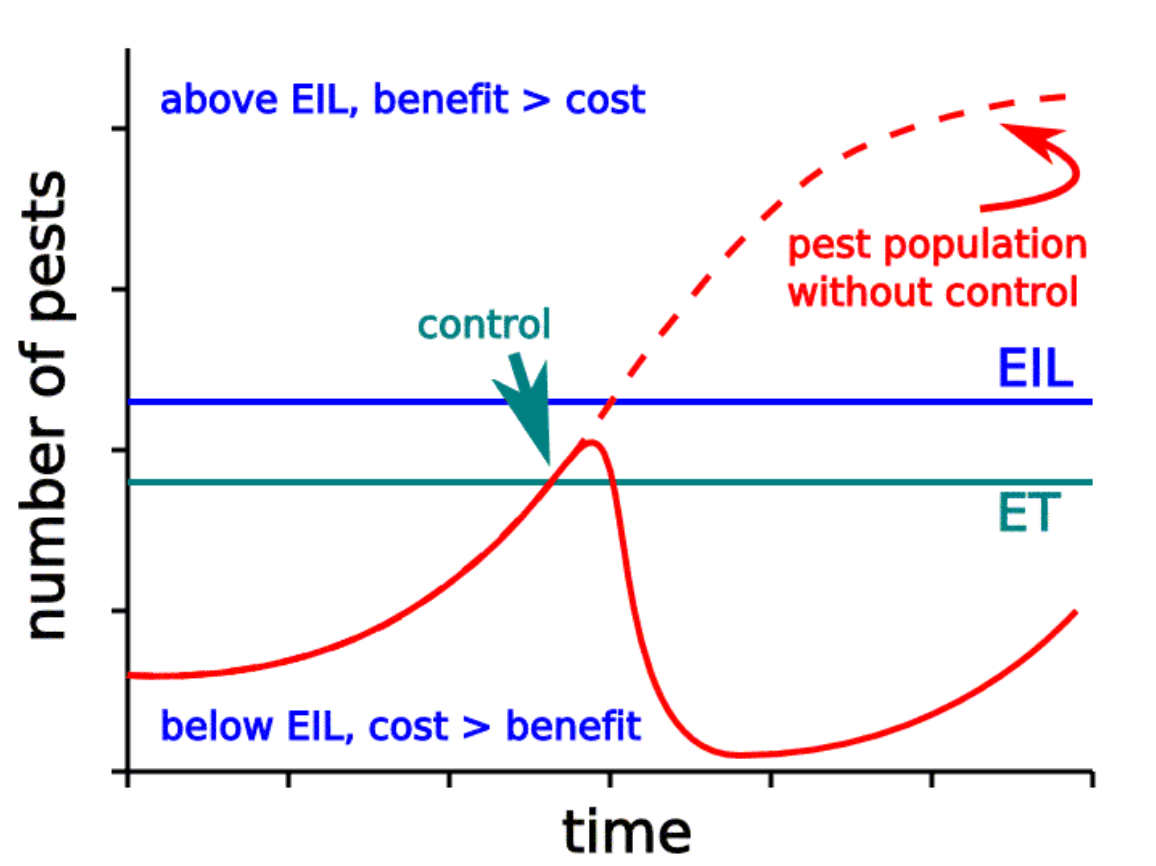
Level 4:

8

Do you adjust your thresholds or increase tolerance for pest damage to reduce pesticide applications?

- Yes
- No

Tolerance



http://articles.extension.org/pages/19915/insect-pest-management:-differences-between-conventional-and-organic-farming-systems

Figure 1. The Economic Injury Level (EIL) is the pest abundance (or level of damage) at which the dollar cost of crop yield loss to the pest begins to exceed the dollar cost of controlling the pest.

The Economic Threshold (ET) is the pest abundance (or damage level) at which the EIL is likely to be equalled or exceeded if left unmanaged.

The ET is almost always lower than the EIL, and is considered to be the point at which action against the pest is economically justified. The ET is sometimes called an Action Threshold (AT).

Figure credit: Ed Zaborski, University of Illinois.

Pests of less concern?
Depending on your market…

Pests of less concern?
Depending on your market…

How do we best implement IPM in Vermont orchards?

- Put the time into it
- Put the thought into it
- Use the tools you have available
- Think about orchard design and surrounding habitat
- Consider your tolerance- and act appropriately when it's approached