Apple IPM 101

TERENCE BRADSHAW, PH.D.

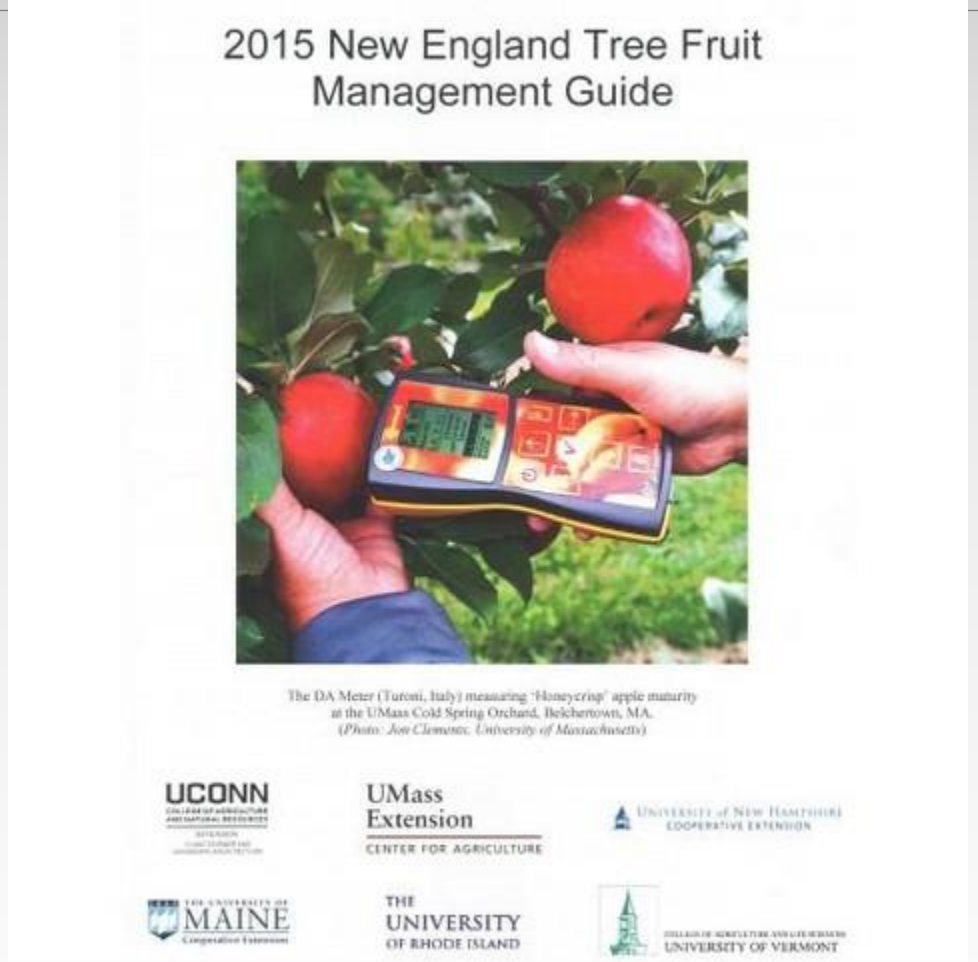
2016 UVM APPLE PROGRAM &
VT TREE FRUIT GROWERS ASSOCIATION 120TH ANNUAL MEETING

FEBRUARY 18, 2016

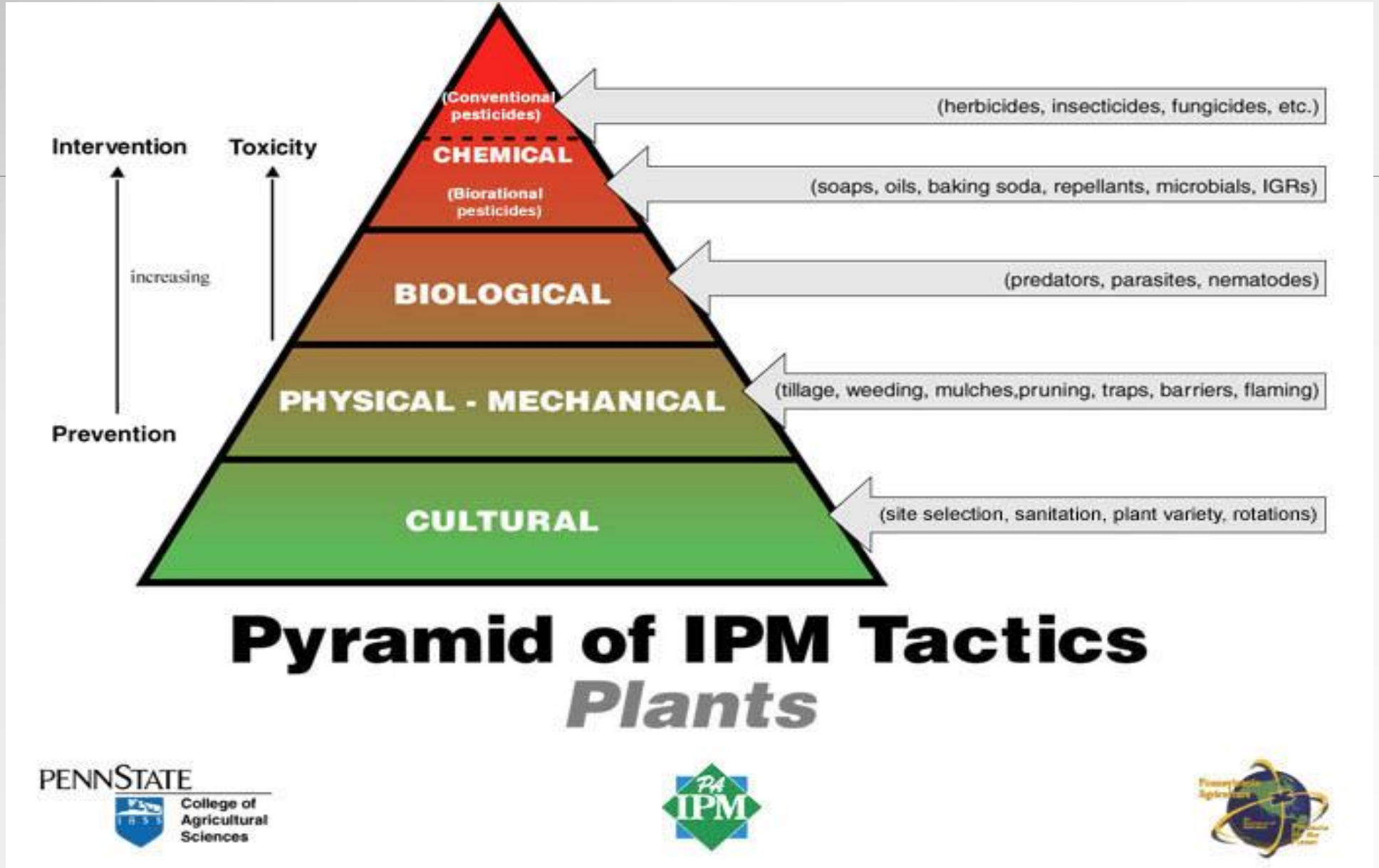
COLLEGE OF AGRICULTURE AND LIFE SCIENCES
UNIVERSITY OF VERMONT

2015 (16) New England Apple Pest Management Guide

- Keep it or get one!
- No updated guide 2016
- USDA Specialty Crops Multi-State Program:
  - "Web-Enhanced IPM Decision Support for New England Tree Fruit"



http://www.target.com/p/2015-new-england-tree-fruit-management-g-new-england-tree-fruit-management-guide-paperback/-/A-50147454



Pyramid of IPM Tactics

Plants

PENNSTATE College of Agricultural Sciences

PA IPM

Monitoring Pest Populations: A Key Concept!

- Regular and deliberative scouting
  - Once (or more*) per week
  - Set up a pattern in the orchard
  - Scout each block separately
  - Consistent scouting pattern

