

Blueberry Insect Pest Management

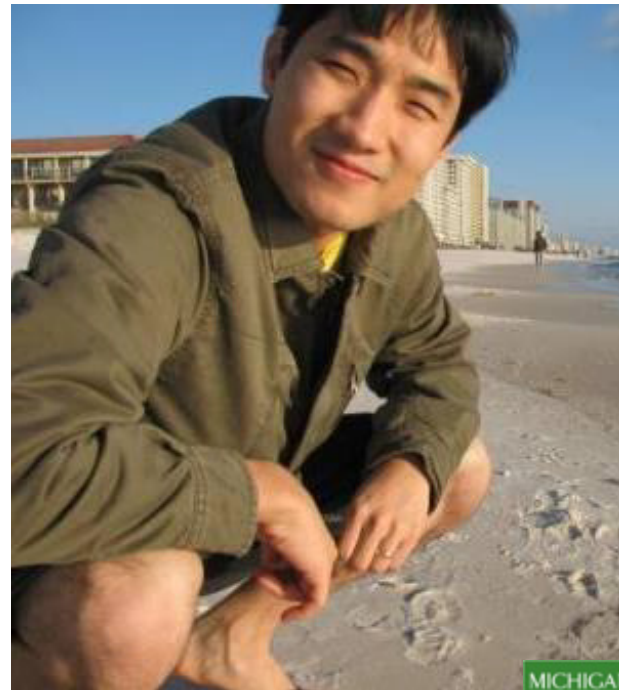
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research

MICHIGAN STATE
UNIVERSITY
EXTENSION

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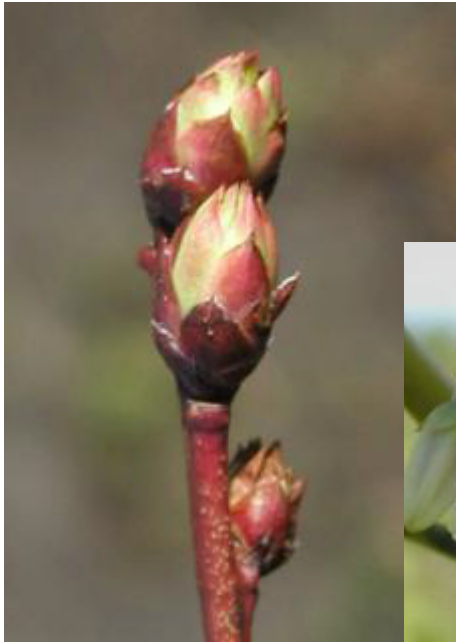
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Outline

- Blueberry IPM
- Cranberry fruitworm
- Blueberry aphid
- Spotted wing drosophila
- Blueberry bud mite
- Blueberry gall midge

Insects may be present in blueberry fields to feed on, or infest:



buds



flowers



leaves and stems



fruit

and roots....

Main activity and management periods of blueberry insect and mite pests

Growth stage	pre-bloom				bloom				mid-season				pre-harvest				harvest				post-harvest			
Degree days base 50 F from March 1	100				300				400				700				1100				1300			
Cutworms																								
Spanworms																								
Leafrollers																								
Gypsy moth																								
Thrips																								
Cherry FW																								
Cranberry FW																								
Plum curculio																								
Aphids																								
BB maggot																								
Japanese beetle																								
Tussock moth																								
BB bud mite																								
SW Drosophila																								

Bars show period when scouting and management of the pest is most important. Blue = key pest



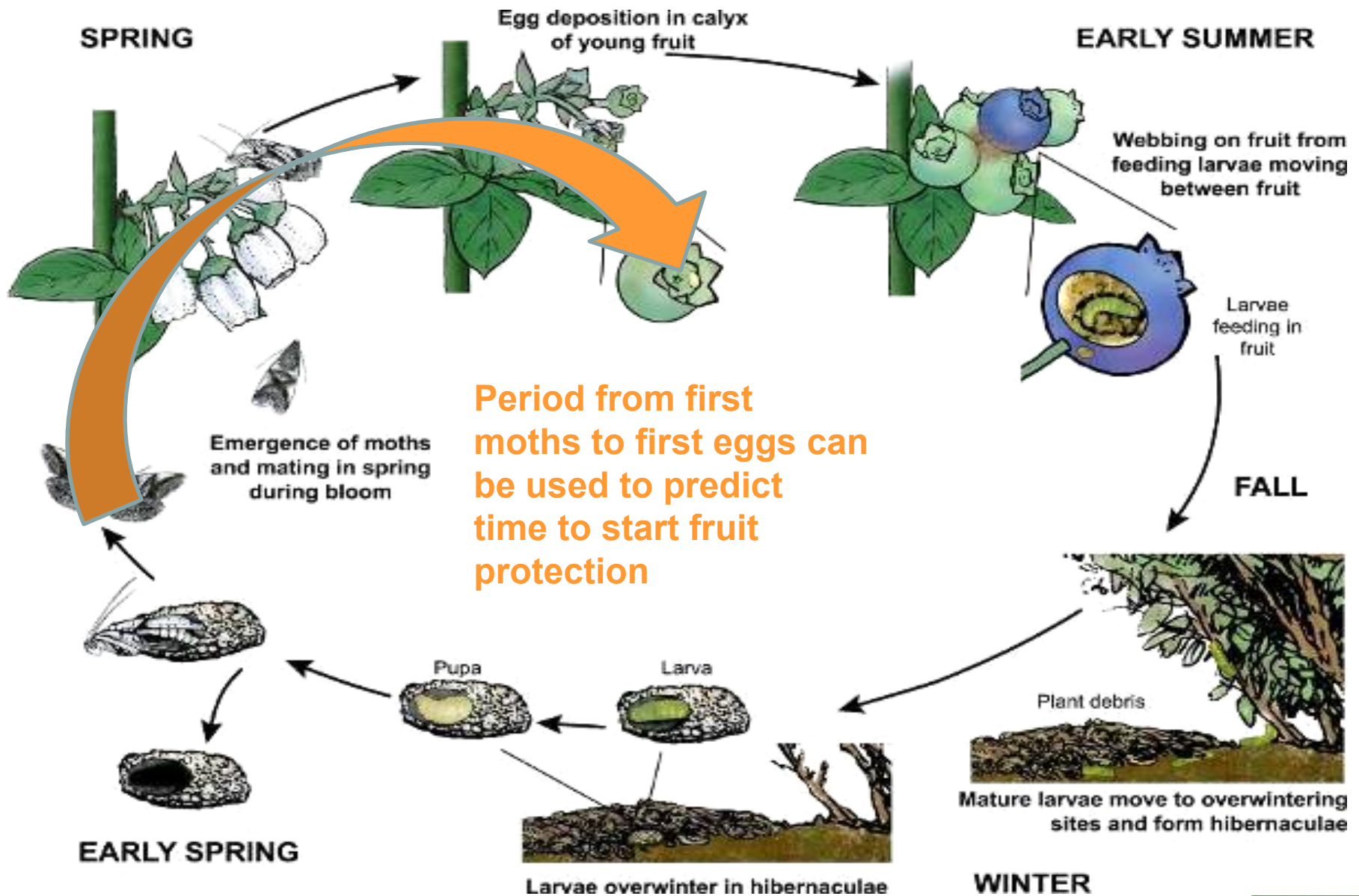
Guthion phaseout update

- US-EPA phasing Guthion out of blueberries by Sept 2012.

Changes for 2011

- **Guthion WP yearly max. at 1.5 pounds/ac.**
- **Aerial application of Guthion is now banned.**
- Maximum single application of 1.5 pounds.
- 7 day REI and PHI, except in U-pick fields (30 or more days).
- 60 ft buffer zone to bodies of water, occupied dwellings, and recreational areas.

Cranberry fruitworm life cycle



Cranberry fruitworm on fruit

Eggs



Larvae



Insect phenology is based on temperature

Key events can be predicted most accurately using degree days, not the calendar

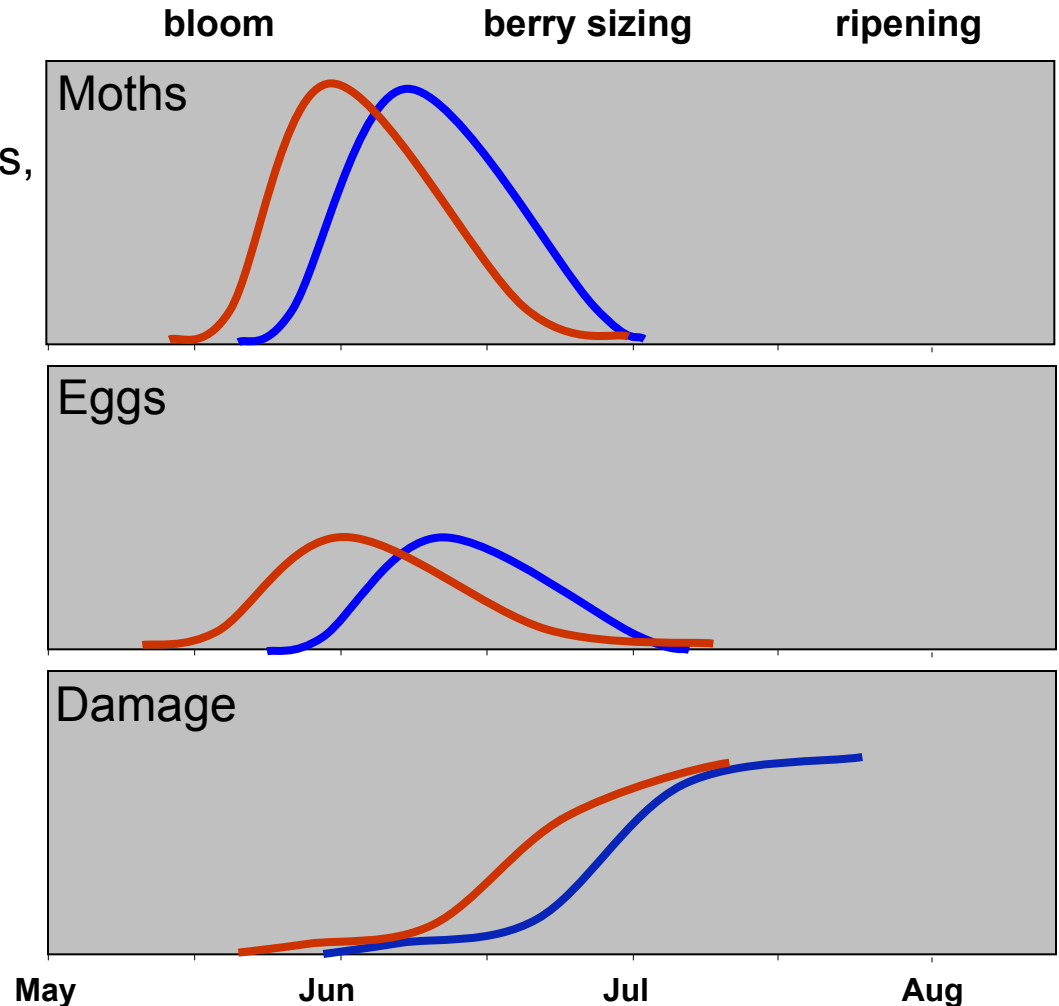
Events happen on different dates, but at the same degree days each season