Insect Monitoring

Red Trunk Traps

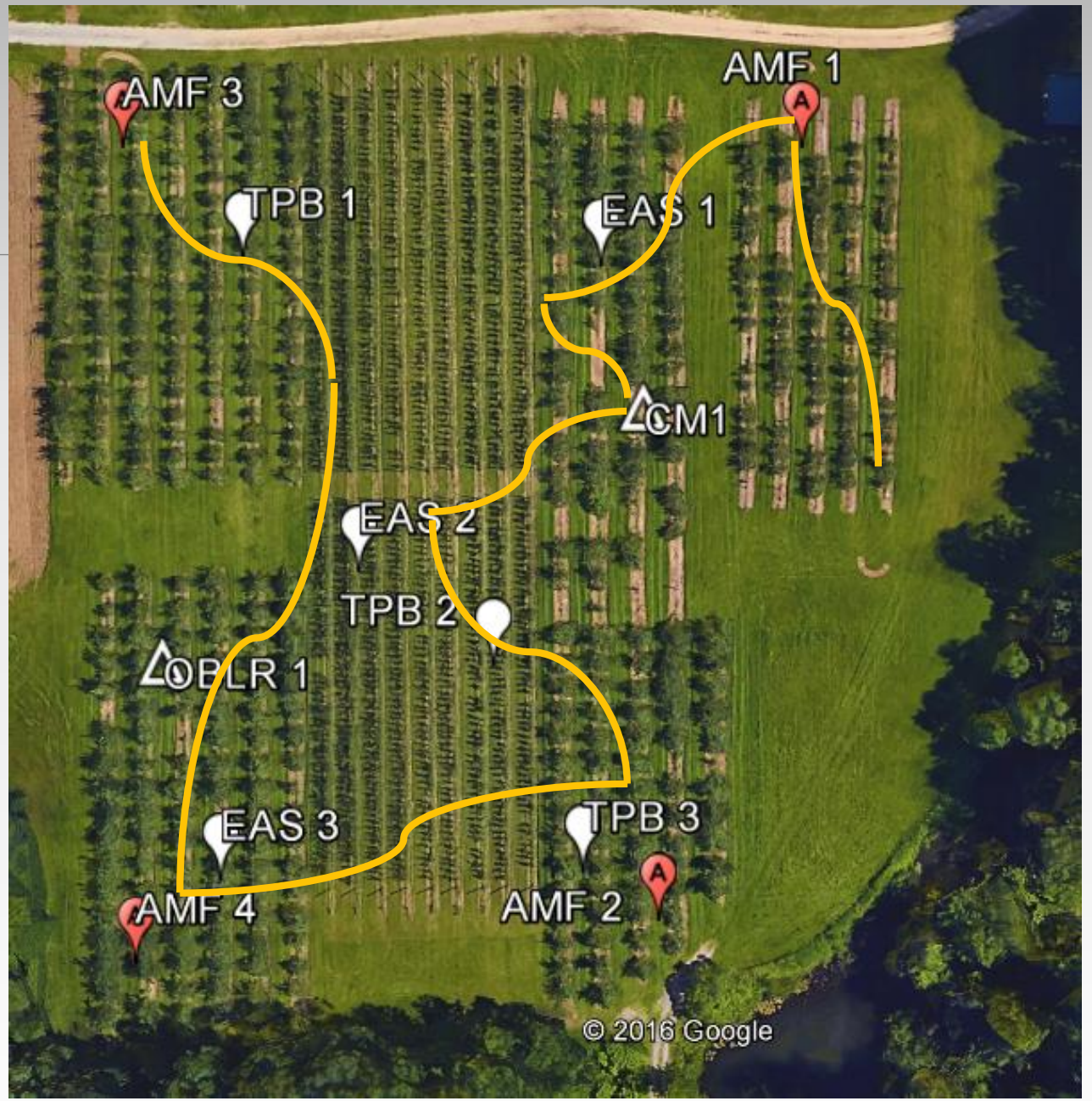
White Visual Traps

Wing Traps w/ Pheromones

Apple Maggot Red Sticky Traps

Make a consistent scouting map

- Don’t go straight down one or two rows
- Cover edges + interior
- Scout for mites, curculio stings, scab between traps
- Alter your path but cover the block each time



Recordkeeping

- Use datasheets in the field
  - Smartphone??
- Use a spreadsheet in the office/shop
- Compute cumulative captures, reset the clock after spray applications

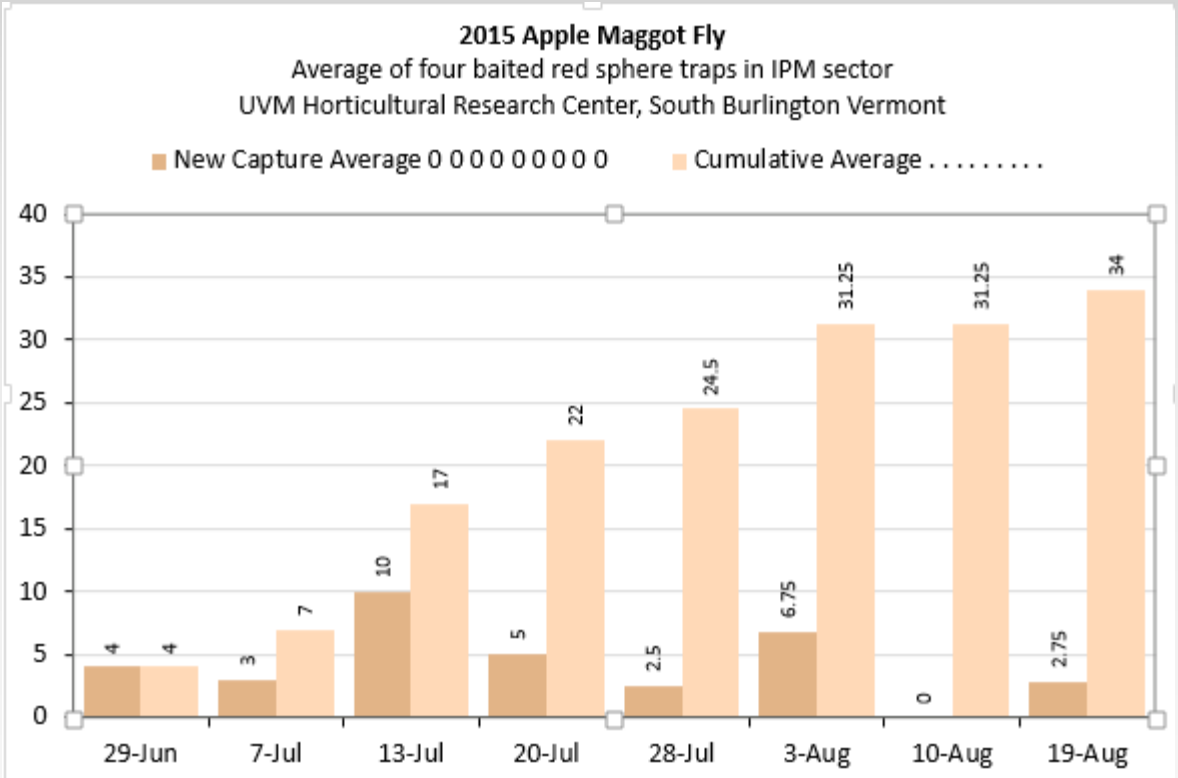
IPM					DATE:	
					NAME:	
REMOVE ALL CAPTURES EVERY WEEK						
AMF 1	AMF 2	AMF 3	AMF 4			
Block 17	Block 11	Block 11	Block 4			
NE r 1	SE 1	SW 5	NW 5			
OFM	RBLR	CM	LAW	TABM	OBLR	STLM
Block 11	Block 16	Block 17	Block 11	Block 4	Block 19	Block 17
SW row 2	NE row 2	NE row 2	SE row2	NW row 1	row 2	row 5
Foliar-ERM	Foliar-TSSM	Foliar-PLH	Foliar-WALH	Foliar-STLM		

Recordkeeping

- Use datasheets in the field
  - Smartphone??
- Use a spreadsheet in the office/shop
- Compute cumulative captures, reset the clock after spray applications

Please enter each cell individually - DO NOT CUT/PASTE OR CLICK/DRAG CELL CONTENTS																
BIOFIX DATE															26-May	
trap set DATE:		20-Apr				20-Apr				5-May				5-May	5-May	18-May	18-May
		STLM t1	STLM t2	STLM t3	STLM t4	TPB 1	TPB 2	TPB 3	TPB 4	EAS 1	EAS 2	EAS 3	EAS 4	OFM	RBLR	CM	LAW
	location:	Block 19	Block 11	Block 11	Block 17	Block 19	Block 11	Block 11	Block 17	Block X	Block X	Block X	Block X	Block X	Block X	Block X	Block X
NAME	DATE	NW	SW	SE	NE	NW	SW	SE	NE	NE	SE	SW	NW	SW row 2	NE row 2	NE row 2	SE row2
Jess F	28-Apr	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
Jess F	5-May	0	0	0	0	0	1	0	8	-	-	-	-	-	-	-	-
Jess F	12-May	0	0	0	1	2	0	1	1	3	4	1	0	0	100	-	-
Jess F	18-May	0	0	0	0	3	0	0	1	11	1	2	1	0	0	-	-
Jess F	26-May	-	-	-	-	0	0	0	0	14	0	1	0	0	44	0	0
Jess F	2-Jun	-	-	-	-	-	-	-	-	-	-	-	-	0	3	0	0
Jess F	8-Jun	-	-	-	-	-	-	-	-	-	-	-	-	0	21	0	0
Jess F	16-Jun	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0
Jess F	22-Jun	-	-	-	-	-	-	-	-	-	-	-	-	0	1	0	0
Jess F	29-Jun	-	-	-	-	-	-	-	-	-	-	-	-	0	0	2	0
Jess F	7-Jul	-	-	-	-	-	-	-	-	-	-	-	-	0	9	0	0
Jess F	13-Jul	-	-	-	-	-	-	-	-	-	-	-	-	0	18	0	0
Jess F	20-Jul	-	-	-	-	-	-	-	-	-	-	-	-	0	18	0	1
Jess F	28-Jul	-	-	-	-	-	-	-	-	-	-	-	-	0	10	0	0
Jess F	3-Aug	-	-	-	-	-	-	-	-	-	-	-	-	0	23	0	0
Jess F	10-Aug	-	-	-	-	-	-	-	-	-	-	-	-	0	18	0	0
Jess F	19-Aug	-	-	-	-	-	-	-	-	-	-	-	-	0	11	0	0

Recordkeeping



IPM	20-Apr		20-Apr		5-May		5-May
DATE (m/d	STLM New Capture Average	STLM Cumulative Average	TPB New Capture Average	TPB Cumulative Average	EAS New Capture Average	EAS Cumulative Average	OFM New Captures
28-Apr	0	0	0	0	0	.	0
5-May	0	0	2.25	2.25	0	.	0
12-May	0.25	0.25	1	3.25	2	2	0
18-May	0	0.25	1	4.25	3.75	5.75	0
26-May	0	0.25	0	4.25	3.75	9.5	0
2-Jun	0	0.25	0	4.25	0	9.5	0
8-Jun	0	0.25	0	4.25	0	9.5	0
16-Jun	0	0.25	0	4.25	0	9.5	0
22-Jun	0	0.25	0	4.25	0	9.5	0
29-Jun	0	0.25	0	4.25	0	9.5	0
7-Jul	0	0.25	0	4.25	0	9.5	0
13-Jul	0	0.25	0	4.25	0	9.5	0
20-Jul	0	0.25	0	4.25	0	9.5	0
28-Jul	0	0.25	0	4.25	0	9.5	0
3-Aug	0	0.25	0	4.25	0	9.5	0
10-Aug	0	0.25	0	4.25	0	9.5	0
19-Aug	0	0.25	0	4.25	0	9.5	0

TracApple

Record-Keeping and Reporting Software

TracApple

version 2011

Authored by J.E. Carroll

Changes in pesticide registrations, regulations, and use guidelines frequently occur. This software and any information contained herein is not a substitute for pesticide labeling.

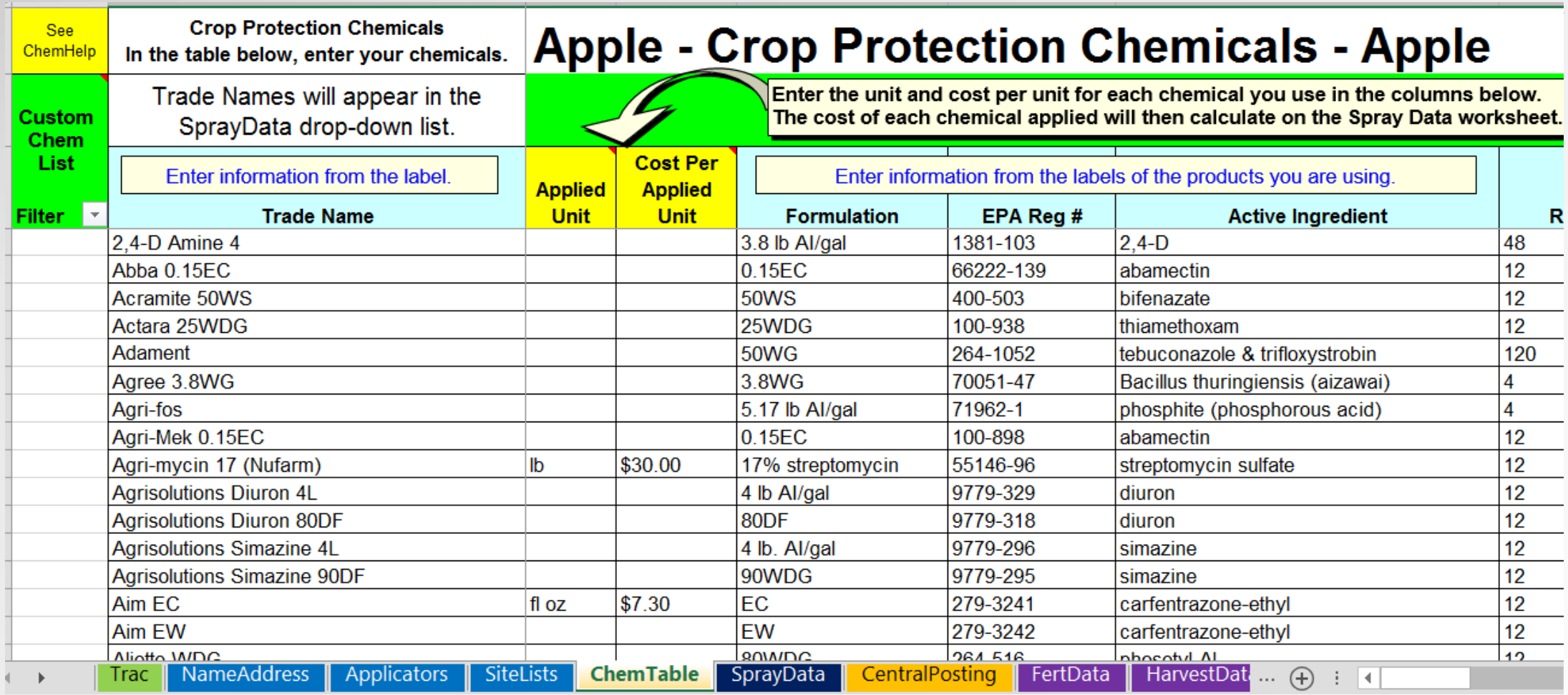
The sample pesticide list included on the ChemHelp sheet was created in 2010 and is provided here for guidance only; it is not intended to be used as a substitute for pesticide label information.
Always read the pesticide label prior to use.
Verify all information on the label for the product(s) you use.
The software user must verify that the pesticide information used in their Trac Software ChemTable matches the label for the pesticide(s) they have used and what's been applied.

This software is not a substitute for pesticide labeling.
Accuracy of reports is the responsibility of the end user.
Always read the label before applying any pesticide.

Open the next worksheet and begin entering data.
Refer to the Trac Software Manual for detailed instructions.