Blue line = cool season

Red line = warm season

Growing degree days

$$GDD = \frac{T_{\max} + T_{\min}}{2} - T_{\text{base}}$$



Insect phenology is based on temperature

Key events can be predicted most accurately using degree days, not the calendar

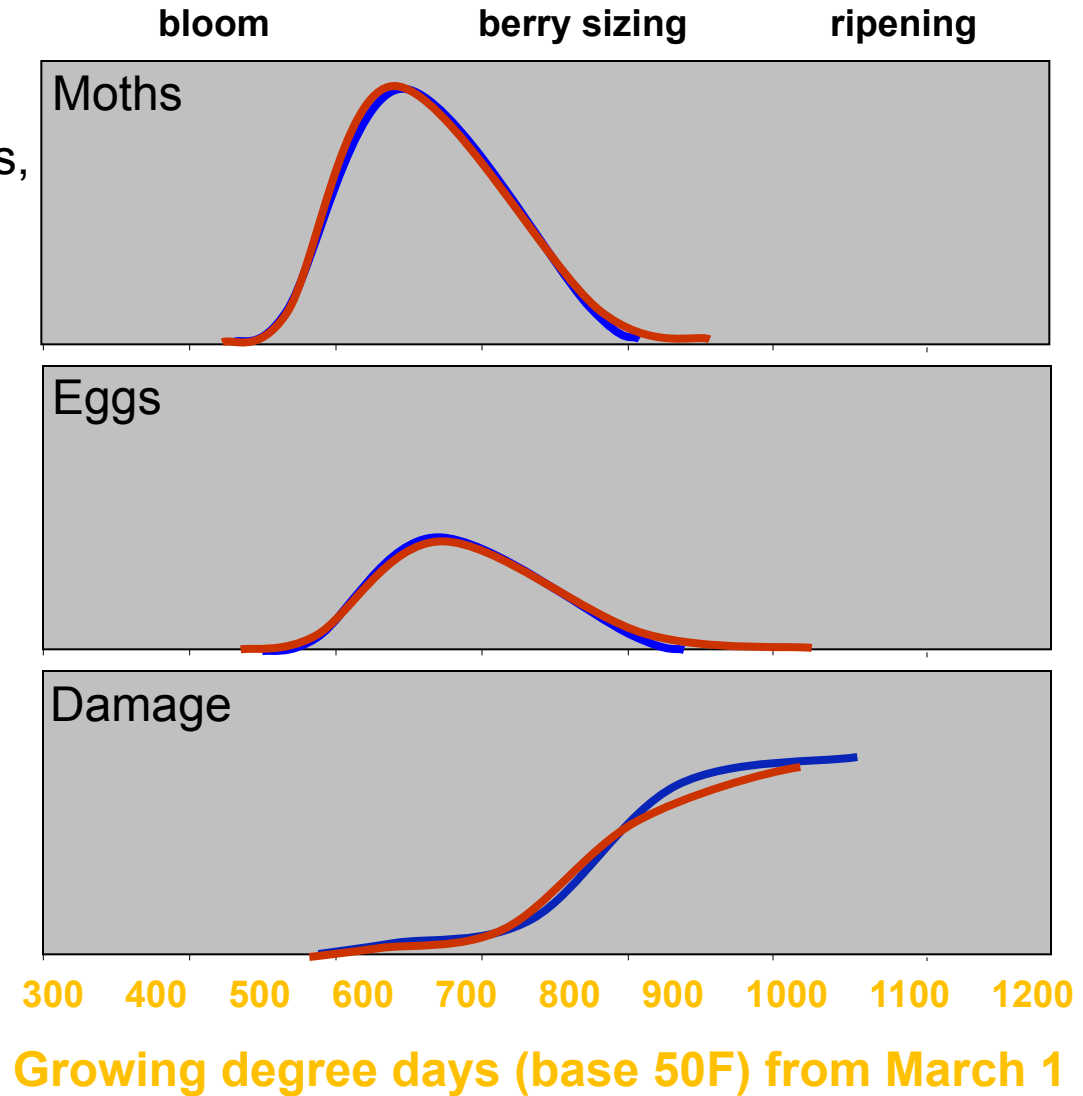
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Growing degree days

$$GDD = \frac{T_{\max} + T_{\min}}{2} - T_{\text{base}}$$



Using the degree day model to identify the start of CBFW flight

- Put traps out at the start of flowering
- One trap/10 ac in top of bushes, at edge of fields
- Check twice a week to identify first sustained catch of moths
- Count DD from day before sustained moth catch
- First eggs predicted **85 GDD** later

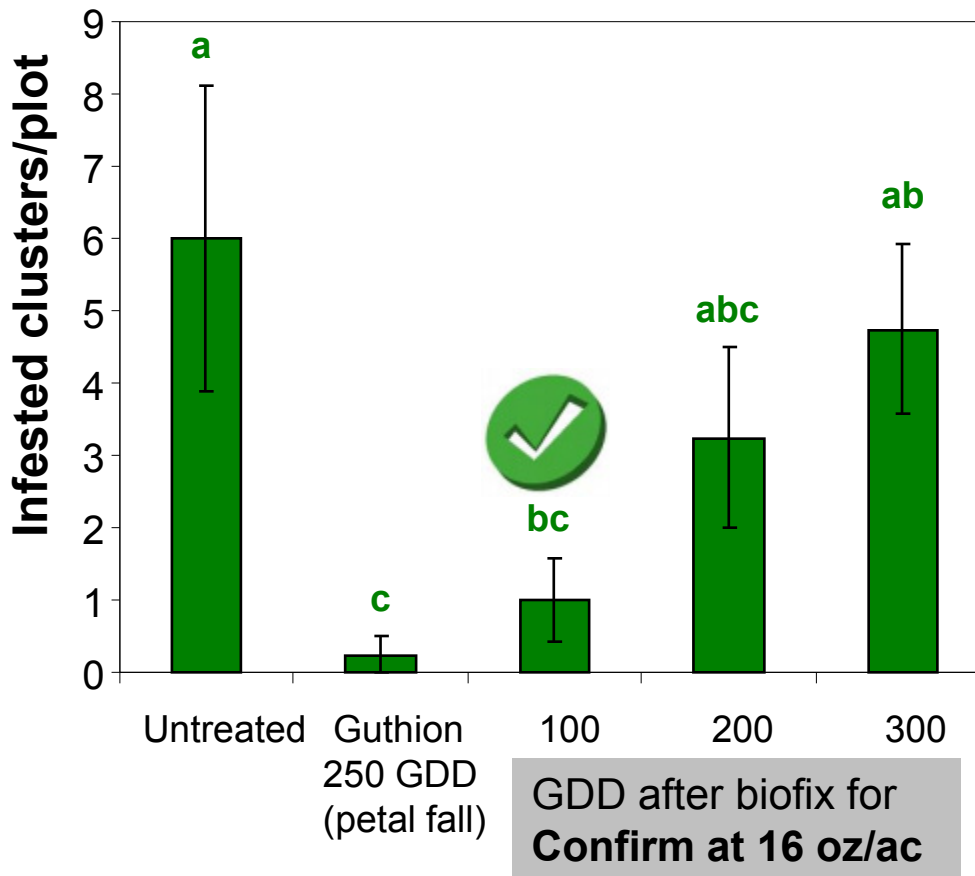


Trap check	Site 1	Site 2	Site 3	Site 4
6/3	0	2	0	0
6/6	0	0	0	3
6/9	1	0	0	0
6/13	0	0	0	10
6/17	0	2	0	17
6/21	1	5	0	25
6/24	2	9	0	10
6/27	4	0	5	4
6/30	10	0	17	2
7/2	25	2	11	1

Gray boxes indicate date to start counting DD to predict start of egg laying

For selective insecticide, correct timing improves control

Comparison of different timings of growth regulator Confirm to the broad-spectrum Guthion. All treatments reapplied 14 days later.



Tracking degree days on your farm

DIY: max-min thermometer

$$\frac{(\text{Max} + \text{Min})}{2} - 50 = \text{daily DD accumulation}$$



Weather monitor:



MSU Online Information:

Fruit CAT Alert

Blueberry IPM Update

Enviroweather



Using the cranberry fruitworm model

www.enviroweather.msu.edu

Free online service to access weather information from around Michigan

Weather forecasts, frost warnings

Pest development models for blueberry
cranberry fruitworm
blueberry maggot
oblique-banded leafroller



2009		Temperature (F)			Degree Days Base 50 F		Biofix Date (date immediately before first sustained moth captures)																							
Day	Date	Max	Min	Avg	Today	Since 3/1	5/12	5/13	5/14	5/15	5/16	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30					
Wed	5/13	70	55	63	12.7	299.1	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
Thu	5/14	71	48	60	9.9	309	23	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
Fri	5/15	68	47	58	8	317	31	18	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
Sat	5/16	62	38	50	3.7	320.7	34	22	12	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
Sun	5/17	60	34	47	2.9	323.6	37	24	15	7	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
Mon	5/18	69	32	51	6.2	329.8	43	31	21	13	9	6	--	--	--	--	--	--	--	--	--	--	--	--	--					
Tues	5/19	80	47	63	13.7	343.5	57	44	34	26	23	20	14	--	--	--	--	--	--	--	--	--	--	--	--					
Wed	5/20	86	54	70	20.2	363.7	77	65	55	47	43	40	34	20	--	--	--	--	--	--	--	--	--	--	--					
Thu	5/21	84	57	71	20.6	384.3	98	85	76	67	64	61	54	41	21	--	--	--	--	--	--	--	--	--	--					
Fri	5/22	72	52	62	12.4	396.7	110	98	88	80	76	73	67	53	33	12	--	--	--	--	--	--	--	--	--					
Sat	5/23	83	52	67	17.4	414.1	128	115	105	97	93	90	84	71	50	30	17	--	--	--	--	--	--	--	--					
Sun	5/24	80	60	70	20	434.1	148	135	125	117	113	110	104	91	70	50	37	20	--	--	--	--	--	--	--					
Mon	5/25	76	56	66	16.1	450.2	164	151	141	133	130	127	120	107	86	66	54	36	16	--	--	--	--	--	--					
Tues	5/26	84	58	71	21.4	471.6	185	172	163	155	151	148	142	128	108	87	76	58	38	21	--	--	--	--	--					
Wed	5/27	80	64	72	21.8	493.4	207	194	184	176	173	170	164	150	130	109	97	79	59	43	22	--	--	--	--					
Thu	5/28	84	48	56	6.5	499.9	214	201	191	183	179	176	170	156	136	116	103	86	66	50	28	6	--	--	--					
Fri	5/29	68	45	57	7.8	507.7	221	209	199	191	187	184	178	164	144	123	111	94	74	58	36	14	8	--	--					
Sat	5/30	77	46	61	12	519.7	233	221	211	203	199	196	190	176	156	135	123	106	86	70	48	26	20	12	--					
Sun	5/31	70	41	56	7.7	527.4	241	228	218	210	207	204	198	184	164	143	131	113	93	77	56	34	28	20	8					
Mon	6/1	80	49	64	14.4	541.8	255	243	233	225	221	218	212	198	178	158	145	128	108	92	70	48	42	34	22					
Tues	6/2	69	52	61	10.6	552.4	266	253	243	235	232	229	223	209	189	168	156	138	118	102	81	59	53	45	33					
Wed	6/3	68	45	56	7.4	559.8	273	261	251	243	239	236	230	216	196	176	163	146	126	110	88	66	60	52	40					
Thu	6/4	73	42	58	9.4	569.2	283	270	260	252	248	246	239	226	206	185	172	155	135	119	98	76	69	62	50					
Fri	6/5	77	40	58	10.7	579.9	294	281	271	263	259	256	250	236	216	196	183	166	146	130	108	87	80	72	60					
Sat	6/6	75	50	63	12.7	592.6	306	293	284	276	272	269	263	249	229	208	196	178	158	142	121	99	93	85	73					
Sun	6/7	77	60	68	18.8	611.4	325	312	302	294	291	288	282	268	248	227	215	197	177	161	140	118	104	92	80					



Fruitworm control, 2006

Treatment	Timing	% clusters infested 7/7/06
Untreated		21.5 a
Guthion 50WP, 1.5 lb	A,B,C	1.5 b
Assail 30SG, 5 oz	A,B,C	1.5 b
Avaunt 30 WG, 6 oz	A,B,C	0.5 b
Delegate 25 WG, 4.5 oz	A,B,C	1 b

Treatment timing: A = 6/7 (Petal Fall), B = 6/21, C = 7/6

Fruitworm control trial, 2009

Trial at TNRC Rubel planting

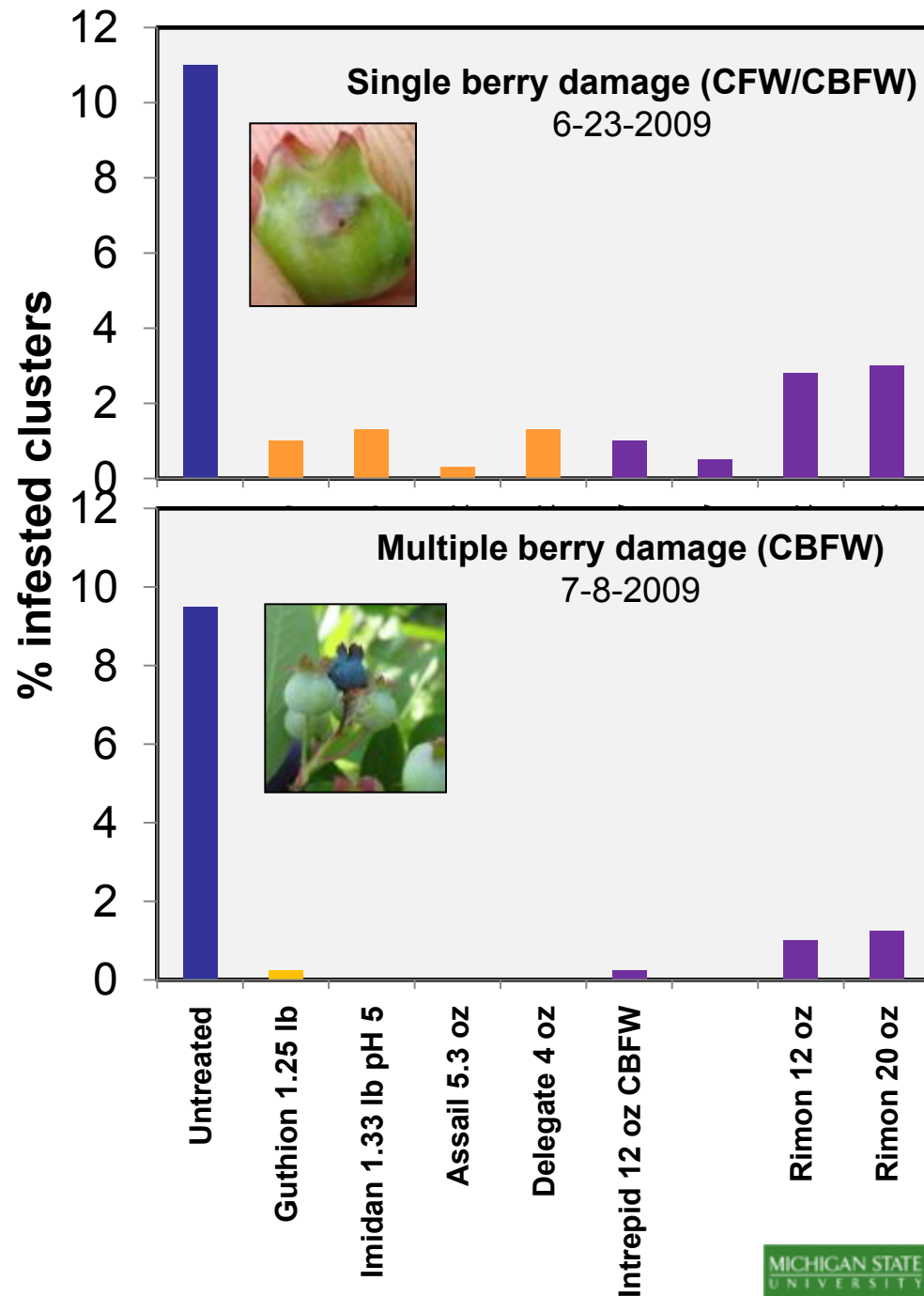
Treatments applied at:

Std timing: 6-5 (PF), 6-19, 7-3

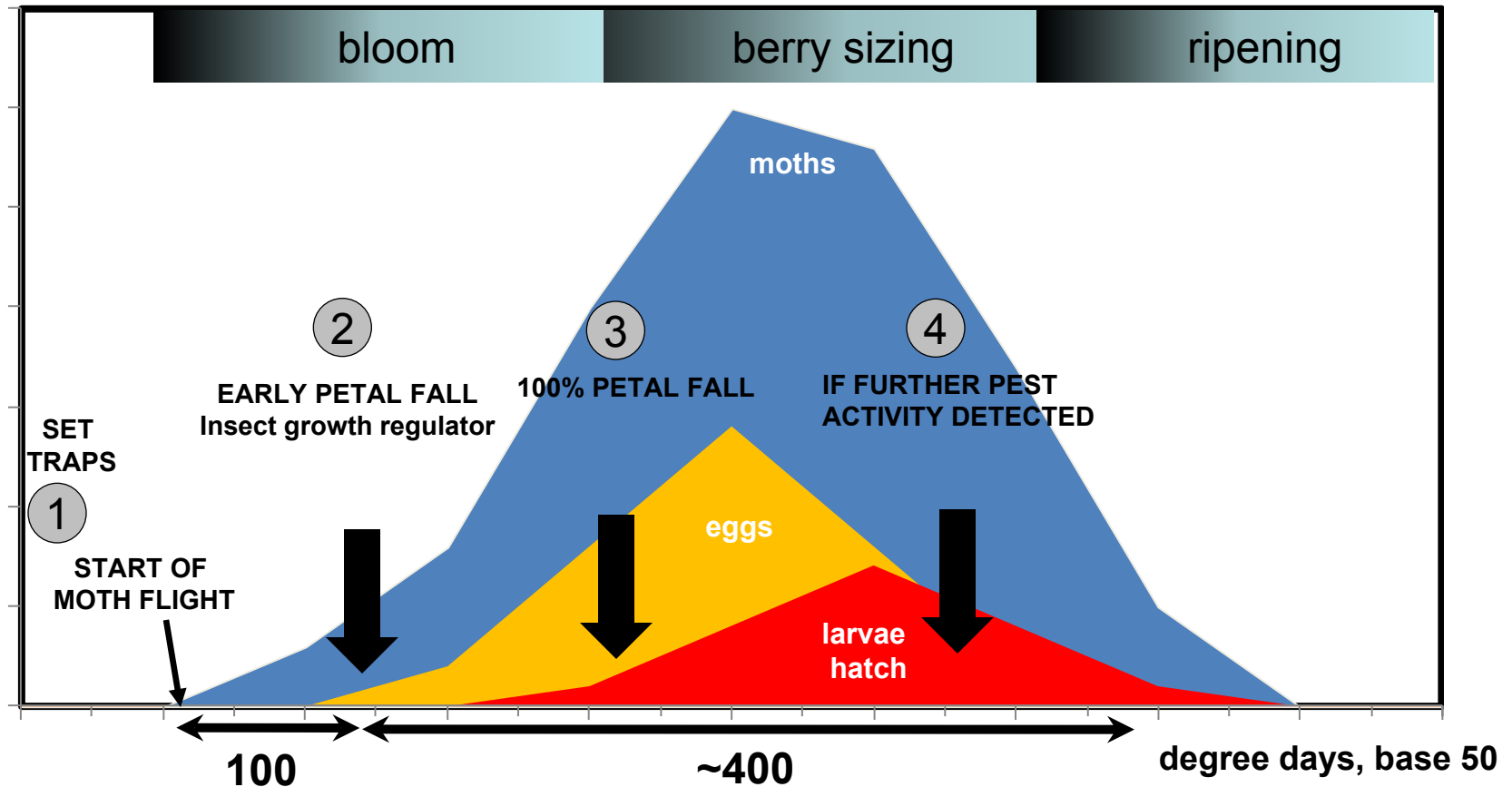
Model timing: 5-27 (85 GDD), 6-10, 6-24

All insecticide treatments were active against CFW and CBFW

Broad-spectrum and reduced-risk insecticides performed very well against fruitworms