Enable Macro Content

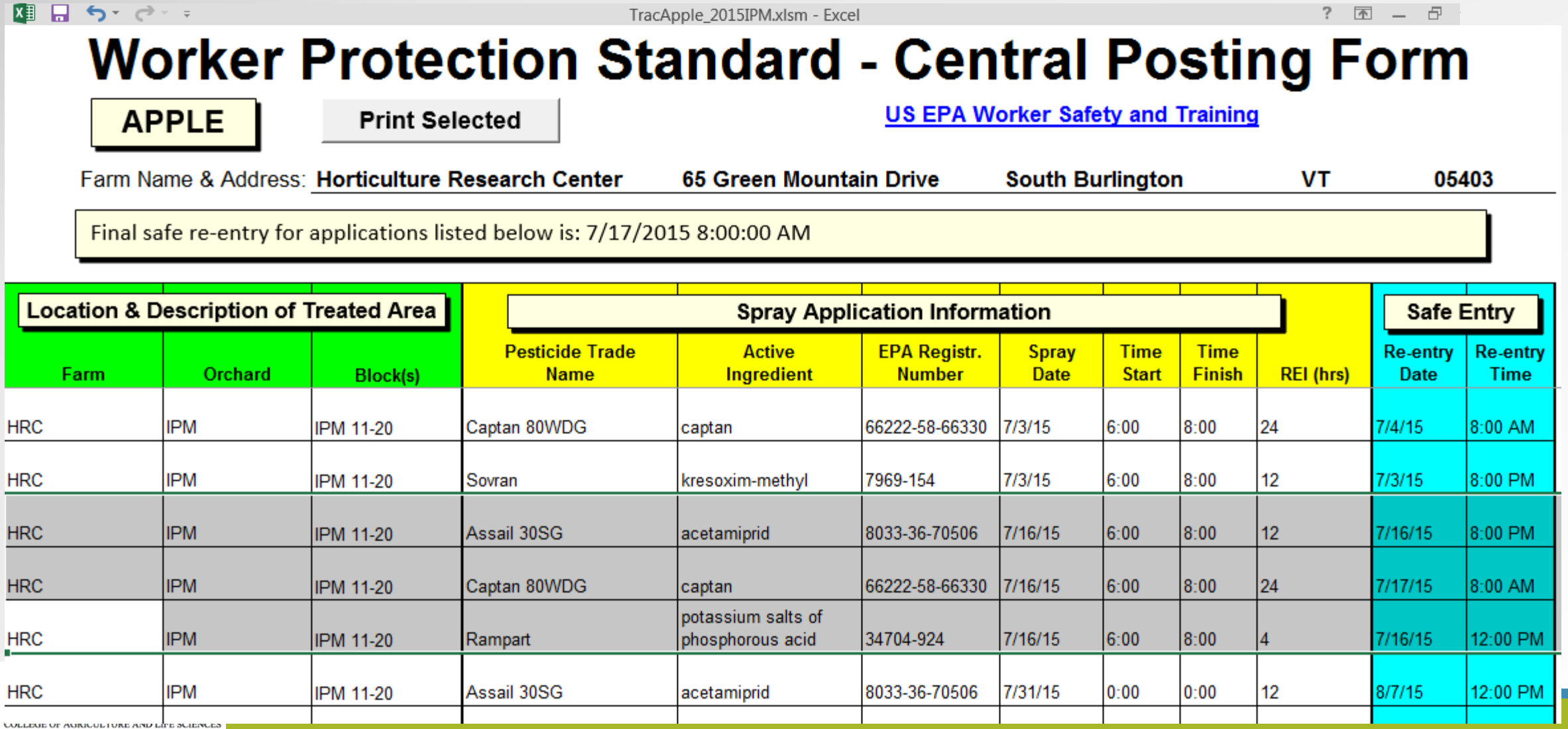
TracApple



See ChemHelp	Crop Protection Chemicals In the table below, enter your chemicals.	Apple - Crop Protection Chemicals - Apple					
Custom Chem List Filter	Trade Names will appear in the SprayData drop-down list.	Enter the unit and cost per unit for each chemical you use in the columns below. The cost of each chemical applied will then calculate on the Spray Data worksheet.					
	Enter information from the label.			Enter information from the labels of the products you are using.			
	Trade Name	Applied Unit	Cost Per Applied Unit	Formulation	EPA Reg #	Active Ingredient	R
	2,4-D Amine 4			3.8 lb AI/gal	1381-103	2,4-D	48
	Abba 0.15EC			0.15EC	66222-139	abamectin	12
	Acramite 50WS			50WS	400-503	bifenazate	12
	Actara 25WDG			25WDG	100-938	thiamethoxam	12
	Adament			50WG	264-1052	tebuconazole & trifloxystrobin	120
	Agree 3.8WG			3.8WG	70051-47	Bacillus thuringiensis (aizawai)	4
	Agri-fos			5.17 lb AI/gal	71962-1	phosphite (phosphorous acid)	4
	Agri-Mek 0.15EC			0.15EC	100-898	abamectin	12
	Agri-mycin 17 (Nufarm)	lb	$30.00	17% streptomycin	55146-96	streptomycin sulfate	12
	Agrisolutions Diuron 4L			4 lb AI/gal	9779-329	diuron	12
	Agrisolutions Diuron 80DF			80DF	9779-318	diuron	12
	Agrisolutions Simazine 4L			4 lb. AI/gal	9779-296	simazine	12
	Agrisolutions Simazine 90DF			90WDG	9779-295	simazine	12
	Aim EC	fl oz	$7.30	EC	279-3241	carfentrazone-ethyl	12
	Aim EW			EW	279-3242	carfentrazone-ethyl	12
	Aliotte WDG			80WDG	264-516	phosetyl-Al	12

Trac | NameAddress | Applicators | SiteLists | ChemTable | SprayData | CentralPosting | FertData | HarvestDat ...

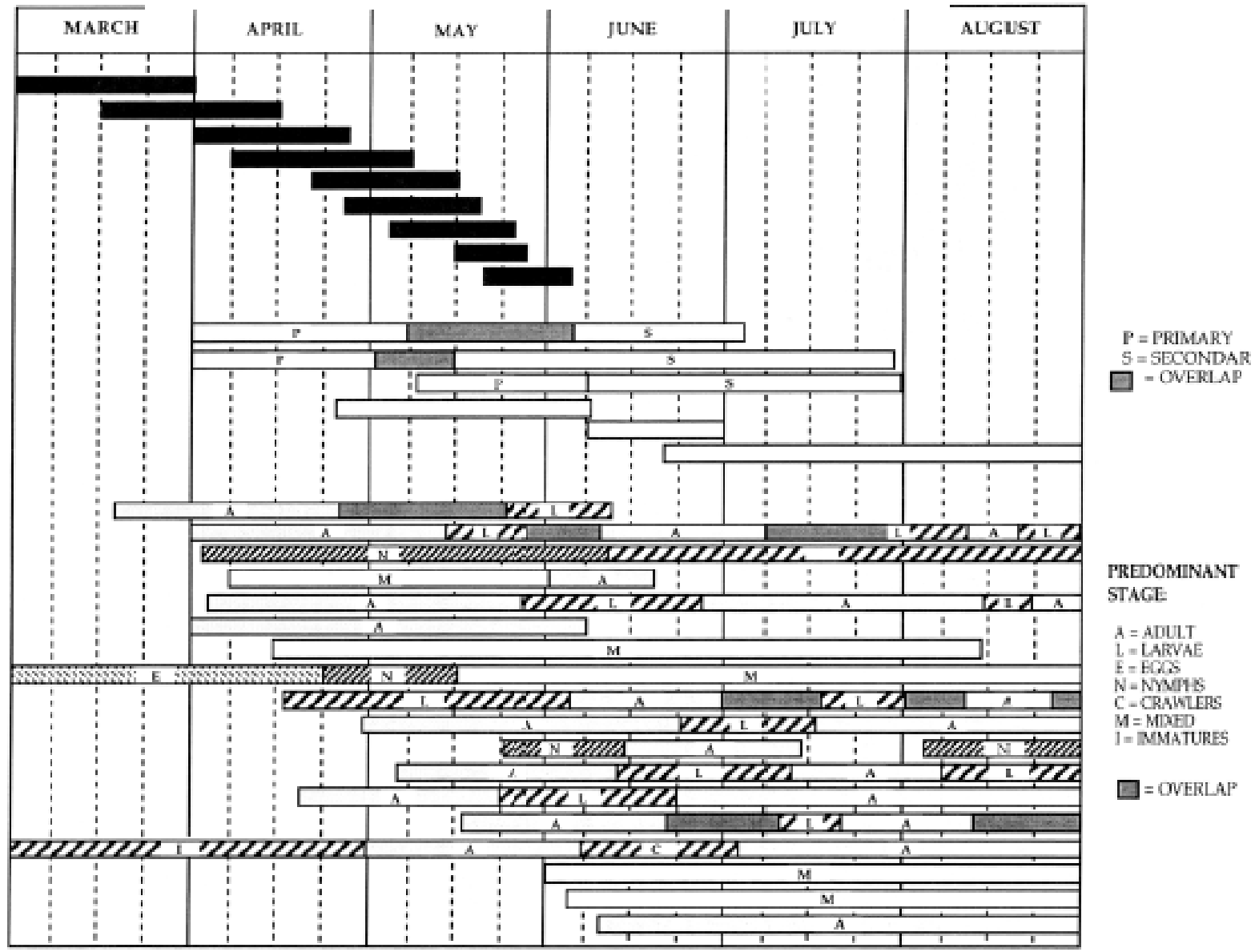
TracApple



Location & Description of Treated Area			Spray Application Information							Safe Entry	
Farm	Orchard	Block(s)	Pesticide Trade Name	Active Ingredient	EPA Registr. Number	Spray Date	Time Start	Time Finish	REI (hrs)	Re-entry Date	Re-entry Time
HRC	IPM	IPM 11-20	Captan 80WDG	captan	66222-58-66330	7/3/15	6:00	8:00	24	7/4/15	8:00 AM
HRC	IPM	IPM 11-20	Sovran	kresoxim-methyl	7969-154	7/3/15	6:00	8:00	12	7/3/15	8:00 PM
HRC	IPM	IPM 11-20	Assail 30SG	acetamiprid	8033-36-70506	7/16/15	6:00	8:00	12	7/16/15	8:00 PM
HRC	IPM	IPM 11-20	Captan 80WDG	captan	66222-58-66330	7/16/15	6:00	8:00	24	7/17/15	8:00 AM
HRC	IPM	IPM 11-20	Rampart	potassium salts of phosphorous acid	34704-924	7/16/15	6:00	8:00	4	7/16/15	12:00 PM
HRC	IPM	IPM 11-20	Assail 30SG	acetamiprid	8033-36-70506	7/31/15	0:00	0:00	12	8/7/15	12:00 PM

Scouting throughout the season

Figure 7.1.9. Average Timing for Apple Events for New England



Spotted Tentiform Leafminer (STLM)

- Silver Tip- Place red visual traps on south side of tree trunks. Minimum of 4 traps per 8 acre block.
- Tight Cluster:
  - MacIntosh:4/trap
  - Non-Macs: 8/trap
- Late Pink:
  - MacIntosh:9/ trap
  - Non-Mac: 21/trap
- Petal Fall: Check for 1st gen. sap mines in leaves
  - Macs: 7 mines/100 leaves
  - Non-Macs: 14 mines/100 leaves
- July
  - Macs: 50 Mines/100 leaves
  - Non-Macs: 100 Mines/ 100 leaves

STLM: Non-chemical management

Tarnish Plant Bug

- White Visual Traps: 6X8” traps are set out at silver tip and checked weekly. Traps should be placed near the edge of the block, at one per 3-5 acres. Hang traps at about 2’ above ground, on an outer branch. TPB(3/trap TC, 4/Trap late pink)

- Tight Cluster Thresholds
  - Wholesale: 3/trap
  - Retail- 5/ trap
- Late Pink Thresholds
  - Wholesale: 5/ trap
  - Retail:/ 8 trap