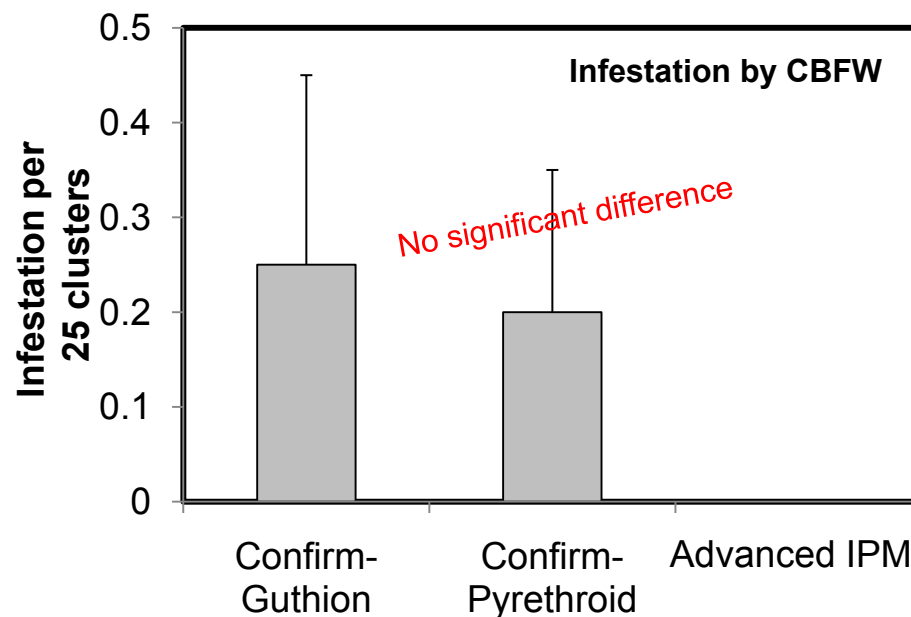
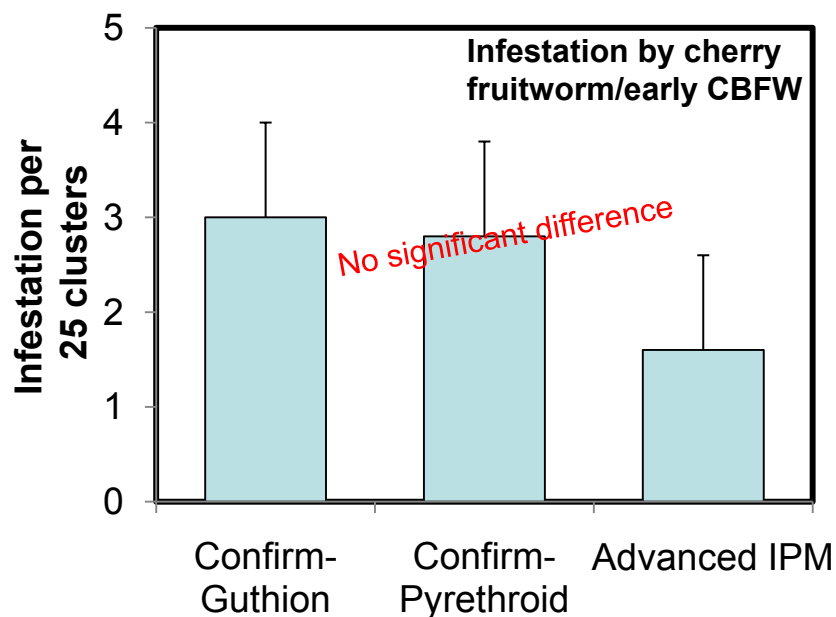
Cranberry fruitworm program in blueberry



- ① Set traps at early bloom and check twice a week. Set biofix as the date of the trap check preceding sustained catch.
- ② First egg laying starts around 85 GDD after biofix (base 50 °F). Intrepid at this timing reduces infestation during bloom.
- ③ Apply a second spray with excellent activity and long residual at 100% petal fall, once bees are removed. **This is a key spray!!**
- ④ If cranberry fruitworm is still active 7-14 days later, consider a follow-up spray to protect berries against hatching larvae. May overlap with the need for aphid or maggot control.

On-farm program comparison, 2009

Timing	Confirm-Guthion	Confirm-Pyrethroid	Advanced IPM
Bloom	Confirm 16 oz	Confirm 16 oz	Intrepid 8 oz 85 GDD
Petal fall	Guthion 1.25 lb	Asana 9.6 oz	Intrepid 8 oz 10-14 d later
7-10 days later	Guthion 1.25 lb	Asana 9.6 oz or Mustang Max 4 oz	Assail 5.3 oz 7-10 days later

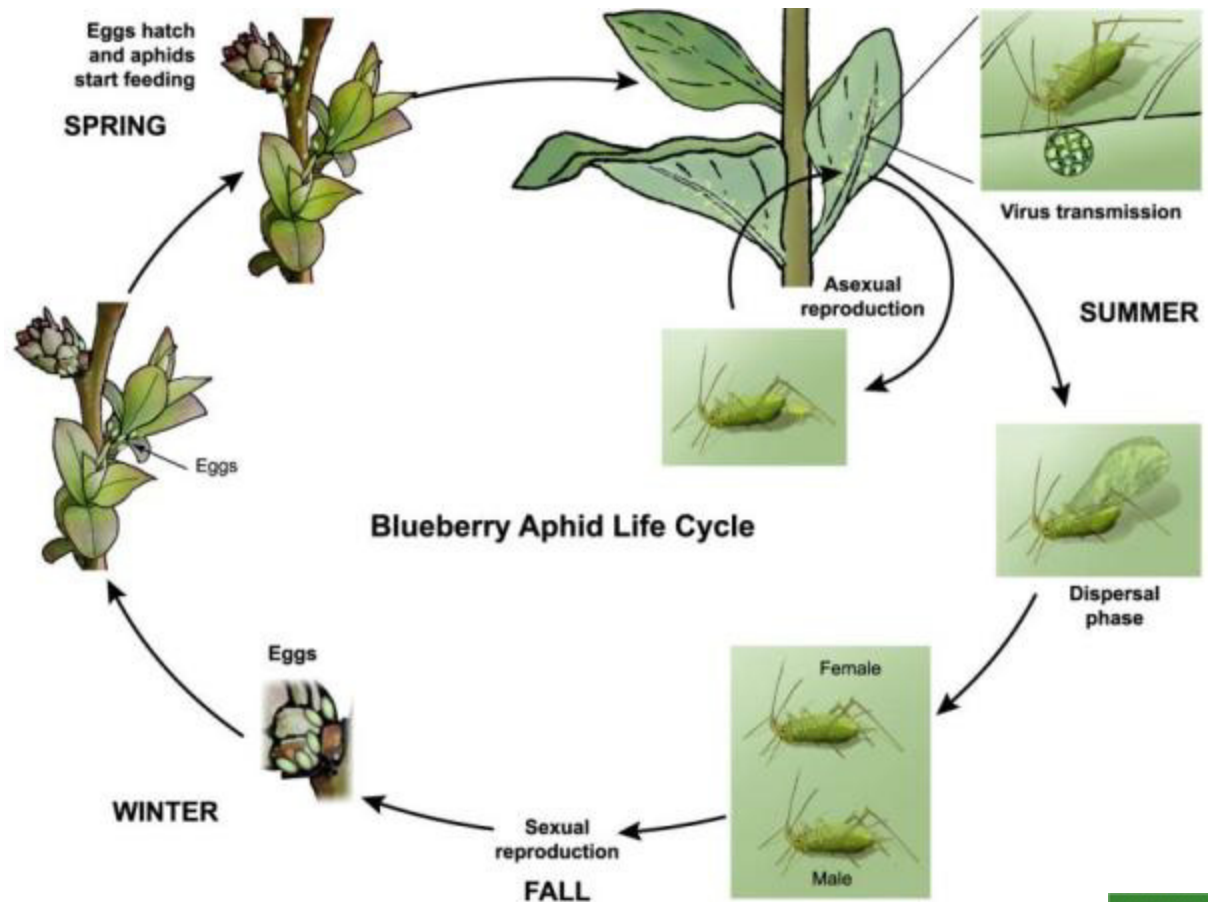


Blueberry aphid

Aphids transmit viruses – shoestring virus in Michigan.

Natural enemies suppress populations.

Control is most important in shoestring susceptible cultivars.



Aphid control for virus control

- If an aphid-vectored virus detected, aphid control prevents further spread.

- Many broad spectrum insecticides will provide short-term control of aphids. Lannate is the most effective of these.
- Neonicotinoids (e.g. Provado, Assail, Actara) are systemic. They move into the leaves and stems, protecting the residue and directing it into the aphid.
- The neonicotinoid class is highly effective against aphids and may control other pests active at the same time.

Ratings of registered neonicotinoids for control of blueberry insect pests

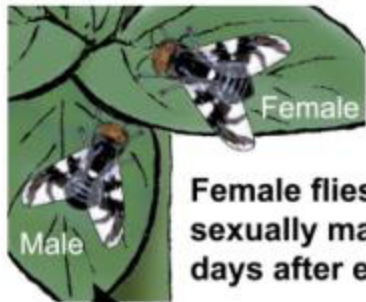
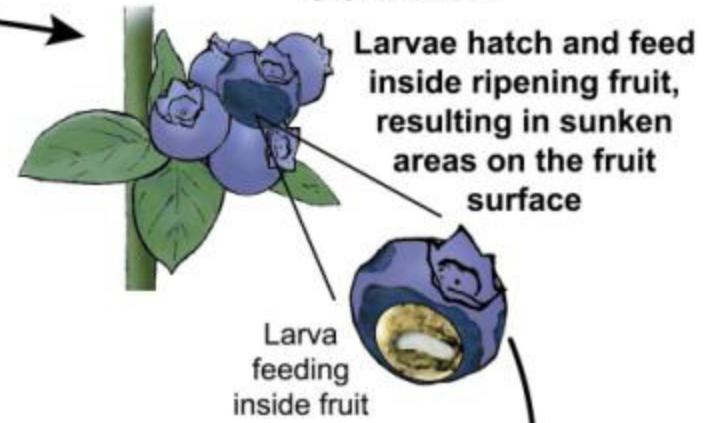
Insecticide	REI (h)	PHI (d)	Aphids	CBFW	BBM	JB	
Actara 3-4 oz	12	3	****	*	**	**	foliar
Assail 2.5-3.5 oz	12	1	****	***	****	**	
Provado 3-4 oz	12	3	****	*	***	**	
Admire (soil) 16 oz	12	7	****			****	grubs
Platinum (soil) 5-12 oz	12	75	****			****	grubs
							soil

- For all foliar aphid sprays, be sure to cover the whole bush, including the lower branches.

SPRING

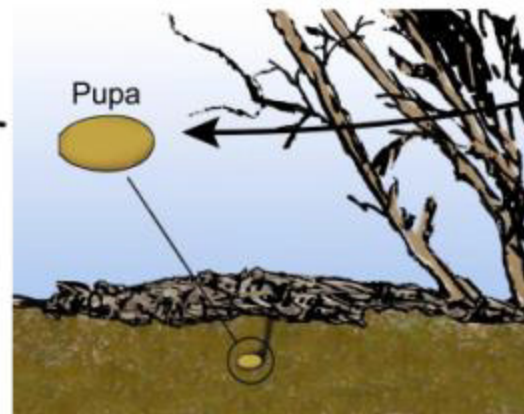


SUMMER



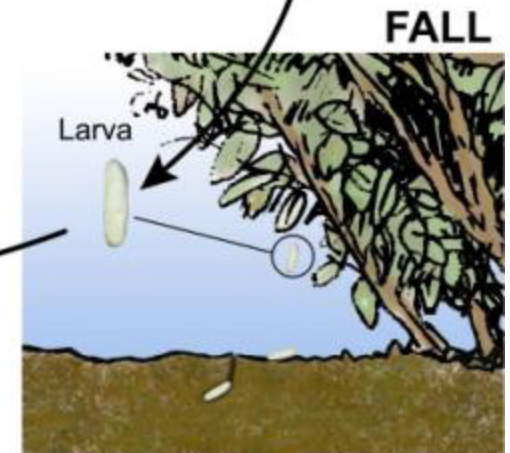
Female flies become sexually mature 10 days after emergence

Blueberry Maggot Life Cycle



Larvae pupate and overwinter in soil

WINTER



Mature larvae drop to ground and burrow up to several inches in soil

Monitoring for Blueberry Maggot Adults

- Adult emergence is best monitored using yellow boards
 - Place in perimeter rows
 - Bait with ammonium acetate
 - Check weekly
 - Can also use green sphere, but not very economical



Blueberry Maggot Adult Identification

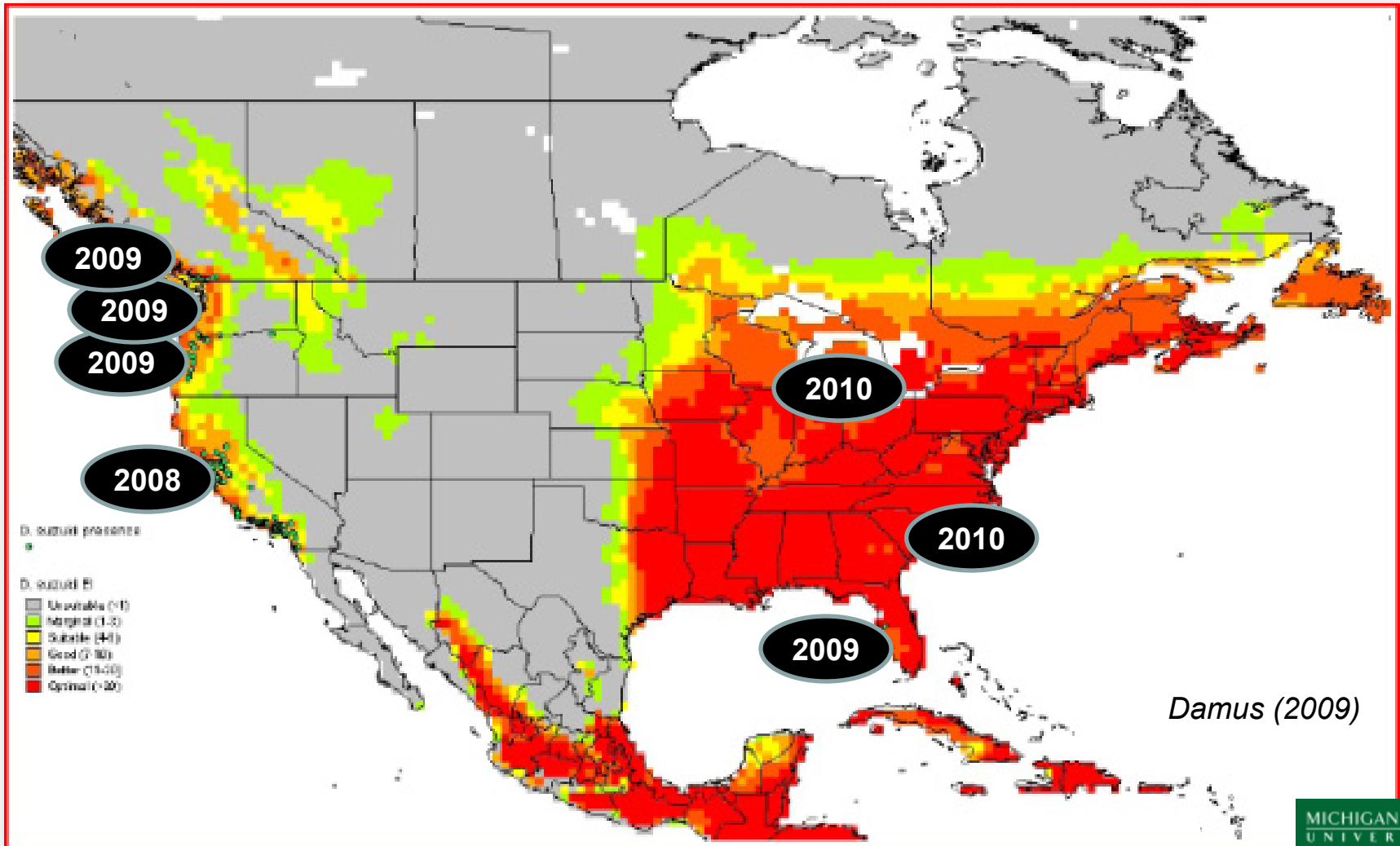
- Blueberry Maggot adults are about 5 mm in length. Most characteristic is the wing banding with an 'M' pattern (three lines that join together).





Where can SWD survive in N. America?

- Native to East Asia, where it is a pest on fruit.
- Information on climate in Asia used to **predict** distribution in the Americas.





Detections in blueberry, raspberry, grape, cherry, rest areas, backyards.

13 counties positive for SWD as of Nov 20, 2010.





Fruit affected by SWD

Highest risk

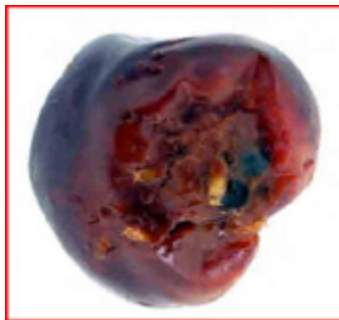
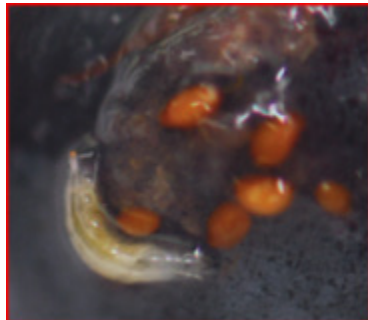
Strawberries
Raspberries
Cherries
Nectarines
Blueberries
Blackberries

Moderate risk

Peaches
Grapes
Pears
Apples
Tomato

Alternate hosts

Wild plants with berries,
such as...
Snowberry
Elderberry
Pokeweed
Dogwood

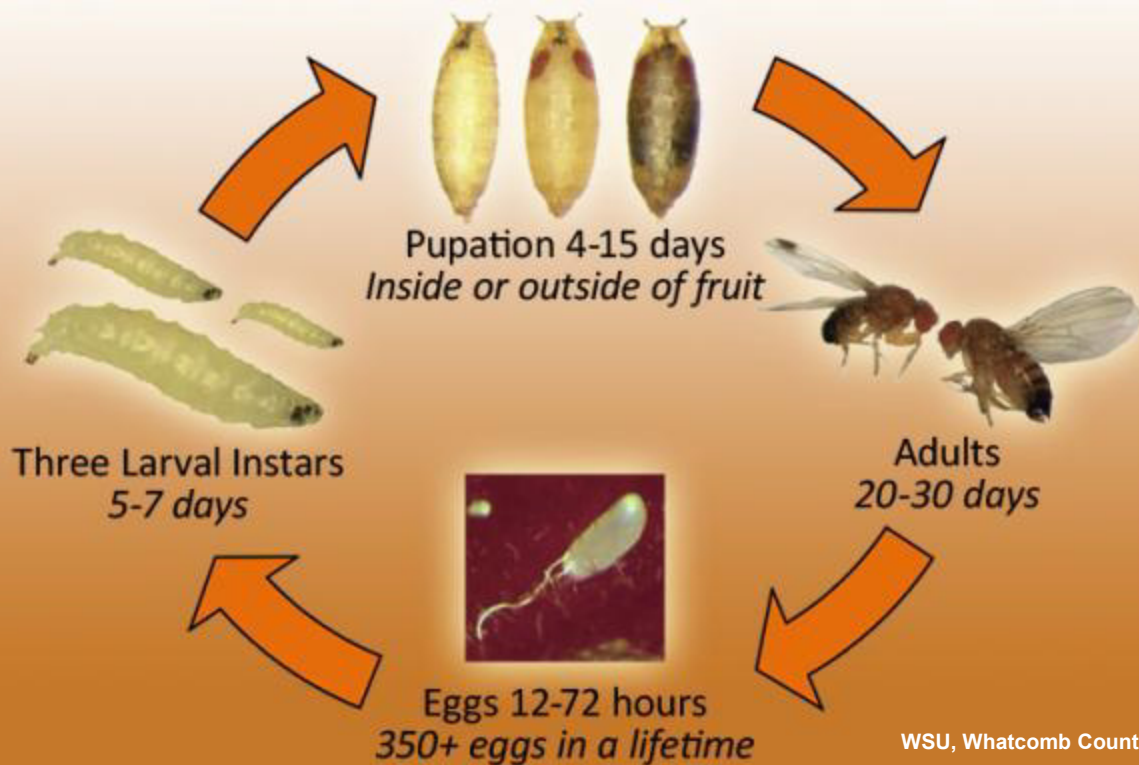




Biology of SWD

Life Cycle of the Spotted Wing Drosophila

Drosophila suzukii (Matsumura)



- Optimal development at 65-70°F, ~**12 day** generation time.
- Adult flies live for 3-6 weeks, and females can lay over 300 eggs.
- Female fly lays eggs into ripening fruit.
- Limited by high heat in summer and by winter cold. But, SWD populations are found in cold regions of Japan.