Tarnished Plant Bug Damage

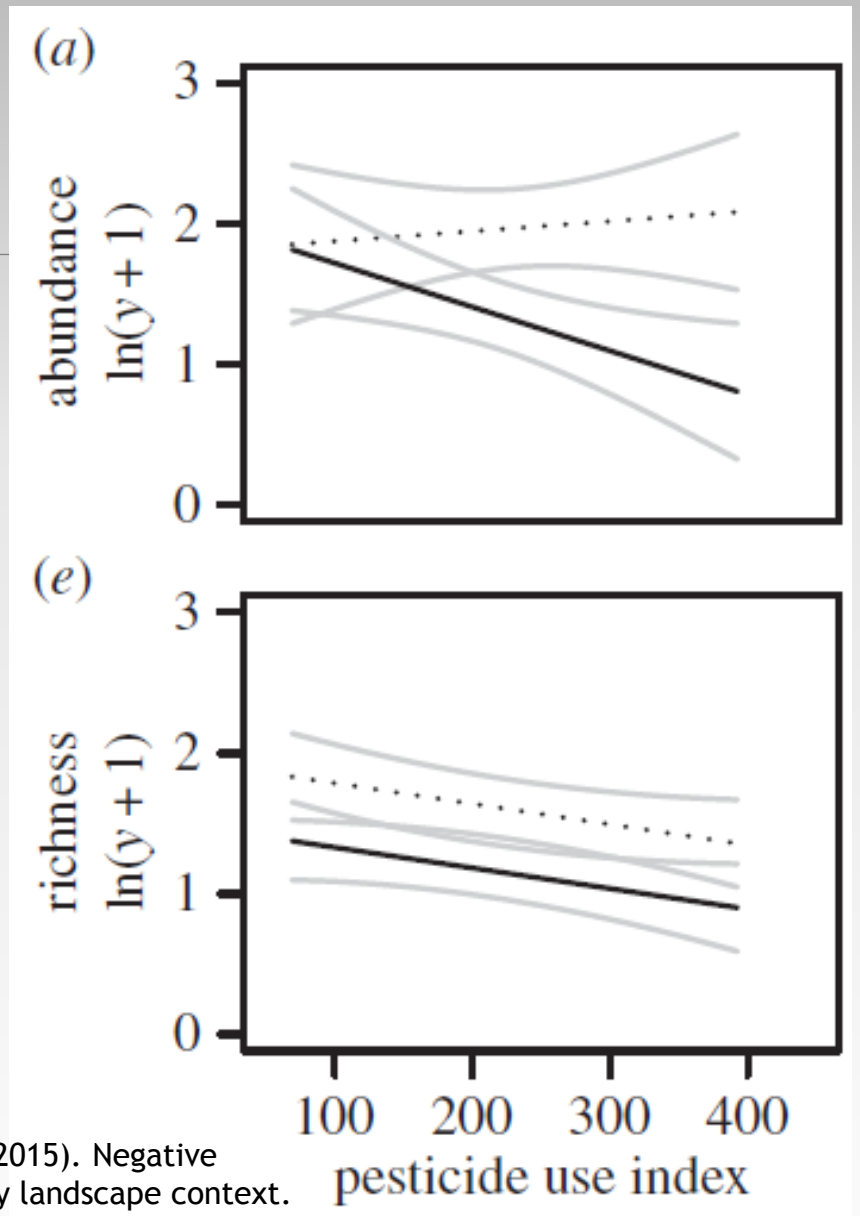
Tarnished Plant Bug Trap

Pollinator protection

- Bloom is a critical time in the orchard
- No Insecticides During Bloom!
- Pesticide selection near bloom:
  - Bee hazard ratings in NETFMG
  - Organophosphates/ carbamates **HIGH**
  - Pyrethroids **HIGH**
  - Neonicotinoids **LOW** (?)
  - IGRs **LOW**
  - Fungicides **LOW**
- **Research on pesticide effects on bee populations is increasingly being conducted**

Current research on pollinator protection in orchards

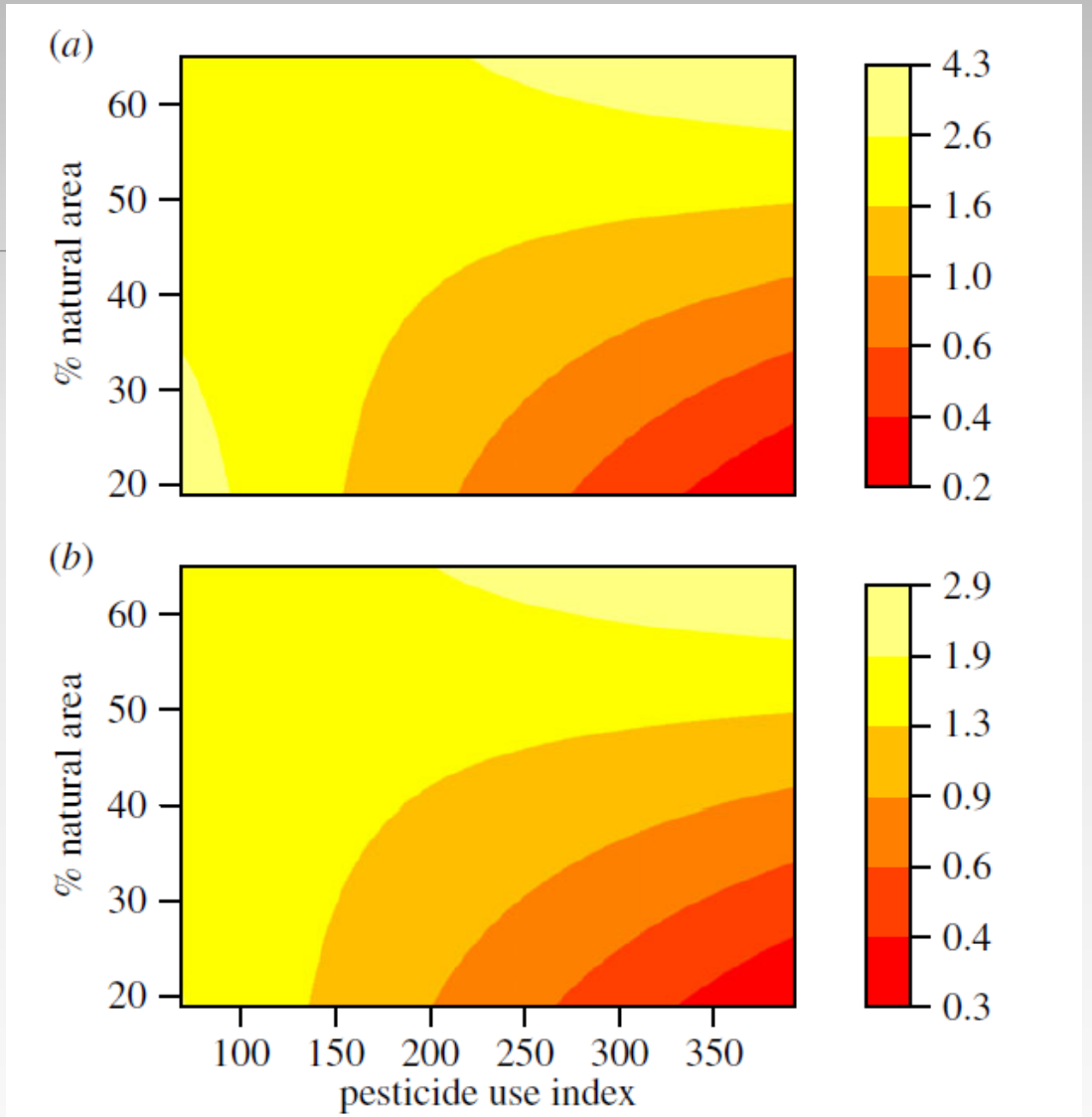
- On-going research
  - Federal mandate
  - Popular concern
- Recent research (NY)
  - Pesticide use index decreases species richness & abundance of native pollinators
    - Fungicides pre-bloom
    - Insecticides post-bloom



Park, M. G., E. Blitzer, J. Gibbs, J. E. Losey and B. N. Danforth (2015). Negative effects of pesticides on wild bee communities can be buffered by landscape context. Proc. R. Soc. B, The Royal Society.

Current research on pollinator protection in orchards

- On-going research
  - Federal mandate
  - Popular concern
- Recent research (NY)
  - Pesticide use index decreases species richness & abundance of native pollinators
    - Fungicides pre-bloom
    - Insecticides post-bloom
  - 'Natural' landscape surrounding orchards buffers negative impacts



Park, M. G., E. Blitzer, J. Gibbs, J. E. Losey and B. N. Danforth (2015). Negative effects of pesticides on wild bee communities can be buffered by landscape context. Proc. R. Soc. B, The Royal Society.

Key IPM practices to minimize pollinator impacts in orchards

- No insecticides when bees are foraging
- Consider bee poisoning hazard

Table 7.1.3. Relative toxicity of pome fruit insecticides and miticides to beneficial arthropods.

		Beneficial Species			
Trade Name (active ingredient)	Honeybee[1]	*Amblyseius fallacis*[2]	*Typhlodromus pyri*[2]	*Stethorus punctum*[3]	*Aphidoletes aphidimyza*[4]
Acramite (bifenazate)	M	M	M	L	L
Actara (thiamethoxam)	M	L	L	L	L
Admire Pro, Pasada, Sherpa (imidacloprid)	H	L	L	M	L
***Agri-Flex** (abamectin/thiamethoxam)	M	M	M	M	L
***Agri-Mek, *Abacus, *Abba, *Epi-Mek, *Temprano** etc. (abamectin)	L	M	M	M	L
***Altacor** (chlorantraniliprole)	L	L	L	L	L
Apollo (clofentezine)	L	L	L	L	L
***Asana** (esfenvalerate)	H	H	H	H	M
Assail (acetamiprid)	L	M	L	M	M
Avaunt (indoxacarb)	M	L	L	L	L
§**Aza-Direct**, §**Azatin**, §**Trilogy** (azadirachtin)	M	L	L	L	L
***Battalion, *Decis** (deltamethrin)	M	H	H	H	M
***Baythroid, *Tombstone** (cyfluthrin)	H	H	H	H	H
Belay (clothianidin) w/ suppl. label	H	L	L	M	L
Beleaf (flonicamid)	L	L	L	?	?
Belt (flubendiamide)	L	L	L	L	L
***Bifenture, *Brigade, *Fanfare** (bifenthrin) [Pears only]	M-H	?	?	?	?