Male and female SWD

MALE

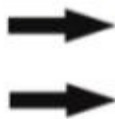


M. Hauser, UC



dark spot on
each wing

two dark bands
on each foreleg



FEMALE

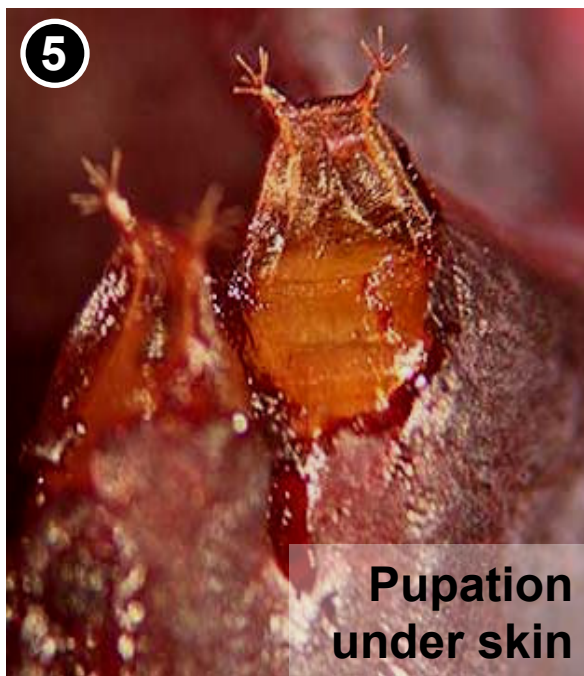
two rows of serrations on ovipositor

no dark spots on wings



M. Hauser, UC

[Click HERE for a detailed
key for identifying SWD](#)





Monitoring SWD



Approx. \$1/trap for materials and construction.

- Plastic cup with side holes, apple cider vinegar bait.
- Use small yellow sticky trap to capture flies. Or, use only vinegar with a drop of unscented soap.
- Hang in fruit canopy near fruit and in the shade.
- Change vinegar weekly, and dispose away from trap.
- Best detection potential expected as fruit ripens.
- Check weekly, and record catches.



Spotting SWD males on traps





Checking fruit for SWD

To see eggs on berry surface

Look for pits in fruit surface or egg tubes

Use a 30x hand lens, also available with LED light for better viewing



To check berries for SWD larvae

Start as fruit begins coloring

Sample 1-2 lbs, ripest suspect fruit

Place in a shallow pan

Pour solution over: 1 Tbsp salt in 1 cup water

Look for mature larvae

Eggs and smallest larvae difficult to detect





IPM for SWD

Current information is primarily from experiences in western US. We will learn a lot in 2011 about pest impact, timing, overwintering survival, and control.

- Midwest growers should be prepared to monitor and manage SWD in 2011.
- Flies were trapped in vineyards only after late September in 2010.
- Grape infestation has generally been lower than other crops, and only after fruit ripen.



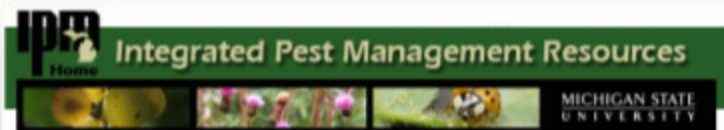
IPM for SWD

- If SWD is detected, current IPM programs will require adjustment.
- If flies are detected, SWD is sensitive to OPs (e.g. Imidan) and pyrethroids (e.g. Mustang Max).
- Entrust and Pyganic are the most effective organic insecticides. Shorten interval (5 days) to maintain control.
- Stay informed through workshops, newsletters, websites.



Stay informed...

www.ipm.msu.edu/SWD.htm



Search

Scout our IPM resources

Resources for managing pests

- Christmas trees
- Field crops
- Fruit
- Home and yard
- Nursery and landscape
- Turfgrass
- Vegetable

Related pest diagnostic/management programs

- Diagnostic Services
- Soil/Plant Nutrient Lab
- Enviro-weather
- Regional IPM Center
- Pesticide safety
- Organic: New Ag Network
- Invasive species
- Sustainable ag & food systems

Organizations

- MSU AHR departments
- MSU Extension
- Michigan Agricultural Experiment Station
- Project GREEN

Site index
Contacts/permissions

Updated 11/30/10

SWD home

Welcome to MSU's Spotted Wing Drosophila site

This site contains information and links for growers and homeowners about a **new invasive pest in Michigan, the Spotted Wing Drosophila**.

Background

The Spotted Wing Drosophila (SWD) is a vinegar fly of East Asian origin that can cause damage to many fruit crops. This small insect has been in Hawaii since the 1980s, was detected in California in 2008, spread through the West Coast last year, and was detected in Florida, Utah, and the Carolinas this year (2010). Because the flies are only a few millimeters long and cannot fly very far, natural dispersion between states is unlikely. Human-assisted transportation is a more likely cause of the recent rapid spread.

What crops are affected?

In other regions, SWD has been reported in most berry crops, grapes, cherries and many other tree fruits, with a preference for softer-fleshed fruit.

Status in Michigan

In fall 2010, SWD was detected in Michigan for the first time as part of a widespread Early Detection and Rapid Response program. It is important to note that SWD have not been found in any fruit in Michigan. SWD flies were detected only in a small part of the state, and only well after fruit harvest. Also, over 300 monitoring traps placed in crops throughout the season caught no SWD flies, despite regular checking. We also do not yet know whether this insect can survive the cold Michigan winter.

What is being done?

Because of these first detections it is important that growers and others with susceptible fruit are aware of this pest and know how to manage it. A SWD Response Team has been formed that combines the expertise of MSU entomologists, horticulturalists, Extension educators, and Michigan Department of Agriculture staff. This website will be the central location for dissemination of information about this insect. Check back for updates.

Managing SWD

If SWD survives the winter in Michigan, we are confident that the Integrated Pest Management (IPM) programs available for SWD control can be implemented to enable continued harvest of high-quality crops. This site will soon contain information about monitoring and management of this insect.



Above, a male Spotted Wing Drosophila fly.

Quick links to:

NEW - See our list of educational meetings.

- Fact sheets
- Biology and life cycle
- Monitoring
- Control recommendations by crop
- Educational meetings - schedule
- Contacts for more information
- Response team info

Funding for the SWD Response Team is provided by Project GREEN and the Michigan Department of Agriculture.



Spotted Wing Drosophila

A new invasive pest of Michigan fruit crops

Rufus Isaacs and Noel Hahn, Department of Entomology | MSU Extension Bulletin E-3140
Rob Tilton and Carlos Garcia, MSU Extension | Nov • October 2010

Introduction

The Spotted Wing Drosophila (SWD) is a small vinegar fly with the potential to damage many fruit crops. It was first detected in Michigan in late September 2010, unlike most other vinegar flies that require damaged fruit to attack, SWD causes damage, when the female flies cut a slit and lay eggs in healthy fruit. This insect is a pest of most berry crops, cherries, grapes and other tree fruits, with a preference for softer-fleshed fruit. Given the propensity for this insect to spread and its potential to injure fruit, it is important to learn about monitoring and management of SWD to minimize the risk of larvae developing in fruit and affecting fruit marketability.

SWD, or *Drosophila suzukii*, was first discovered in the western United States in 2008 and moved quickly through the Pacific Northwest into Canada. In the spring of 2010, SWD was discovered in Florida on strawberries and detected later in the summer in the Carolinas. It has also been detected in Europe. Because the flies are only a few millimeters long and cannot fly very far, human-assisted transportation rather than natural dispersion is the most likely cause of the recent rapid spread.

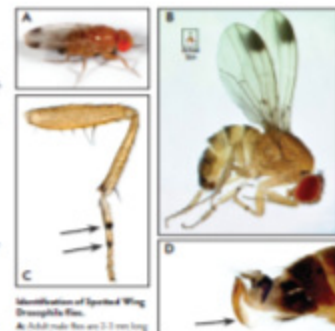
Damage

Female SWD can cut into intact fruit using their serrated ovipositor to inject eggs under the skin. By being able to insert eggs into intact fruit, the larvae of SWD can be present during ripening, leading to a risk of detection in ripe fruit after harvest. During egg laying, wear rot and fungal diseases can also be introduced, further affecting fruit quality. There is a greater risk of fruit contamination at harvest from SWD compared with native species that lay eggs only in already-damaged and rotting fruit.

The adult SWD lives for about two weeks, and can lay more than 100 eggs in a day. This demonstrates their high potential for fruit infestation and spreading through a field if not controlled, infested fruit do not show obvious symptoms of infestation at first, with only a small pinprick visible from egg-laying. Within a few days, the fruit flesh will start to break down, leading to discolored regions and eventual collapse of the tissues. By this point, the white larvae can be relatively easy to detect.

SWD Management

There are three important components to effective SWD management: Monitoring, Identification, and Control.



Identification of Spotted Wing Drosophila flies.
A: Adult male flies are 2-3 mm long and may be seen on the outside of fruit. B: The male SWD has two distinctive dark dots on the wings. C: On the inside of the fruit, the male SWD has two dark bands on the body. D: On the inside of the fruit, the female SWD has a distinctive morphological feature, longer than other vinegar fly species and with two rows of serrations. Photos by Maria Hahn (A, C, D) and Carlos Garcia (B).

Monitoring: The first and most important step is to determine whether SWD are present. This can be done using a simple monitoring trap, consisting of a plastic 52 oz. cup with several 5/16" x 3/16" holes around the sides of the cup, leaving a 2" to 4" section without holes to facilitate pouring out liquid. The holes can be drilled in sturdy containers or burned with a hot wire or wood burner in the thinner plastic cups. Four 1" to 2" of pine apple odor vinegar into the trap as bait. To help attract flies and ensure that trapped flies do not escape, a small yellow sticky trap is placed inside the trap. Traps are hung in the shade in the fruit zone using a stake or a wire attached to the side of the trap, and fastened to a branch or utility.

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Blueberry gall midge

Dasineura oxycoccana



Blueberry gall midge life cycle

Pupae



Adult



Larvae

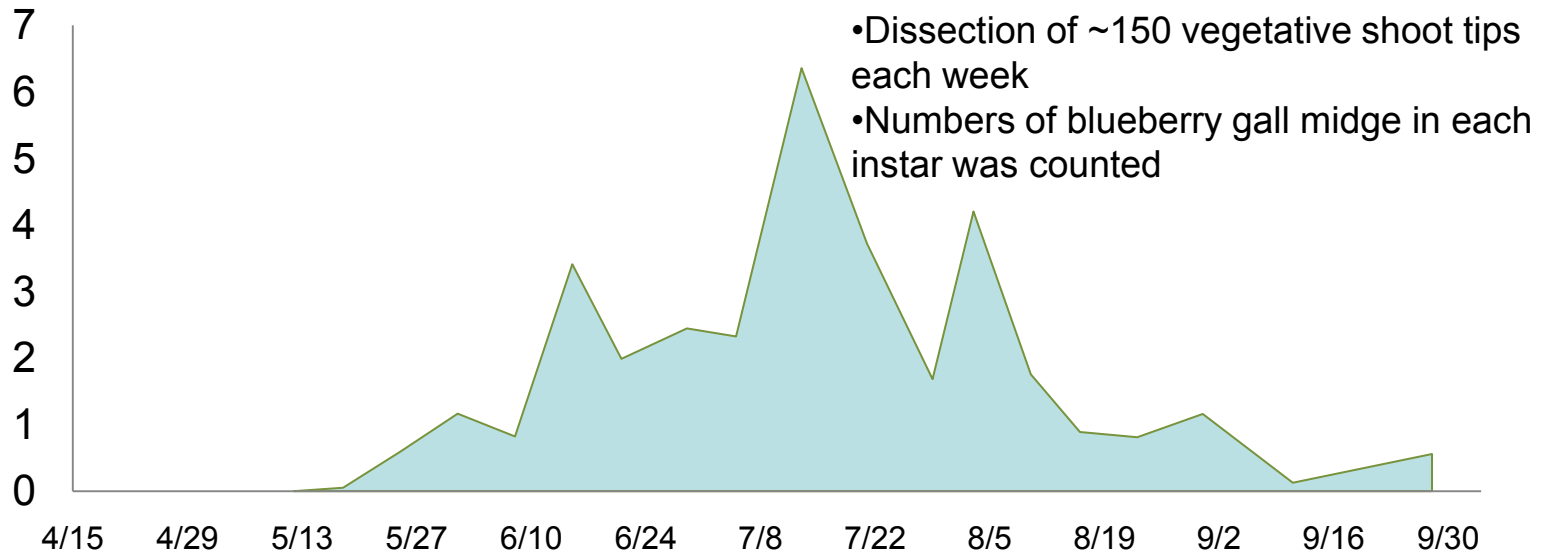


Eggs

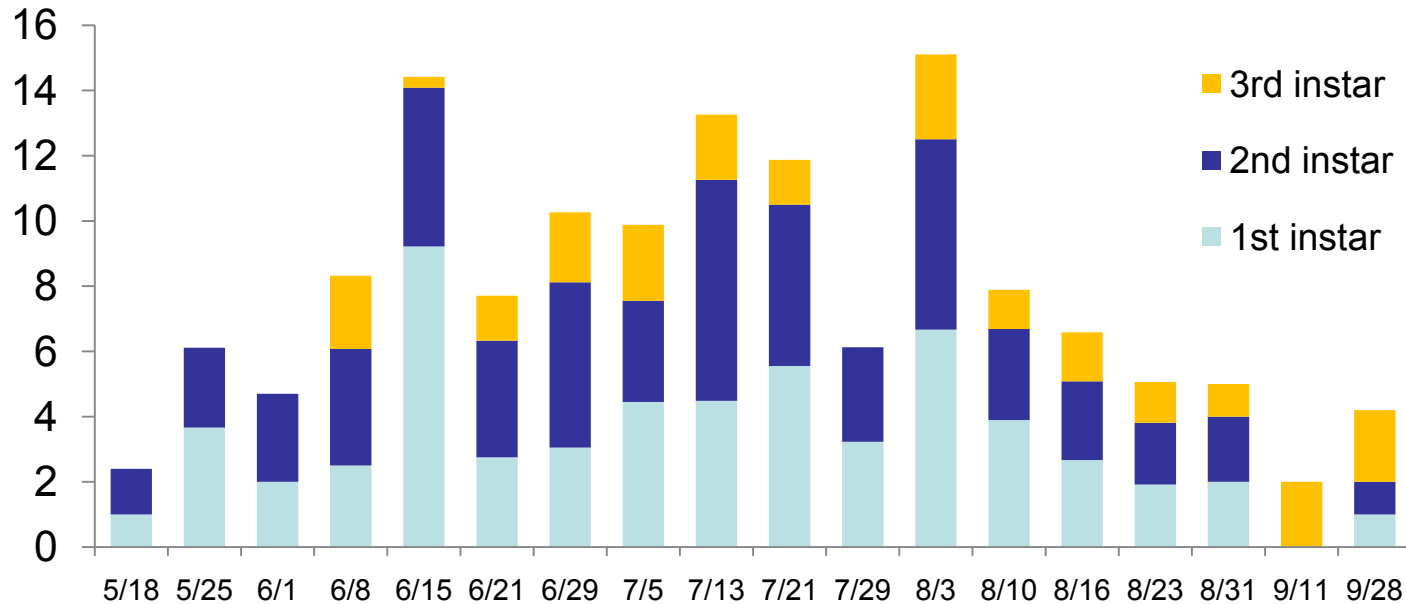


Shoot tip dissections

Avg # of larvae per shoot

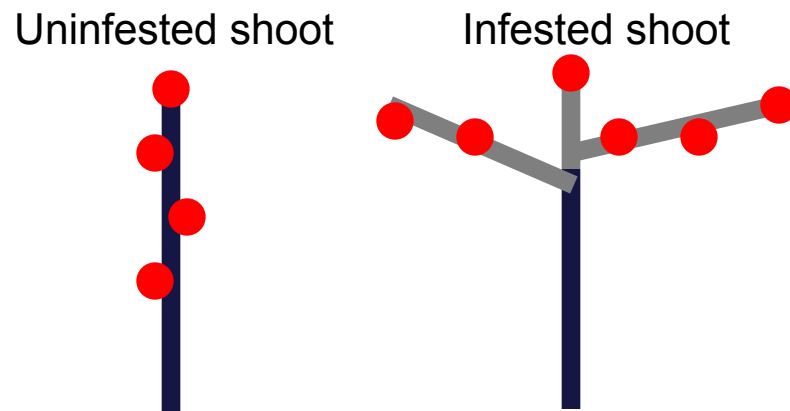


Avg # of larvae per shoot

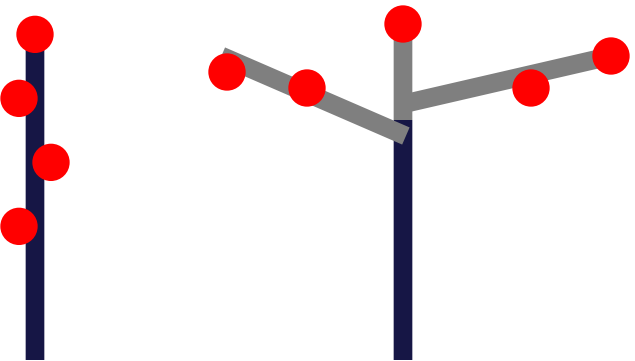
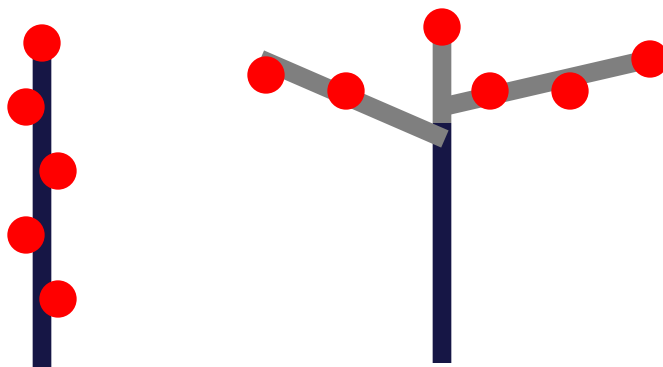
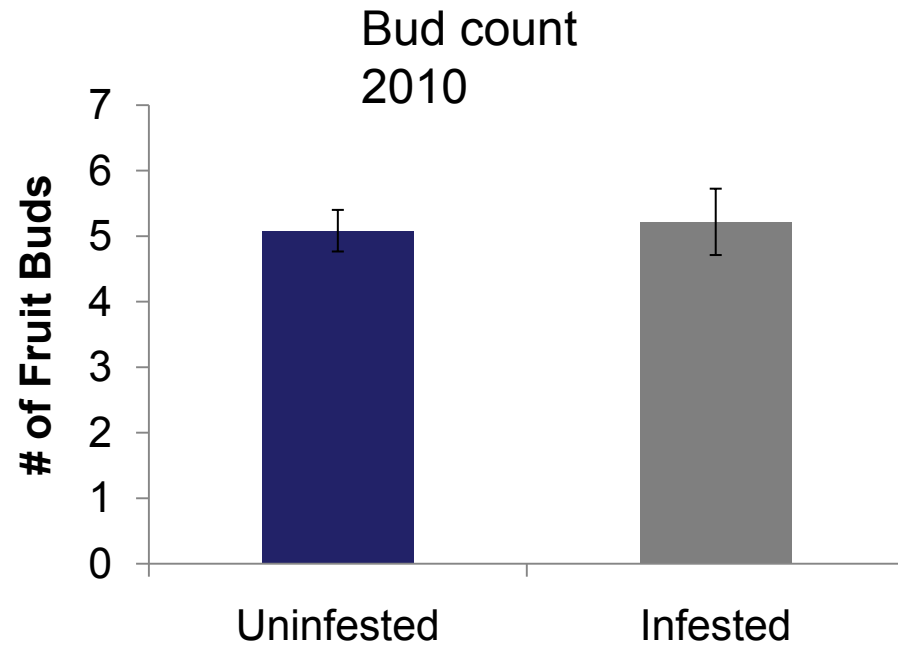
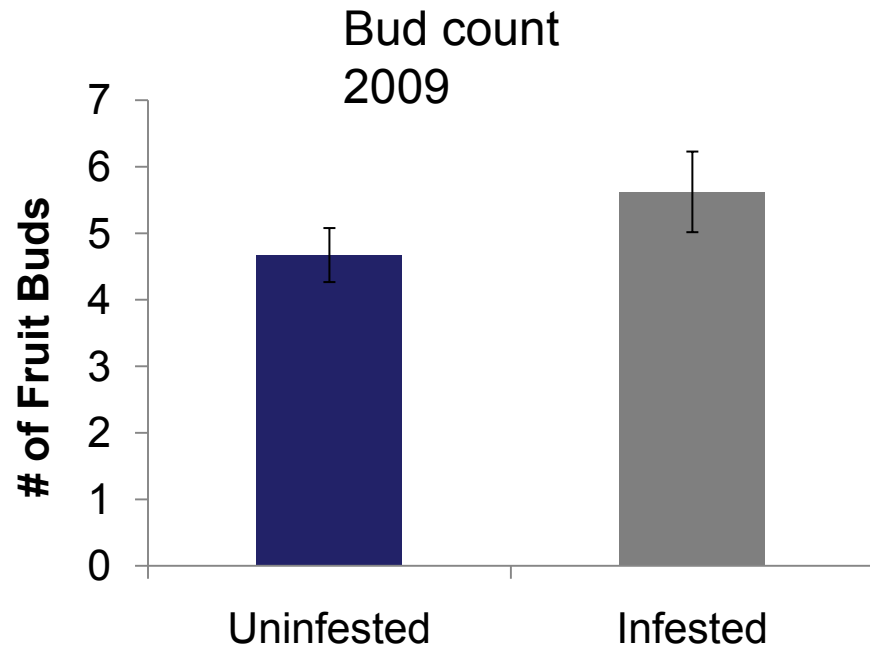