Key IPM practices to minimize pollinator impacts in orchards

- No insecticides when bees are foraging
- Consider bee poisoning hazard
  - Select appropriate materials when possible
- Thinning:
  - Use liquid carbaryl formulations when possible
- Maintain good bee habitat
  - No flowering plants in orchard during spray season
  - Flowering ‘natural’ habitat within 2 km of orchard

European Apple Sawfly



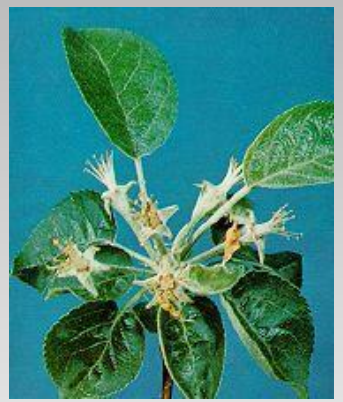
- Traps similar to those for monitoring TPB, non UV reflecting white sticky traps. Trap density is the same 1 per 3-5 acres near edges. Hang traps at pink on south side of the tree, outside branches at 5-6 feet above ground.
- Early Pink: Place White Sticky Traps in Orchard
- Threshold (Petal Fall):
  - No Pre-Bloom Insecticide: 5/trap
  - Blocks receiving Pre-bloom Insecticide: 9/trap

Plum Curculio

- Late Bloom- begin to inspect fruit on early-blooming cultivars in perimeter rows for fresh egg-laying scars
- Visual inspection of 10 fruit per tree.
- Threshold:
  - Traditional: prophylactic petal fall spray
  - IPM: first evidence of damage
- Use DD model to determine time of last spray
  - 308 DDb50°F from McIntosh petal fall: end of ovipositional period

Plum Curculio adult

Plum Curculio egg-laying damage

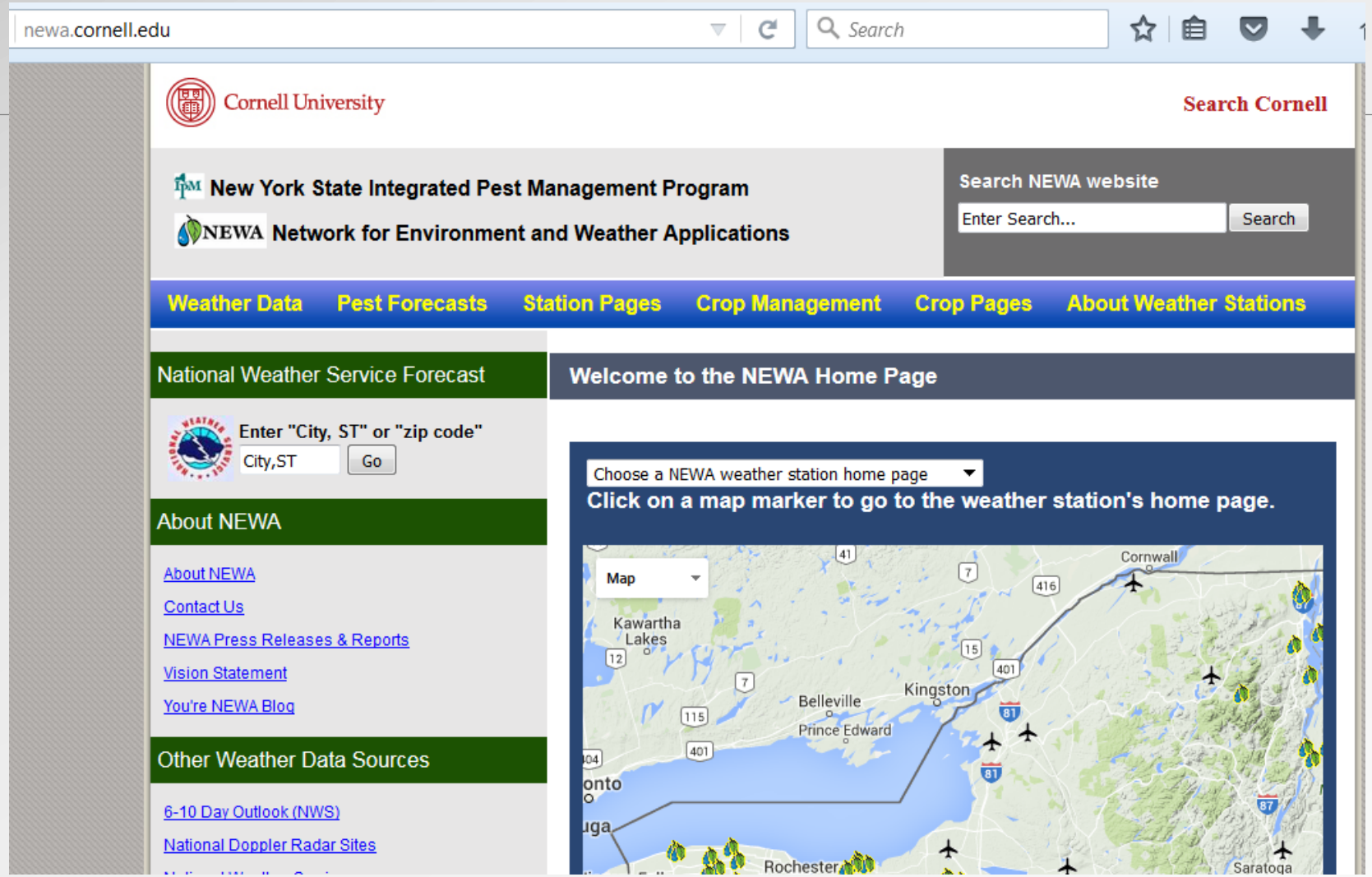


Plum Curculio damage (“bumps”)

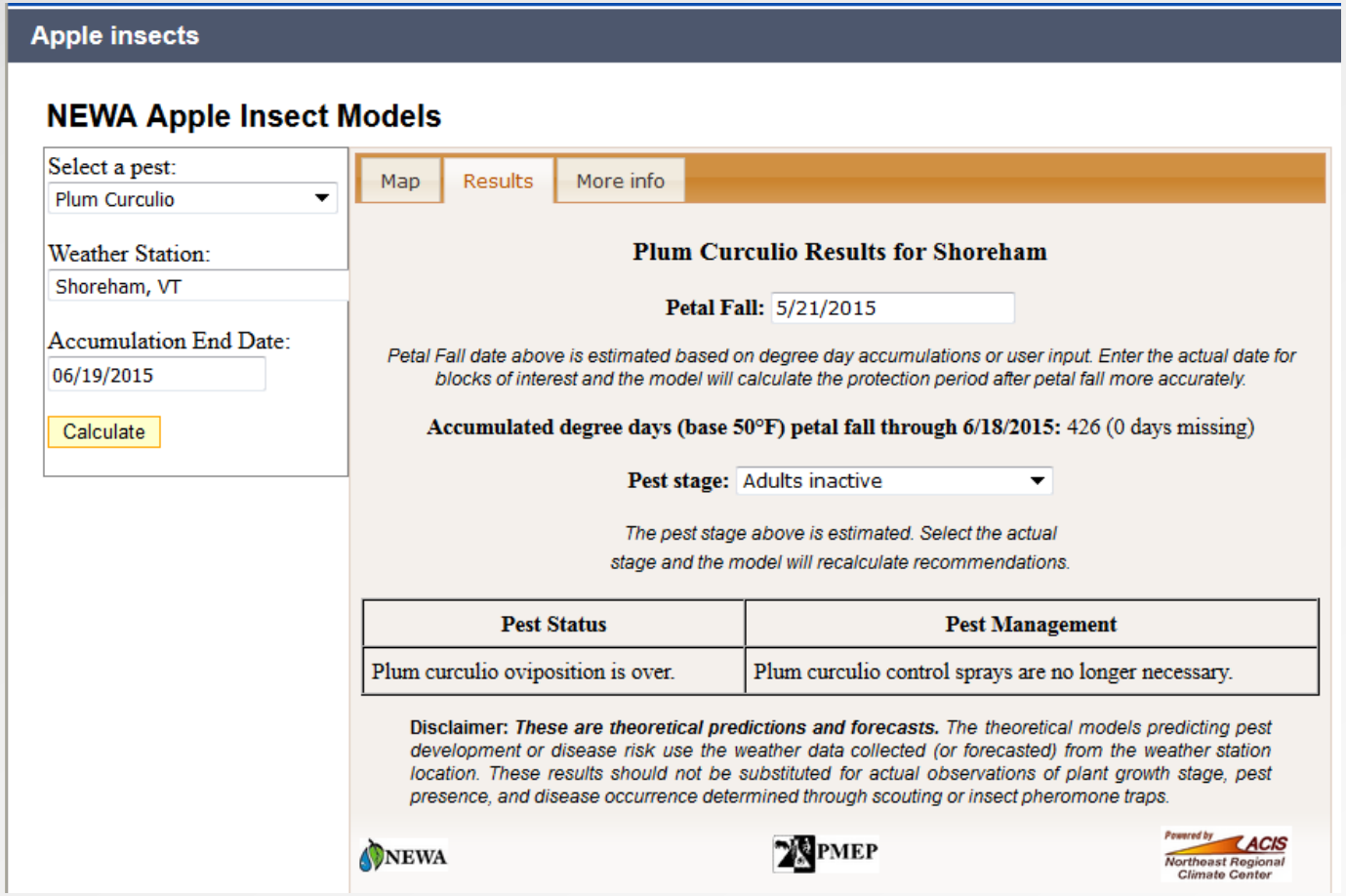
Plum Curculio feeding hole

Photo credits: L.P. Berkett; Integrated Management of Apple Pests in Massachusetts and New England, Coop. Ext. Sys., University of Mass. 1984.