Economic impact of blueberry gall midge?

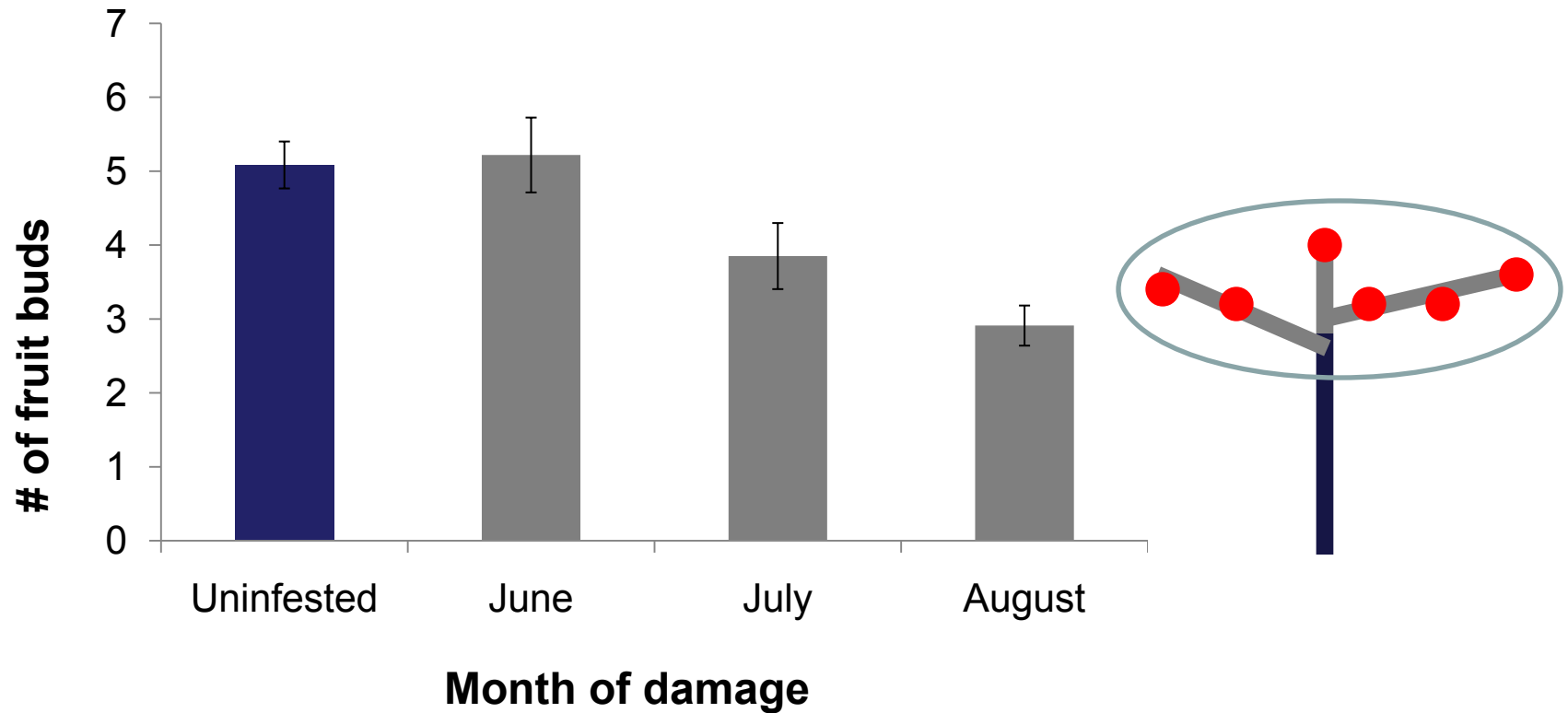
- Four farms, 20 uninfested shoots and 20 infested, branched shoots per farm
- Fruit buds counted on each uninfested shoot and each branch of infested shoots



Economic impact of blueberry gall midge?

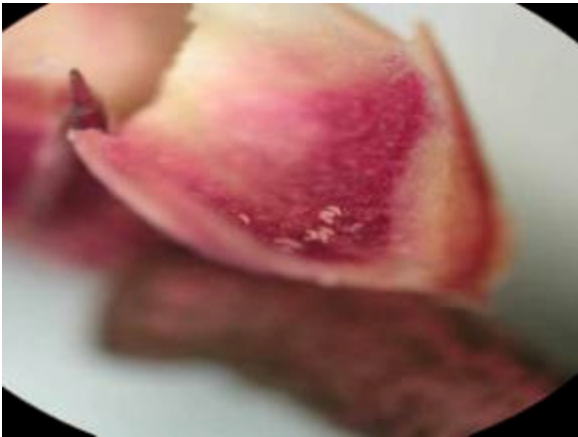


Does timing of damage affect bud formation?



Blueberry gall midge summary

- Blueberry gall midge is widespread and active throughout the summer
 - Emergence traps were the first to detect BGM in the field
 - Shoot dissections were effective but time consuming
- Parasitoids are present, although in low numbers
- There is no overall difference in the number of fruit buds on uninfested and infested shoots. But, bud production is lower on shoots infested in later part of the season.



Blueberry Bud Mite



Acalitus vaccinii Keifer - from Eriophyid family of mites

White body, 1/128 inch long. Spherical eggs.

Sporadic pest. More important in southeast US

Spend fall and winter under bud scales

Leads to mis-formed flowers and fruit, poor yield

Typically few mites per bud, but can be >50

Cultivars vary in sensitivity (Rubel is v. sensitive)





Summary

Use monitoring and degree day models to optimize spray timings

Integrate new insecticide tools where they fit best

- Intrepid for fruitworms and tussock moth during bloom

- Assail, Avaunt, Asana, Mustang, or Delegate for fruitworms post bloom

- Assail or Provado for aphids and blueberry maggot post bloom

- Provado or Mustang for Japanese beetle

Be on the lookout for SWD this season

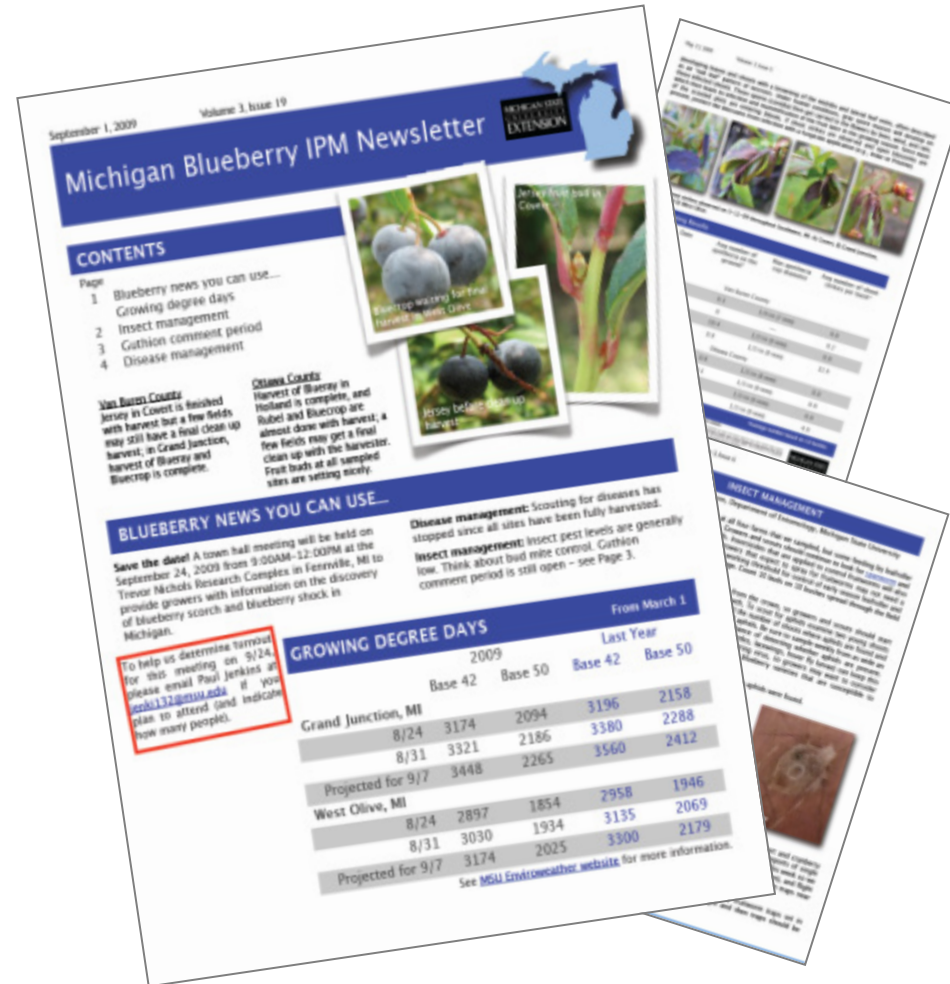


MSU Extension information is online

www.blueberries.msu.edu



ipmnews.msu.edu/fruit/



Email to: jenki132@msu.edu to subscribe

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