NEWA model for Plum Curculio



NEWA model for Plum Curculio



Codling Moth

- Place pheromone traps at pink stage, on the outside of the trees about 6-7 feet above ground level.
- One trap per 5 acres, for orchards over 5 acres min of 5 pheromone trapes is rec. one for each cover and one in center. Traps should be checked daily until first capture, then weekly.

Codling Moth

- Petal Fall:
  - For 1st generation CM, 250-350 DDb50°F from first capture.
- July:
  - For 2nd Gen CM, 1260-1370 DDb50°F from first capture.

Feeding Codling Moth larva

Codling Moth adult

Codling Moth pheromone trap

NEWA Apple Insect Models

Select a pest: Codling Moth

Weather Station: South Hero, VT

Accumulation End Date: 08/14/2015

Calculate

Map | Results | More info

Codling Moth Results for South Hero

First Trap Catch: 5/26/2015

Second Generation Flight Start: 8/7/2015

The dates above are estimated based on degree-day accumulations or user input. Enter the actual dates for blocks of interest and the model will calculate the protection period more accurately.

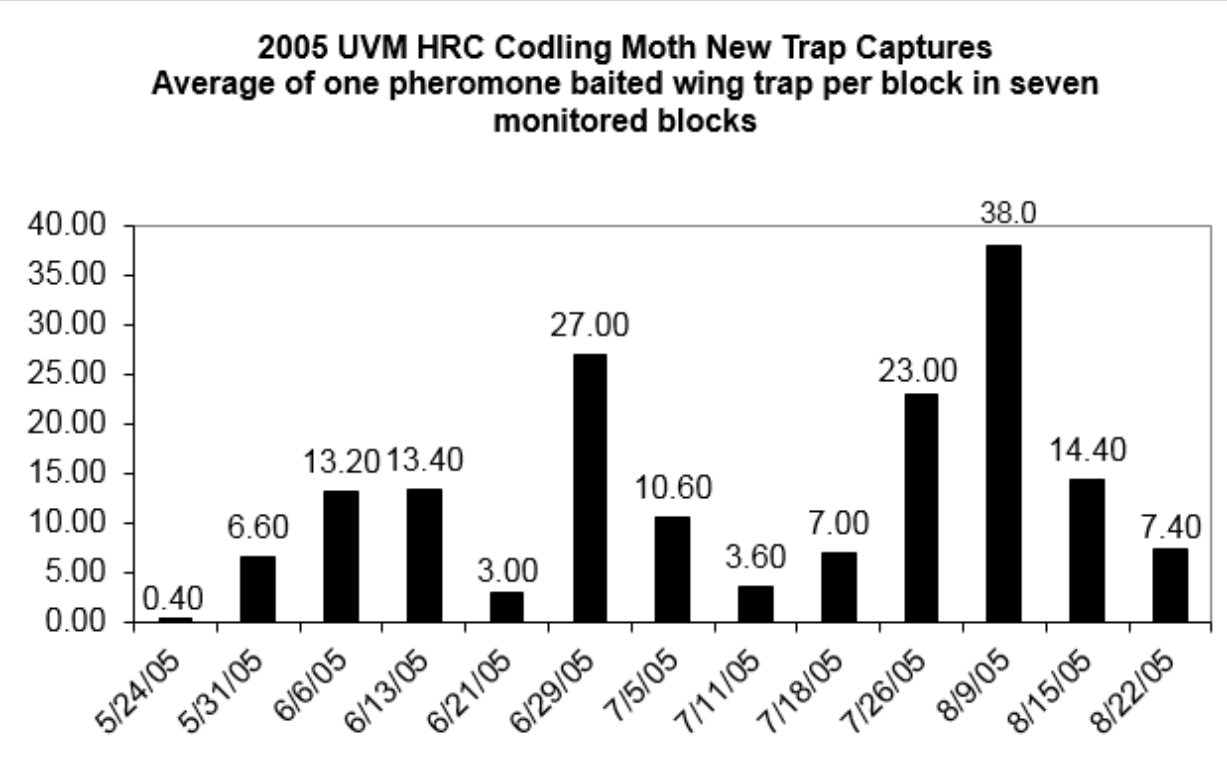
Accumulated degree days (base 50°F) second generation flight start through 8/14/2015: 144 (0 days missing)

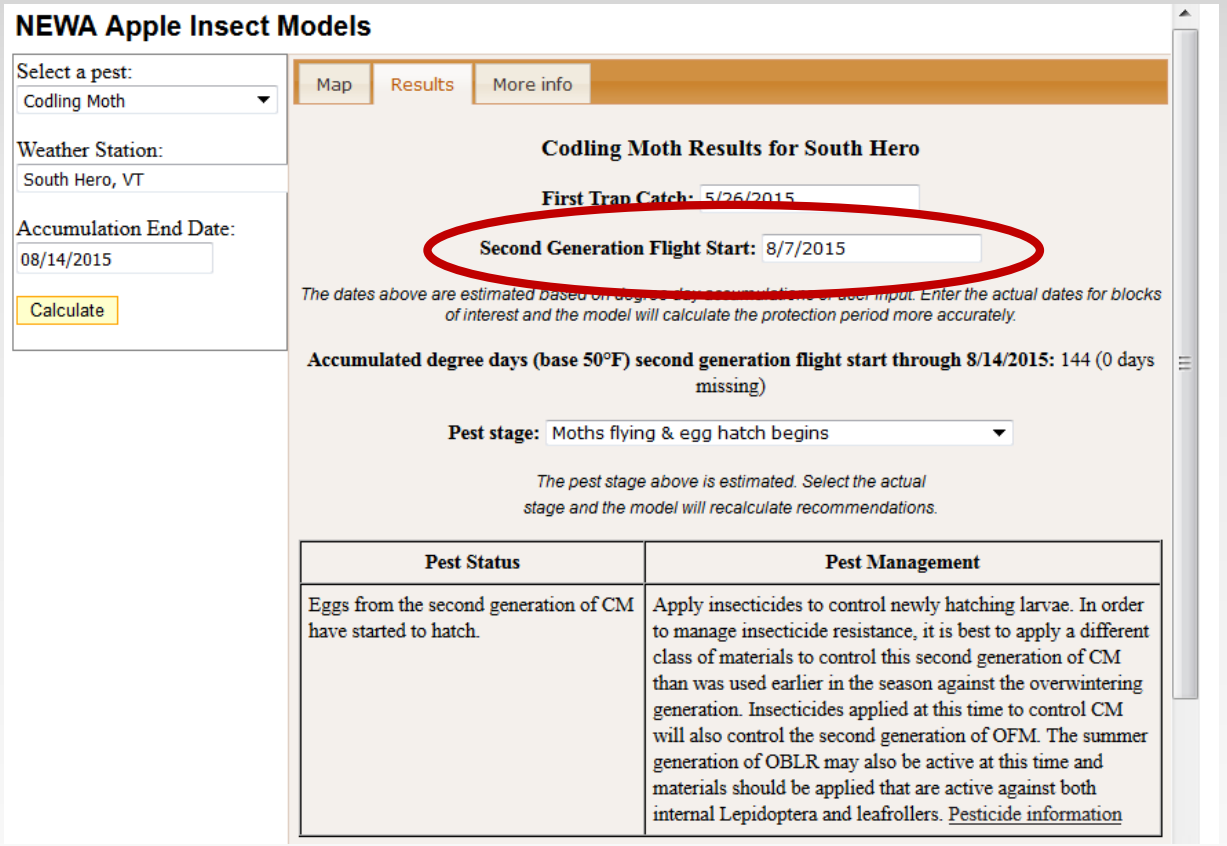
Pest stage: Moths flying & egg hatch begins

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

Pest Status	Pest Management
Eggs from the second generation of CM have started to hatch.	Apply insecticides to control newly hatching larvae. In order to manage insecticide resistance, it is best to apply a different class of materials to control this second generation of CM than was used earlier in the season against the overwintering generation. Insecticides applied at this time to control CM will also control the second generation of OFM. The summer generation of OBLR may also be active at this time and materials should be applied that are active against both internal Lepidoptera and leafrollers. Pesticide information

Codling Moth





Apple scab: Evaluating for end of 1° spraying

- End of primary ascospore release (??)
  - 900 DDb32°F from McIntosh green tip
  - 0.1" rain, temp >50°F will release 'final' spores
- IF you have covered for all infection periods AND ALL ascospore release is complete, you are done spraying against apple scab for the season.

- Scout orchards after 10-14 days of last infection period
  - 50 terminals in all parts of trees (interior, treetops)
  - <1% of leaves with any scab lesions visible

Apple scab: Evaluating for end of 1° spraying

- End of primary ascospore release (??)
  - 900 DDb32°F from McIntosh green tip
  - 0.1" rain, temp >50°F will release 'final' spores
- IF you have covered for all infection periods AND ALL ascospore release is complete, you are done spraying against apple scab for the season.
- Scout orchards after 10-14 days of last infection period
  - 50 terminals in all parts of trees (interior, treetops)
  - <1% of leaves with any scab lesions visible

Table 6.2.1. Revised Mills Table. Approx. hours of wetting necessary to produce primary apple scab infections, and approx. number of days required for lesions to appear, at different average temperatures.

Temperature (°F)	Hours [1]	Lesions Appearance (days) [2]
34	41	–
36	35	–
37	30	–
39	28	–
41	21	–
43	18	17
45	15	17
46	13	17
48	12	17
50	11	16
52	9	15
54–56	8	14
57–59	7	12–13
61–75	6	9–10
77	8	–
79	11	–

[1] Refer to Notes on Apple Scab Management for computing wetting intervals for primary infection when rain begins at night in low-inoculum orchards. Data of MacHardy & Gadoury (1989); and Stensvand, Gadoury, & Seem (1997).

[2] Number of days required for lesions to appear after infection has been initiated. No further wetting is required. Additional days may be required if conditions are unfavorable for lesion development (prolonged periods above 80° F or very dry weather).

Apple Maggot Fly

- Red ball traps used to monitor emergence & flight

NEWA Apple Insect Models

Select a pest: Apple Maggot

Weather Station: South Hero, VT

Accumulation End Date: 08/14/2015

Calculate

Map | Results | More info

Apple Maggot Results for South Hero

First Trap Catch: 7/28/2015

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 8/14/2015: 373 (0 days missing)

Pest stage: Adults move into orchards, eggs laid

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

Pest Status	Pest Management
Previous studies have shown that August 1-15 is the time period when the most AM flies immigrate into commercial orchards, although flies can be trapped in late June and into September and early October.	After 10-14 days have elapsed since the first AM treatment (estimated period of residual effectiveness of insecticides), continue to check AM traps and apply additional sprays when trap catches exceed the threshold. Perimeter sprays can be used for low pressure orchards. In high pressure orchards, after the first spray is applied, continue to apply sprays to a larger perimeter area. Repeat monitoring protocol and apply additional sprays as necessary to provide protection until at least September 1. Pesticide information

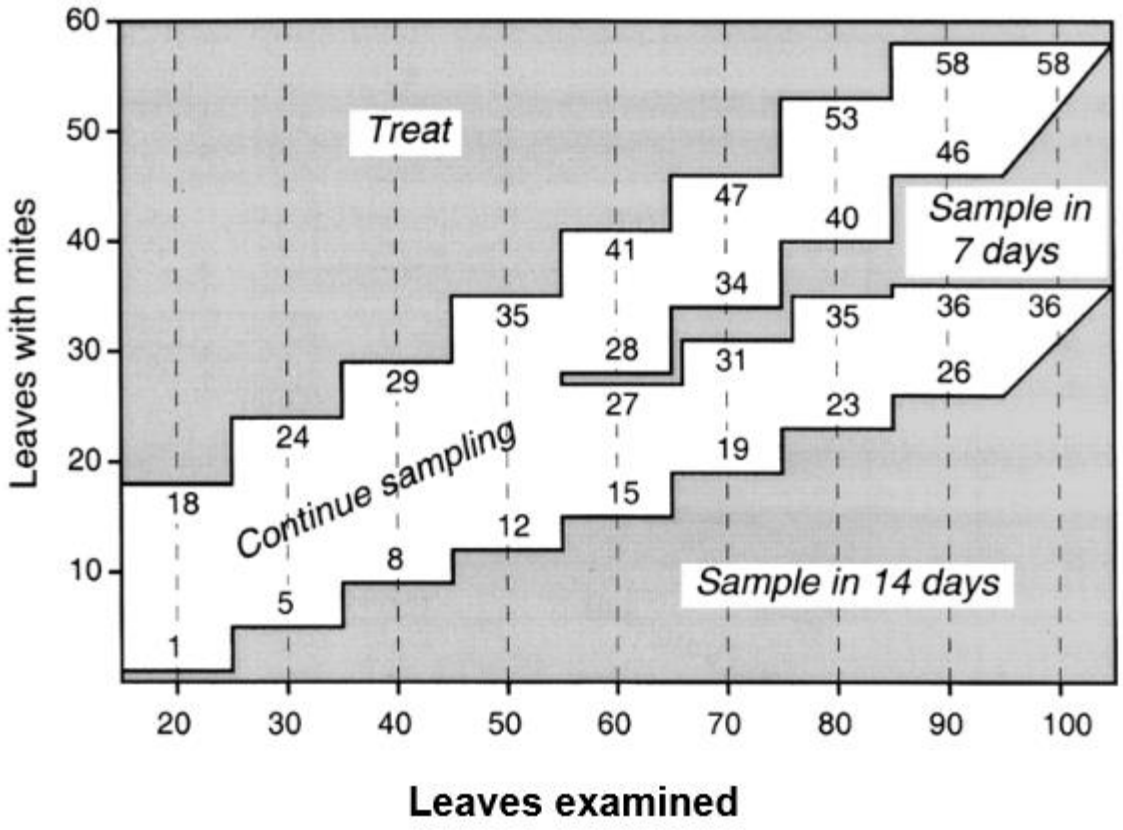
Apple Maggot Fly: Mid-June

- Red ball traps used to monitor emergence & flight
- Three traps/block,
  - 1-2 rows in from the edge
  - 5-6 feet above
  - Surrounded but not touched by fruit and foliage
  - Inspected weekly.
- Thresholds:
  - Non Baited Spheres: 1/trap
  - Baited Spheres: 5/ trap
- Continue to Monitor through August

Photo credits: L.P. Berkett; Instructional Media Center, Mich. State University, East Lansing, MI; Integrated Management of Apple Pests in Massachusetts and New England, Coop. Ext. Sys., University of Mass. 1984.

European Red Mite

Figure 7.1.3 – Mite Sampling Chart
Threshold = 2.5 mites/leaf
(June 1 - 30)



Leafhoppers: mid-summer

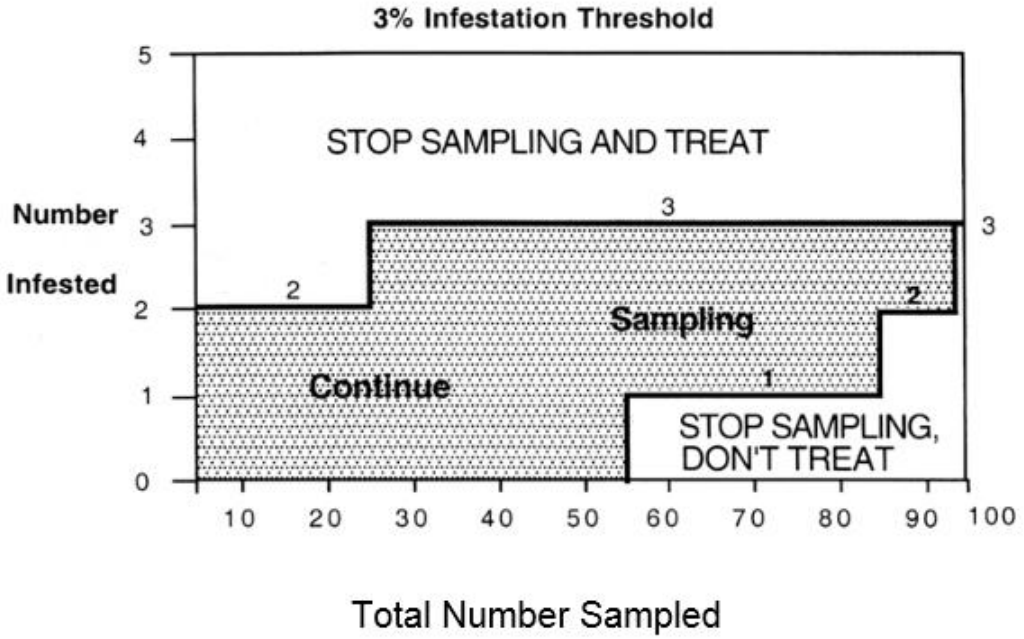
- Petal Fall-June : examine leaves for presence of 1st gen. nymphs and adults
  - Threshold: 25/ 100 Leaves

- August: examine leaves for presence of 2nd gen. nymphs and adults
  - Threshold: 25/ 100 Leaves

Oblique Banded Leaf Roller

- Petal Fall: hang pheromone traps in orchard
- Begin to accumulate DD base 43F from first capture
- June: When 600 DD base 43F are reached examine 10 expanded terminal shoots per tree from as wide and are of the block as possible. Record number of terminals infested.

Figure 7.1.1 - Obliquebanded Leafroller Sampling Form



Oblique Banded Leaf Roller

- Petal Fall: hang pheromone traps in orchard
- Begin to accumulate DD base 43F from first capture
- June: When 600 DD base 43F are reached examine 10 expanded terminal shoots per tree from as wide and are of the block as possible. Record number of terminals infested.
- June-July: Scout 100 fruit per block at least weekly, spray at first sign of damage

Practice good IPM!

- Plan ahead
- Use decision support tools (NEWA)
- Have necessary information on management tools available (NETFMG)
- Dedicate an employee to regular & consistent scouting program
- Be methodical
- Be ready to act

2016 UVM Apple Program

Terence Bradshaw
- UVM Tree Fruit & Viticulture Specialist
  College of Agriculture & Life Science

Ann Hazelrigg
- Director, UVM Plant Diagnostic Clinic
  UVM Extension

Sarah Kingsley-Richards
Jessica Foster
- Research Technicians

Funding acknowledgements:

USDA Extension Integrated Projects Program
- The Transdisciplinary Vermont Extension IPM Program Addressing Stakeholder Priorities and Needs for 2013-2016

Northeast SARE
- Biological Management of Apple Replant Disease

Vermont Agricultural Experiment Station

Vermont Tree Fruit Growers Association

Vermont Hard Cider Company